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The Development of a Problem-Based Learning Pop-up Book to Enhance Critical Thinking Skills in Kindergarten B Students

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Abstract: This study is a form of applied research using the Research and Development (R&D) method. The population of the study consisted of Kindergarten B students in the Mayong sub-district, Jepara. Data collection techniques included observation, interviews, and questionnaires, while data analysis was carried out using both quantitative and qualitative approaches. The research findings led to the following conclusions: (1) the developed Pop-up Book learning media based on Problem-Based Learning (PBL) for Kindergarten B students met the eligibility standards for guidebook formatting; (2) the content or instructional material within the Pop-up Book media was deemed appropriate for learning procedures; (3) the product proved effective in enhancing students' critical thinking skills; and (4) the media can be utilized by teachers, as it has been validated both theoretically and practically in terms of feasibility and effectiveness.

Keywords: Critical Thinking, Pop-up Book Development, Problem-Based Learning

1. Introductions

Symbolic thinking is a cognitive ability that allows children to mentally represent objects that are not physically present (Nursyamsiah et al., 2019). Symbolic play, as described by Quinn et al. (2021), refers to activities in which children project real-life situations in imaginative ways, driven by the joy of exploration and survival instincts. Through symbolic play, children use objects around them to represent other things, unknowingly developing their cognitive and language skills. One important component of cognitive development is problem-solving ability. George Polya, as cited by Santos-Trigo (2021), refers to problem-solving as a heuristic discipline.

Critical thinking is the ability to respond wisely to problems based on experience, involving logical investigation and reasoning (Sanders & Moulenbelt, 2021). Therefore, it is essential to stimulate critical thinking from an early age through activities that promote analysis of options, idea integration, and evaluation of steps to reach a logical conclusion (Fernández-Santín et al., 2020). Ennis (2023) defines critical thinking as the active and skilful process of conceptualizing, applying, analysing, synthesizing, and evaluating information derived from observation or experience. Additionally, it is a reflective and reasoned form of thinking focused on deciding what to believe or do (Rademaekers et al., 2019).

Given the importance of fostering critical thinking in early childhood, appropriate stimulation is needed to enable children to make decisions through problem-solving-based learning (Problem-Based Learning), which will benefit them not only in school but also in future life situations (Jean WJiar Y, 2022). One indicator of successful learning is behavioral and character changes in knowledge (cognitive), skills (psychomotor), and values or behavior (affective) (Akollo et al., 2023). Learning can be influenced by technological developments and the use of varied learning resources. Gagne (as cited in Umami & Utaminingsih, 2025) emphasizes that teaching includes designing and organizing resources and facilities that help improve students' academic performance. The role of educators, therefore, includes selecting or creating learning media that enhance student engagement and curiosity (Rahayu, 2021).

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Effective learning media facilitate interaction between teachers and students, making learning more efficient and meaningful. Media should stimulate students' curiosity (Putri & Fajri, 2023), and learning becomes more impactful when children are involved visually, through touch, and by directly experiencing learning materials (Masykuroh & Wahyuni, 2023). One such media is the Pop-up Book. A Pop-up Book is a three-dimensional book that includes movable parts and presents an engaging visual story. Its pages are designed to move, change, or pop out when opened, making the learning experience more interactive (Assyauqi, 2020). It is expected that by using Pop-up Books integrated with Problem-Based Learning, children's critical thinking skills can be effectively enhanced (Purnamasari & Damayanti, 2021).

1.1 Conceptual framework

Critical thinking is a fundamental aspect of cognitive development that can be nurtured from an early age. It can be developed through dialogues that involve in-depth questioning about specific objects or issues (Susiani, 2023). Critical thinking is also defined as rational, reflective, and focused thinking used in making decisions about what to believe or do. It encompasses observation, drawing conclusions, generalizing, reasoning, and evaluating (Priyangga, Utaminingsih & Setiawan, 2021). Essentially, critical thinking emphasizes the ability to analyse and make wise decisions based on evidence and strong arguments (Nugroho, 2023). It is the reflective capacity involved in decision-making (Handayani et al., 2022). This thinking ability includes understanding, analysing, evaluating evidence, providing explanations, formulating strategies, and drawing conclusions. It represents a wise attitude in responding to problems based on personal experience (Andriyansah, 2020).

Children who can conceptualize, analyse, evaluate, and conclude based on information from observation, direct experience, or learning at school are considered to have developed critical thinking skills (Fitriani et al., 2022). The development of these skills signifies that children are progressing cognitively (Anggraini et al., 2020). Hence, fostering critical thinking in children involves creating learning processes that help them communicate thoughts clearly, solve problems systematically, and critically filter received information.

The development of critical thinking skills is closely tied to open-mindedness and the application of analytical thinking in framing problems. Boangmanalu et al. (2023) identified eight essential critical thinking skills: analytical thinking, open-mindedness, problem-solving, self-regulation, observation, interpretation, evaluation, and communication. According to Benjamin S. Bloom's taxonomy (in Nugraha et al., 2023), critical thinking falls under higher-order cognitive domains such as analysis, synthesis, and evaluation, which involve breaking down information, organizing ideas, and assessing arguments and evidence.

