Ceria: Jurnal Program Studi Pendidikan Anak Usia Dini
Volume 15, Number 1, 2025 pages 1-16
P-ISSN: 2301-9905 E-ISSN: 2775-409X
Open Access: https://jurnal.umt.ac.id/index.php/ceria/index

The Development of POPBUL (*Pop-Up* Badminton) to Improve Critical Thinking in Children Aged 5-6 Years

Lutfia Ananingrum[1], Kartika Rinakit Adhe[2], Dhian Gowinda Luh Safitri [3], Mallevi Agustin Ningrum
[1,2,3,4] Universitas Negeri Surabaya, Surabaya, Indonesia
e-mail: *[1]lutfia.21029@mhs.unesa.ac.id, [2]kartikaadhe@unesa.ac.id, [3]dhiansafitri@unesa.ac.id, [4] malleviningrum@unesa.ac.id

ARTICLE INFO

Article history:
Received: July 3, 2025
Accepted: December 5, 2025
Available online on: December 30, 2025

Keywords:
POPBUL; Early Childhood Education Critical Thinking;

ABSTRACT

This study aimed to develop a learning medium called POPBUL (Pop-Up Badminton) and evaluate its effectiveness in enhancing the critical-thinking skills of children aged 5–6 years. The research was motivated by young learners' low critical-thinking ability and the lack of engaging, developmentally appropriate learning media. The ADDIE model—analysis, design, development, implementation, evaluation—guided the development process. Expert validation and field testing were conducted with 16 group-B children at TK Dharma Siwi III Surabaya. Instruments included validation sheets, practicality questionnaires, and observation sheets administered before and after using the medium. POPBUL was rated very valid by media experts (87.5 %) and fairly valid by content experts (68.75 %); teacher practicality reached 93 %. Children's mean score increased from 11.63 (pre-test) to 16.63 (post-test). A paired t-test showed a significant difference ($p = 0.000 < 0.05$) with an n-gain of 0.67 (moderate). Therefore, POPBUL

is feasible and moderately effective for improving critical thinking in early childhood education.

Introduction

Early childhood is recognized as a golden age—a crucial period for individual growth and development, particularly in cognitive aspects. One of the most significant cognitive skills that should be developed during this stage is critical thinking. This skill not only supports children's ability to solve problems and answer questions, but also enables them to observe patterns, analyze everyday experiences, and draw logical conclusions from various real-life situations. According to Ilhafa and Rakhmawati (2022), critical thinking must be developed from an early age, especially at 5–6 years old, to enhance logical reasoning and adaptive thinking in future learning. Facione (as cited in Catherine, 2022) also emphasized that critical thinking is not merely about reasoning but involves active and complex processes such as reading, writing, speaking, and listening to reach well-justified conclusions or decisions.

At the age of 5–6 years, children are in the pre-operational stage, where symbolic and visual thinking begins to develop. However, they are not yet fully capable of explaining the reasons behind their responses (Marinda, 2020). As such, they need stimulation that aligns with their cognitive development to foster logical, reflective thinking. Unfortunately, many educators still rely on conventional methods and worksheets (LKA), which are less engaging and limit children's

opportunities to observe, analyze, or evaluate experiences. Purnamasari and Ningrum (2018) argue that monotonous media such as LKA can make children easily bored and demotivated to learn, thereby limiting the emergence of critical thinking.

Several previous studies have proven the importance of meaningful and visually stimulating learning experiences in enhancing children's critical thinking. Putri and Adhe (2023) developed the KAKUMA game media, which encourages analytical skills through attractive visuals and puzzles. Fauziyah et al. (2024) also reported that thematic encyclopedias with concrete, colorful designs help children grasp abstract concepts, triggering analytical thought from lived experiences. Moreover, sports-based themes have been proven to support cognitive and social development. Yuliandi et al. (2024) found that sports like badminton help children build values such as teamwork, sportsmanship, and strategic thinking—skills closely aligned with critical thinking.

Badminton is a familiar and engaging sport for young children. Through this sport, children learn about equipment, rules, techniques, and the benefits of playing. However, a preliminary study at TK Dharma Siwi III Surabaya revealed that children often give brief or copied answers, showing a lack of critical reasoning. Most learning activities still rely on printed worksheets, offering limited opportunities for reflection or exploration. This finding highlights the urgent need for instructional media that can bridge symbolic and visual learning with

critical thinking development in early childhood.

To address this need, this study proposes a learning media called *POPBUL* (Pop-Up Badminton)—a three-dimensional, sport-themed pop-up book designed to enhance children's critical thinking through visual interaction and contextual learning. The media is structured around Facione's (2011) critical thinking framework, which includes interpretation, evaluation, and explanation. This approach is expected to encourage children to observe, analyze, and justify their thoughts based on real-life experiences.

