



Interactive Books for Problem Solving: Improving Cognitive Skills in Early Childhood Education

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ARTICLE INFO

Article history:

Received November 25, 2025

Revised April 05, 2026

Accepted May 25, 2026

Available online June 23, 2026

Keywords:

Cognitive Development, Early Childhood Educations, Interactive Book Media, Problem-Solving.



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ABSTRACT

This development highlights children's cognitive ability issues, particularly their problem-solving abilities which are below average for the five to six age group. This research is intended to create a practical and efficient interactive book medium. This development applies the R&D method. The procedures passed include the identification phase, design, development stage, which is then followed by *implementation* and thorough testing (*Evaluation*). The number of research subjects was 15 children. In order to determine the media's viability and efficacy, data analysis techniques were employed, utilizing both quantitative and descriptive qualitative methods. In addition to user trials, product validation involves three specialists: material, language, and media. 'Highly Valid' is the decision given for this interactive book medium, which receives a 100% score in the validation process. N-Gain was also determined to be 88% in the efficacy test. The effectiveness criterion is >76%, so this figure is considered effective and belongs to the high group. Since this interactive book media has the potential to greatly enhance student learning result, it is extremely practical to employ it as a learning activity support.

INTRODUCTION

Preschool education is the main pillar as an effort to build a comprehensive foundation, especially at the kindergarten level. This level is a crucial phase to stimulate high-level thinking skills, one of which is *problem solving skills*. Ideally, learning at the kindergarten level in this golden age should support children for direct exploration supported by innovative means (Durrotunnisa et al., 2025; Nurhayati et al., 2024). As explained by Nirmala (2021) Children who receive appropriate and appropriate encouragement will improve their cognitive abilities in a shorter time than their peers who do not receive adequate encouragement. However, in reality in the field, the problem-solving skills of preschool-age children often do not develop optimally. Based on the results of initial observations carried out in class B of the Jannatul Ma'wa Integrated Kindergarten, most children have difficulties in understanding the concepts and instructions of learning in the classroom. This condition is exacerbated by the learning patterns of conventional educators and the lack of innovative learning media such as special interactive book media to maximize children's cognitive abilities in problem solving.

Efforts to optimize children's problem-solving abilities through visual and manipulative media have actually been widely studied in the last five years. Several studies confirm that the use of busy *books* or interactive books is very effective in increasing the capacity of concrete thinking, learning practicality, and basic cognitive abilities of preschoolers (Aprita et al., 2021; (Febrianti et al., 2023). On an international scale, it was shown that interactive animation in *touchscreen interactive books* significantly affected the ability to understand the content of stories and cognitive intervention skills in preschoolers Li et al., (2023). However, most of the previous research is still held back on testing the effectiveness of interactive books in very broad cognitive mastery or limited to basic literacy and numeracy skills. The development of interactive book designs specifically aimed at honing high-level cognitive skills is still limited, and the role of guidance in supporting children's independent interaction with media has not received adequate attention (Forssman & Gottwald, 2022).

This is where there is a fundamental research gap, because although the effectiveness of interactive books on cognitive abilities in general has been extensively researched, how to innovate an interactive book media by combining mixed interactive methods (games, participation, and manipulative) specifically to study problem-solving skills in children aged five to six years is still not fully discussed. Previous research has not designed and compiled interactive book media that has been developed specifically through an approach with multi-level problem-solving scenarios in the form of logic games, mazes, and puzzles adapted to the characteristics of children in the school environment.

To fill the research gap, this study offers a novelty in the form of the development of interactive book media based on mixed-interactive methods (*games, participation, and manipulative*) that focuses exclusively on indicators of children's problem-solving towards the end. Based on this background, this research was conducted with the title "Interactive Books for Problem Solving: Improving Cognitive Skills in Early Childhood Education". In fact, this study aims to analyze the needs and development of characteristics, test feasibility based on expert assessments, and increase the effectiveness of the use of interactive book media in improving the problem-solving ability of preschool-age children in the Jannatul Ma'wa Integrated Kindergarten Early Childhood Education.

Through this approach, the theoretical contribution of the research is expected to be able to expand the scope of science related to the design of high-level cognitive level-based learning media for preschool-age children, as well as become an applicable practical reference for kindergarten teachers in applying fun and child-centered problem-solving methods.