Indicators used to assess critical thinking include analytical ability, evaluative ability, inferencing, explanation, metacognitive reflection, and problem-solving. A learning focus using a Problem-Based Learning (PBL) approach supported by Pop-up Book media is believed to help young children understand learning content. The Pop-up Book enhances children's critical thinking skills, particularly in early childhood learning contexts (Manshur & Rodhi, 2022).

Pop-up Books not only present information visually and interactively but also stimulates children to think, interpret, and draw conclusions from the content (Susilana et al., 2021). The critical thinking aspects embedded in Pop-up Books include stimulating curiosity and analysis, encouraging evaluation and comparison, fostering inference and prediction, enhancing explanation abilities, and supporting reflection (Mahmudah et al., 2024). In short, Pop-up Books are not just visual aids—they are effective tools for developing critical thinking through interactive media engagement, concept visualization, and active participation in storytelling.

1.2 Research objectives

This research aims to analyze the learning media needs of TK B (Kindergarten B level) students, design the development of a Pop-up Book based on the Problem-Based Learning (PBL) approach, assess the feasibility of the developed Pop-up Book in terms of content and instructional procedures, and evaluate its effectiveness in enhancing the critical thinking skills of TK B students. The outcomes of this research are intended to serve as a foundational model for early childhood learning, particularly for students in TK B throughout the Mayong Subdistrict, Jepara Regency, Central Java Province, in fostering critical thinking abilities.

2. Methodology

2.1 Research design

This study employed a mixed-method approach with an exploratory variant. The type of research used is applied research following the Research and Development (R&D) model, aiming to test the effectiveness of the product as outlined by Borg and Gall (as cited in Sugiyono, 2022b). The full R&D model comprises ten stages: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) design revision, (6) product testing, (7) product revision, (8) usage trials, (9) final product revision, and (10) mass production. However, this study only employed seven stages, as aligned with the simplified R&D model proposed by Sugiyono (2019a), with the intention that subsequent stages may be carried out in future research. Therefore, this study emphasizes the importance of developing a new product or refining an existing one that can be scientifically justified (Creswell, 2023).

2.2 Respondents of the study

The respondents of this study were TK B students located in Mayong Subdistrict, Jepara Regency, Central Java Province. Following Borg and Gall's sampling guidelines (as cited in Okpatrioka, 2023), the initial product testing was conducted in 2 kindergartens involving 30 students. A broader field test was carried out in 6 kindergartens with a total of 90 students, divided equally into two groups: 45 students in the control group and 45 students in the experimental group, in which the Pop-up Book based on the Problem-Based Learning model was implemented.

The sample selection used a cluster sampling technique due to time constraints and the permissions granted by the respective kindergarten principals. All respondents participated after formal approval from the school heads. The data was collected through observation, interviews, questionnaires, and tests. The research instruments consisted of three parts: (1) an expert assessment form for Problem-Based Learning methodology, (2) an expert assessment form for critical thinking education, and (3) an expert assessment form for the Pop-up Book media. These instruments were used to validate the content, methodology, and design of the developed learning media.

Table 1. Expert Evaluation Score Categories for Instructional Media, Learning Content and Language

Total Score Obtained (x)	Evaluation Category of Instructional Media
$0 \leq x \leq 25$	Poor
$25 \leq x \leq 50$	Fair
$50 \leq x \leq 75$	Good
$75 \leq x \leq 100$	Excellent

The results of the calculation regarding the use of the Pop-up Book media based on Problem Based Learning (PBL) in improving students' critical thinking skills can be interpreted using the following table.

Table 2. Gain Index Criteria

Gain Score	Category
$(g) \geq 0{,}70$	High
$0{,}30 \leq (g) \geq 0{,}70$	Moderate
$(g) > 0{,}30$	Low

3. Findings and discussion

The following section presents the results of the product trials, which were evaluated by three experts: an instructional media expert, a subject matter expert, and a language expert. Based on the results in Table 3, the average rating from the instructional media expert was 3.67, which falls under the category of "very high." Meanwhile, both the subject matter expert and the language expert assigned an average rating of 3.71, categorized as "high." These ratings reflect the overall expert evaluation of the Pop-up Book media developed using the Problem-Based Learning (PBL) approach to enhance the critical thinking skills of TK B students.

Table 3. Expert Evaluation of the Pop-up Book Media Development Based on Problem Based Learning (PBL)

Expert	Number of Items	Total Score	Average Index	Category
Instructional Media	18	66	3,67	Very High
Learning Content	7	26	3,71	High
Language	7	26	3,71	High

The conclusion indicates that the Pop-up Book media developed using the PBL model has met the required criteria for acceptability in terms of media quality, content, and language use. Therefore, this product is considered feasible and appropriate for classroom implementation to support the development of critical thinking skills among TK B students.