METHODS

Research and development are the main design that underlies the entire procedure in this scientific work. R&D is a methodical process that ensures accountability while presenting new innovations or optimizing existing models (Salim & Haidir, 2019). The ADDIE model is used to develop appropriate, practical, and effective interactive books to stimulate the development of *problem-solving* by children aged five to six years at the Jannatul Ma'wa Integrated Kindergarten Early Childhood Education, Palu City. This model has been proven to be effective in education, allowing the implementation of systematic and structured learning measures, and achieving the expected results (Munandar dkk., 2024).

The students involved in this study were children in group B at the Jannatul Ma'wa Integrated Kindergarten Early Childhood Education, Palu City, with a *limited trial* involving a sample of 15 children. The sampling technique used is *purposive sampling*. The criteria for determining the sample were based on specific characteristics, namely: children were in the vulnerable group of five to six years old, children were actively registered in the walking center, and children showed a tendency to cognitive barriers in the aspect of problem solving based on the daily observation records of classroom teachers.

This research instrument is in the form of a questionnaire or written questionnaire that is distributed to experts to test the validity of the product and to children of group B of the Jannatul Ma'wa Integrated Kindergarten Early Childhood Education to test the effectiveness of the product. The data collection is divided into four main types of instruments, namely material expert instruments to assess the feasibility of substance content, media expert instruments to assess visual and technical design, linguist instruments to assess readability, and product assessment instruments for children's cognitive abilities in the form of *pre-test* and *post-test observation sheets* based on seven specific indicators of children's problem-solving ability. namely: (1) recognizing the problem, (2) identifying the necessary information, (3) designing alternative solutions, (4) choosing the right solution, (5) implementing the solution, (6) evaluating the results, and (7) showing an attitude in solving the problem. The goal is to build an interactive book media that is appropriate, practical, and effective. The feasibility of all items of expert questionnaires and children's observation sheets is tested using the validity of the content through expert consideration by supervisors and PAUD experts before being used in the field. To measure the effectiveness of interactive book media in improving children's understanding, a *normalized gain analysis* was conducted. This analysis aims to ensure that the product has a significant positive impact on learning outcomes. Data was obtained through *pretest* and *posttest* scores in the preschool age trial group.

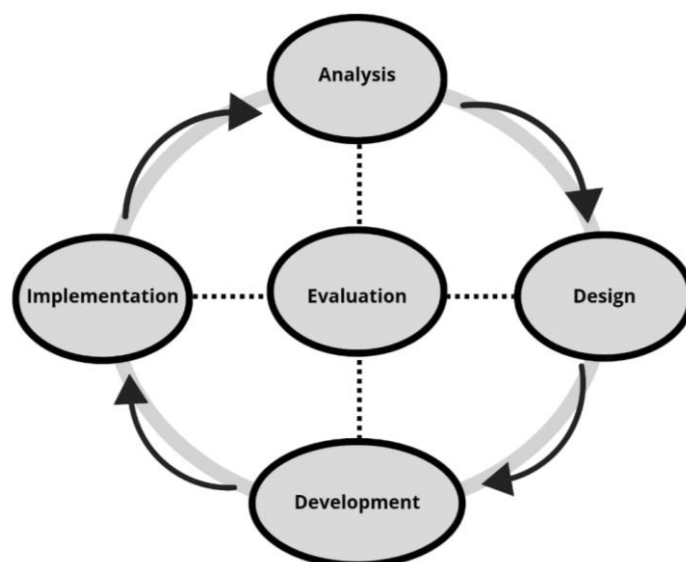


Figure 1. ADDIE Stages

1.1 Interactive Book Media Development Procedure

In this study, the author uses the ADDIE development design which is described into five procedures, here is the explanation:

1.1.1 Analysis

This initial step is filled with an assessment process through data collection in the form of interviews and observations at the Jannatul Ma'wa Integrated Kindergarten Early Childhood Education. Preliminary studies to identify topics to be studied in order to gain a more detailed understanding of a small number of informants are two situations in which researchers use an interview approach for data collection Sugiyono (2023:195). The interview was conducted to understand information about the availability of interactive book media on the cognitive abilities of school-age students. From these interviews and observations, it shows that there are problems related to cognitive development in children, such as during the scope of learning, some students seem to experience obstacles when understanding learning concepts and instructions. This is due to the lack of use of innovative and interesting interactive media in the learning process, thereby hindering children's ability to understand concepts better. In addition, the lack of interactive book media to develop children's cognitive abilities further worsens this condition, so it requires innovations in varied and contextual teaching tools to accelerate children's understanding of fun learning, and their cognitive abilities can develop optimally.

1.1.2 Product Design

At this stage, the researcher makes an interactive book design to support children's cognitive abilities based on the results of the previous analysis, the activity carried out is to design an interactive picture book concept specifically designed to maximize early childhood cognitive abilities. This book is a mixed type of interactive, combining elements of *games, participation, and manipulation*. The researcher also determined the format of the book measuring 21 x 21 cm with a total of 27 pages. The activity continued by compiling the content of the book through conducting an initial design of the main components of the book content. This design includes game concepts, interaction designs, game content, learning objectives for each game, and visual designs that use attractive images and colors to suit early childhood characteristics. All images and visual illustrations in this interactive book are created by the researcher himself based on creative imagination. The depiction process is carried out digitally using *the Ibis Paint X* application, to ensure visual originality that adapts to the concept of the game developed. The color selection in this storybook is based on bright colors. This is carried out to attract children's visual interest and is in harmony with the characteristics of early childhood development. Here are some pages of interactive books:



Figure 2. Interactive book front and back covers



Figure 3. Matching games in interactive books



Figure 4. Maze game in interactive books



Figure 4. Puzzle games in interactive books

1.1.3. Development

This stage focuses on product development which includes a series of activities such as sketching, coloring, illustration drawing, and writing command text. After development, the interactive book media will go through the validation stage by expert lecturers or product validators. This validation process involves three experts who master their fields, namely media practitioners, experts in the field of materials, and language experts.

1.1.4. Implementation

In this phase, an interactive book product test was carried out for group B children at the Jannatul Ma'wa Integrated Kindergarten Early Childhood Kindergarten for three weeks with a total of 15 children. Each trial session involved 5 children in turns for 15 minutes with a total of three sessions per meeting. Before the trial, the children were given a children's worksheet (LKA) to assess early cognitive abilities on the problem-solving aspect. The core activities include the introduction of interactive book media by teachers and researchers, followed by playing *games* in it, and questions and answers. At the end of the trial period, children were given a second LKA to measure cognitive improvement after using the product.

1.1.5. Evaluation

This stage is the final stage of this study, aiming to measure the extent to which picture storybooks are effective as a learning aid. Researchers reviewed the findings of the trial by involving validation from experts and observations to determine which parts already met the criteria and which parts needed improvement. If deficiencies are found, revisions are carried out to make the product more optimal. Quantitative and qualitative descriptive analysis was used to compile the results of this development study. The effectiveness, accuracy, and aesthetic appeal of interactive storybook media products were assessed using data analysis findings. The four-point version of the Sugiyono Likert Scale is used by prospective researchers. Percentage descriptions will be used in the analysis of validity data using validation formulas (Akbar, 2015). The next stage is to provide an interpretation process and make policies related to the quality of the development outputs based on the validation standards described as follows:

Table 1. Student Success Categories

Criteria	Validation Level
75,01% - 100,00%	Very Valid (can be used without revision)
50,01% - 75,00%	Sufficiently Valid (can be used with minor revisions)
25,01% - 50,00%	Invalid (unusable)
00,00% - 25,00%	Very Invalid (prohibited from use)

Furthermore, after obtaining the data obtained from the results of the evaluation before and after the use of the product by the peseta didik, an average calculation is carried out to obtain an overview or representative value of the overall data that represents the general characteristics of the group, with an average formula (Muflihah, 2021). To understand the improvement of children's cognitive abilities in the development of interactive book media, the percent formula is used (Zulmiyetri et al., 2020). The percentage calculation score is carried out by looking at the score obtained by the child with the ideal maximum score. Next, the results of the data calculation are interpreted in the category of tests carried out to:

Table 2. Student Success Categories

Percentage (%)	Category	Shoes
0-25	Not Yet Developed (BB)	1
26-60	Starting to Grow (MB)	2
61-75	Growing Up With Expectations (BSH)	3
76-100	Very Well Developed (BSB)	4

Sources: (Kemendikbud Anak Usia Dini, 2018)

To measure the effectiveness of interactive book media products in improving learning outcomes or user understanding, a *Normalized Gain* (N-Gain) calculation will be carried out. This effectiveness measurement is an integral part of the overall product feasibility test, to ensure that the product meets content and technical feasibility standards and ensures that there is real significance to classroom learning outcomes. The calculation of the nationalized gain was obtained through the results of the evaluation before and after the use of the product given to the trial group (e.g., early childhood). *The pretest* is carried out before the user interacts with the interactive book, while *the posttest* is carried out after the period of use of the interactive book ends. Referring to the views of David E. Meltzer as quoted by Yanti Herlanti, by using the N-gain formula: (Afrilila et al., 2022).

To find out the categorization of normalized gain scores, it can be seen from the table as follows:

Table 3. Normalized Gain Category

Normalized Gain	Rating Categories
$G < 30\%$	Low
$30\% < G < 70\%$	Medium
$G > 70\%$	Height

Source: (Afrilila dkk., 2022)

Refers to (Hake, 1999) The interpretation of *N-gain* effectiveness is classified into categories consisting of:

Table 4. Categories N-Gain Effectiveness Interpretation

Percentage (%)	Interpretation
< 40	Ineffective
40-55	Less Effective
56-75	Quite Effective
> 76	Effective

Source: (Hartini et al., 2024)

RESULTS

The implementation of the development of interactive book media begins with testing the feasibility level of the product to ensure the quality of materials, design, and linguistic aspects before being tested in the field. The feasibility test with three validators (media, material, and language experts) showed very satisfactory results. The validation process was carried out twice to compare the level of product validity before and after revision.

Table 5. Validation Results

Number	Aspects Assessed	Percentage before revision	Percentage after revision	Category
1	Language Specialist	91,67%	100%	Highly Valid
2	Material Specialist	93,18%	100%	Highly Valid
3	Media Expert	93,18%	100%	Highly Valid

Based on the results of validation by three expert councils, namely media practitioners, experts in the field of materials and language experts, interactive books obtained a final score of 100% with the title of very valid and suitable for use without revision. The results of the study indicate that the interactive book media developed has effectiveness in stimulating and improving various dimensions of development, especially children's cognitive competence in the realm of problem solving.

The following are criticisms and suggestions sourced from the assessment of linguists, materials and media.

Table 6. Validator's Criticism and Suggestions

Time	Linguist	Material Expert	Media Member
Before Revision	Some lowercase items in the media need to be eliminated to avoid distractions/tricks.	Some material items need to be revised in size, color and instructions.	Some items need to be added such as pockets or containers so that the pieces of

			media do not get lost or fall off.
After Revision	The revision has been implemented well.	The revision has been implemented well.	The revision has been well implemented.

Based on observations of the cognitive development of group B children in the Jannatul Ma'wa Integrated Kindergarten through interactive book media, the following are the results of the calculation of *pre-test* and *post-test scores* in the problem-solving aspect:

Table 7. Results of Calculation of Average Scores of Pre-test and Post-test Students

Number	Initials of Student's Name	Assessment Results	Assessment Results
		<i>Pre-test</i>	<i>Post-test</i>
1.	MRM	48	75
2.	ANC	48	75
3.	HMK	48	75
4.	SFN	51	78
5.	SKR	51	78
6.	ASY	51	78
7.	MSY	47	74
8.	ZN	47	74
9.	ABD	47	74
10	LTF	51	78
11.	NSR	51	78
12.	ND	51	77
13.	RFK	48	75
14.	MLK	51	78
15.	CSY	51	77
Quantity ($\sum xi$)		741	1.144

$$\bar{x} = \frac{\sum xi}{n}$$

49,40 76,27

Table 8. Results of Post-test and Pre-test Improvement Calculations

Data Type	Average Score	Score Maximum	$P = \frac{a}{b} \times 100\%$
Pre-test	49,40	80	61,75%
Post-test	76,27	80	95,34%

Based on the calculation results, the pre-test score of 61.75% increased to 95.34% in the post-test score, so it was concluded that there was a significant increase in results. After the implementation of interactive book media, this increase in scores shows that the category of student success is at a very good development level.