3.2 Effectiveness of the Product

The effectiveness of the product is illustrated through a bar chart (see Figure 1), which summarizes the results of a limited trial involving six students. Data were collected using both quantitative and qualitative methods. These findings were also supported by feedback from the three experts mentioned earlier.

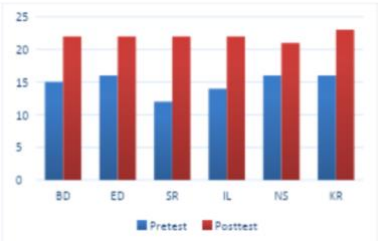

Figure 1. Pretest and Posttest of Limited Trial Effectiveness

To determine the statistical significance of the improvement in students' critical thinking skills, the Wilcoxon Signed-Rank Test was conducted using IBM SPSS Version 23. The test compared the pretest and posttest scores of each student who used the Pop-up Book media based on PBL. The decision rule applied was: if the value of Asymp. Sig (2-tailed) ≤ 0.05, then the null hypothesis (H_0) is rejected, indicating a significant difference. Conversely, if Asymp. Sig (2-tailed) ≥ 0.05, then the null hypothesis is accepted, indicating no significant difference.

Table 4. Results of Wilcoxon Signed Rank Test Analysis Pretest and Posttes Ranks

		N	Mean Rank	Sum of Ranks
Posttest - Pretest	Negative Ranks	0a	.00	.00
	Positive Ranks	6b	7.17	43.00
	Ties	0c		
	Total	6		

a. Posttest < Pretest
b. Posttest > Pretest
c. Posttest = Pretest

Tabel 5. Hasil Analisis Peningkatan Skor Ujicoba Terbatas

	Posttest – Pretest
Z	3.021b
Asymp. Sig. (2-tailed)	.032

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

In the extended trial, the product was tested on 25 students, and both quantitative and qualitative data were collected. Figure 2 presents the results of this extended trial through a bar chart visualization.

Figure 2. Pretest and Posttest of Extended Trial Effectiveness

Similarly, the Wilcoxon Signed-Rank Test was employed to analyze the differences between the pretest and posttest scores of the students who participated in the extended trial using the Pop-up Book media based on Problem-Based Learning. The same decision rule using the Asymp. Sig (2-tailed) value was applied to determine the effectiveness of the product. The results confirmed that the media had a statistically significant impact on improving students' critical thinking skills.

Table 6. Wilcoxon Signed Rank Test Analysis of the Pretest and Posttest of the Extended Trial Ranks

		N	Mean Rank	Sum of Ranks
Posttest – Pretest	Negative Ranks	0a	.00	.00
	Positive Ranks	25b	7.16	179.00
	Ties	0c		
	Total	25		
a. Posttest < Pretest				
b. Posttest > Pretest				
c. Posttest = Pretest				

Table 7. Results of the Extended Trial Score Improvement Analysis

	Posttest – Pretest
Z	3.022b
Asymp. Sig. (2-tailed)	.033
a. Wilcoxon Signed Ranks Test	
b. Based on negative ranks.	

4. Conclusions and recommendations

The results of the needs analysis indicate that the Pop-up Book learning media based on Problem-Based Learning (PBL) developed for TK B students in the Mayong District of Jepara Regency successfully meets the criteria for guide format feasibility. These criteria include systematic presentation, writing quality, and visual design. This confirms that the PBL-based Pop-up Book is suitable for use as an instructional medium for TK B students.

Furthermore, based on data analysis, the content of the developed Pop-up Book has also been deemed appropriate for instructional use, fulfilling the requirements of material feasibility. This demonstrates that the PBL-based Pop-up Book is effective as a teaching tool for TK B teachers and can be used to support the development of students' critical thinking skills.

Additionally, the data show evidence of the effectiveness of the media in improving critical thinking skills among TK B students. This effectiveness—both theoretically and practically—makes the media a viable tool for classroom use by early childhood educators. It is recommended that future users of this PBL-based Pop-up Book conduct effectiveness testing on a broader scale, particularly across other regions in Jepara Regency. In this study, the effectiveness test was limited to two schools: TKIT Al Husna Mayong and TK Ngudi Rahayu Mayong. Broader implementation may yield varied results depending on the educational and cultural background of different institutions.

The current development of the PBL-based Pop-up Book was limited to TK B students. Therefore, its applicability may not extend to students with different educational levels. Moreover, this product was tested in schools with similar educational values, which may influence the perceived effectiveness of the media in other areas. In terms of internalization and media improvement, future researchers are encouraged to explore additional variables in the development of natural-themed media. Further studies could enrich the literature by exploring PBL-based Pop-up Books using other natural materials or adapting the media for different educational contexts. These efforts could enhance the diversity and applicability of Problem-Based Learning methods in early childhood education.

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Conflict of Interest

Authors declare there is no conflict of interest.

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