Table 9. Results of Effectiveness Score Calculation

Data Type	Shoes Average	$g = \frac{\text{Score Posttest} - \text{Score Pretest}}{\text{Ideal Maximum score (80)} - \text{Score Pretest}} \times 100\%$
Pre-test	49,40	88%
Post-test	76,27	

Based on the calculation results, the interactive book media obtained an *N-Gain* value of 88%. This value belongs to the High category ($\geq 70\%$) and declared Effective because it has met the effectiveness criteria above 76%. Therefore, it is concluded that this interactive book media is very suitable to be used as a support for learning activities because it has been proven to be able to significantly improve student learning outcomes.

DISCUSSION

The results of the study are focused on testing the accuracy of interactive book media designed to maximize cognitive skills, especially *problem-solving aspects* for students in the Jannatul Ma'wa Integrated Kindergarten Early Childhood Education institution. These findings are based on three main stages: needs analysis and development of valid products, implementation of trials, and evaluation of effectiveness. Overall, an increase in *pre-test scores* (61,75%) become a *post-test* (95,34%) showed a significant spike in learning outcomes, categorized as "very well developed". This increase is further strengthened by an *N-Gain* value of 88%, which places the product in the category of high effectiveness, exceeding the minimum criterion of 76%. Therefore, these findings strongly support the working hypothesis that the

interactive books produced are on target and should be used as learning support for cognitive stimulation of children aged 5-6 years.

The interpretation of this significant increase cannot be separated from the results of the media that have gone through strict validation procedures sourced from media practitioners, experts in the field of material, and language experts. The final validation score of 100% shows that the interactive book, with a format of 21x21 cm, game content that combines *elements of games, participation, and manipulative*, has met pedagogical, linguistic, and visual feasibility standards. The original visual design and the use of bright colors that appeal to children's visual interests, as described in the design stage, successfully solve the initial problem of the lack of interactive media. Children's difficulties in understanding learning concepts and instructions, revealed from initial analysis (interviews and observations), were successfully overcome through a play-by-play approach applied by interactive books, which focused on hands-on experiences (*touch-and-play*).

Theoretically, the effectiveness of this interactive book can be explored in depth through Jean Piaget's Theory of Cognitive Development, especially in the pre-operational stage (age 2–7 years). At this stage, children begin to show progress in memory skills, imagination, and language use. However, their mindset is still concrete, egocentric, and not yet able to understand abstract logical concepts (Rohmah, 2025). This interactive book facilitates the need for such cognitive transitions through manipulative features (*touch-and-play*) and game elements. When the child opens, slides, or matches the parts in the book, there is an assimilation process in which the child integrates new visual and spatial stimuli into their existing cognitive scheme.

Furthermore, when children face challenges or problems in *games* available on the media, they experience a situation of cognitive imbalance. The guided question and answer process and sensory cues designed in this interactive book lead the child to the process of accommodation, which is to modify the old thinking scheme or form a new scheme to solve the problem. This multi-sensory activity transforms abstract problem-solving concepts into concrete experiences, so that the child's short-term memory is well stimulated without causing excessive cognitive load. Through consistent physical interaction with the media, the child's cognitive structure gradually develops towards a new equilibrium, which is empirically proven by the drastic surge in their problem-solving abilities from the initial *pre-test* state to *the post-test*.

The findings of the effectiveness of interactive book media are in line with and strengthen a series of previous studies. Visual media such as interactive books have been proven to be effective and scientifically proven in an effort to strengthen the capacity of material mastery, participation and cognitive abilities in early childhood (Wahidin 2025; Febrianti et al., 2023; Aprita et al., 2021). Furthermore, the use of physical and visual media has proven to be an important factor in improving focus, memory and learning effectiveness by optimizing kinesthetic and visual information processing (Ehwanti & Suwardi 2025; Rohmah & Aziz, 2024). Furthermore, visual media has been proven to be more effective in increasing the understanding of early childhood concepts through multi-sensory stimulation (Sabrina et al., 2023; Hulu et al., 2022).

However, there are also several perspectives that provide opposing views, which provide room for more in-depth discussion. Digital and audio-visual media have been shown to be more effective in increasing children's enthusiasm, memory, and learning outcomes through practical interactive experiences compared to conventional media (Lesmawan et al., 2025; Toga et al., 2025; Widianoro & Utami, 2024; Hidayati & Budiarti, 2022). Several experts also highlighted the advantages of personalization and *the supportive function of* digital media. The acceleration of cognitive growth in preschool-age children is now largely supported by the vital role of digital platforms, so that they are effective in spurring their intellectual growth in the golden age (Nurita et al., 2025; Pangarti & Yaswinda, 2023; Fini et al., 2024). Through the use of animated content and digital media, educators have succeeded in optimizing the cognitive processes of preschool-age children while presenting preventive solutions to the current dependence on electronic devices (Novelia & Hazizah, 2020; Nurjanah & Mukarromah, 2021). These differences in findings show that the success of interactive books is not just fixated on the media, but is closely related to the way of implementation, teacher supervision, and the relevance of the content to the specific problem (problem solving) that is the focus.

The systematic synthesis and comparison of the above references shows that the success of interactive books in this study is not just fixated on the physicality of the media, but is closely related to the integration of hybrid methods that combine the tactile advantages of physical media with the logic of *interactive games*. The presence of *games, participation, and manipulative* (GPM) elements has been proven to be able to bridge the weaknesses of pure digital media (eye fatigue and lack of motor training) while covering the monotony of conventional media. This success is also supported by the accuracy of implementation, intensive supervision of teachers, and the relevance of content to the stimulation of problem-solving for children aged 5–6 years.

Although it makes significant theoretical and practical contributions, this study has several *limitations* that need to be considered. First, the limited sample *size* which only involved 15 children in group B of the Jannatul Ma'wa Integrated Kindergarten made the level of *generalizability of* the results of this study limited and did not necessarily reflect the same effectiveness if applied to the context of schools with different socio-economic characteristics, learning facilities, or teacher competencies. Second, the duration of the intervention limited to three weeks risks creating a *novelty effect*, where an increase in children's scores is potentially triggered by curiosity about new media, rather than entirely due to permanent changes in their cognitive structure.

Based on these limitations, concrete recommendations for follow-up research are to conduct *large-scale trials* and involve control groups using purely experimental methods to strengthen the external validity of the product. For early childhood education practitioners, it is recommended to integrate this interactive book into the daily learning implementation plan (RPPH) periodically so that the use of media is not temporary. In line with the advancement of educational technology, the direction of future product development is suggested to integrate this interactive print media with *Augmented Reality* (AR) technology to present dynamic and multi-sensory three-dimensional content, as recommended in the current literature (Citariyani et al., 2025; Ramadhani & Asrul, 2025; Yusmaniar & Munawwarah, 2024).

CONCLUSION

This study successfully concluded that the application of the ADDIE model in compiling interactive books is able to present media that has high validity and excellent usability. This has been proven to be able to encourage the potential of children aged five to six years in solving problems systematically. The feasibility of this product is proven through expert validation results with a score of 100% ('Very Valid'). In addition, the medium has been shown to be empirically effective, as shown by the acquisition of *an N-Gain* value of 88% which is in the 'High' category, exceeding the minimum effectiveness standard. These findings prove that the participatory, visual, and manipulative learning approach as described in this book successfully overcomes the difficulty of understanding abstract concepts that are the initial problem. Therefore, this interactive book media is recommended to support learning activities that have been tested to be able to stimulate and maximize children's cognitive competence significantly. As a recommendation for further research, it is recommended that these media be tested on different age ranges of children or integrated into the context of an inclusive learning environment to see a broader generalization of the product's effectiveness

THANK YOU

The author expresses his deepest appreciation and sincere gratitude to all respondents who have taken the time and contributed data to this study. Deep appreciation is also expressed to the lead supervisor for his patience and availability of time to provide invaluable support from the beginning to the completion of the research process and preparation of this report.

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