In addition to its practical relevance, this study also contributes to filling a research gap. While previous studies have focused on visual learning tools or sports education separately, few have integrated sports content into a pop-up book format targeting critical thinking in early childhood education. Bibliometric analysis using VOSviewer further confirms this gap. The overlay visualization shows a rise in pop-up media research between 2021 and 2023, followed by a decline in 2024, suggesting an opportunity for new contributions in this field (see Figure)

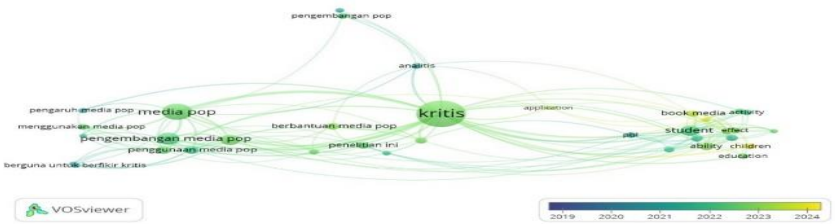


Figure 1. Overlay Visualization of Pop-Up Media Trends (2021–2024)

Source: VOSviewer 1.6.20

Therefore, this study aims to develop POPBUL as an innovative, meaningful, and engaging learning media that supports "The Development of Critical Thinking in Children Aged 5–6 Years." It also serves as a reference for educators and early childhood practitioners to create more effective learning strategies through contextual and developmentally appropriate media.

Methods

This research employed a Research and Development (R&D) approach to create and test the effectiveness of an instructional product designed to improve critical thinking in children aged 5–6 years. The development process was based on the ADDIE model, which consists of five structured stages: analysis, design, development, implementation, and evaluation (Branch, 2009).

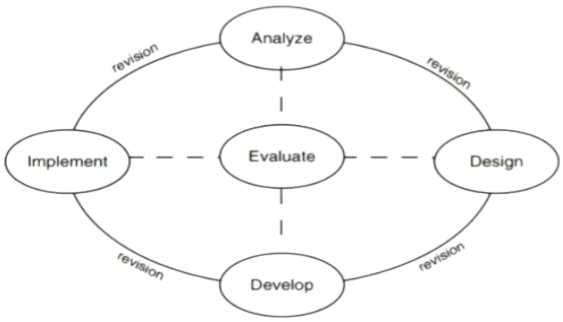


Figure 1. Steps of the ADDIE Development Model (Branch, 2009)

In the analysis phase, the researchers conducted classroom observations and interviews with teachers at TK Dharma Siwi III Surabaya to identify learning challenges, particularly the lack of instructional media supporting critical thinking. The design phase focused on constructing

POPBUL (Pop-Up Badminton), a three-dimensional pop-up book that introduced badminton-related content using colorful illustrations, simple language, and question prompts to stimulate children's reasoning. The initial prototype was validated by two university lecturers—one content expert and one media expert—who completed questionnaires adapted from Setiawan et al. (2023) and Hapsari (2023). Suggestions from this expert review led to revisions in the visual layout, sequence of content, and use of language, ensuring the media's suitability for children's developmental stage.

The practicality of the final product was assessed by two kindergarten teachers using a ten-item practicality questionnaire developed from Romadhona (2017). Effectiveness was evaluated using a pre-experimental method with a One Group Pretest-Posttest Design (Sugiyono, 2015), where 16 children from group B participated in pre-testing, three sessions of POPBUL-assisted learning, and post-testing.

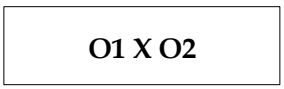


Figure 2. One Group Pretest-Posttest Design (Sugiyono, 2015)

During implementation, each child was assessed using an observation sheet aligned with critical thinking indicators developed by Facione (2011): interpretation, evaluation, and explanation. The researcher also measured the validity and reliability of the instruments. Validity was assessed using expert judgment and item-total correlation in SPSS, while reliability was tested using Cronbach's Alpha, where a score

above 0.60 indicated that the instrument was reliable (Lestari & Yudhanegara, 2015).

To assess validity quantitatively, Likert-scale scores were converted to percentages using the formula:

$$P = \frac{f}{n} \times 100\%$$

Figure 3. Formula for Validity Percentage (Sugiyono, 2015)

Media scoring ≥ 51% was considered valid (Ramadhani & Bina, 2021). For effectiveness, data were analyzed using descriptive and inferential statistics. The results of the pretest and posttest were compared using the normalized gain (N-Gain) formula from Hake (in Arisa et al., 2020) to determine the magnitude of learning improvement:

$$N\ Gain = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

The N-Gain score was interpreted as high ($g > 0.70$), moderate ($0.30 \leq g \leq 0.70$), or low ($g < 0.30$). A paired-sample t-test was also conducted to determine the statistical significance of the difference between pre- and post-test results. Throughout the implementation period, teachers provided assistance during sessions, while observers documented children's engagement and learning behavior using a checklist. All data—both quantitative and qualitative—were then triangulated to

evaluate the validity, practicality, and effectiveness of the POPBUL media.

Result and Discussions

This study aimed to improve the critical thinking skills of children aged 5–6 years by developing a pop-up book media called POPBUL (Pop-Up Bulutangkis). The intervention was implemented through several treatments, and the effectiveness was measured by comparing the children's pre-test and post-test results using descriptive statistics and inferential analysis.

Before the intervention, children's critical thinking skills were assessed through a pre-test. The average scores indicated that most children were still in the early stages of development, particularly in indicators such as *giving reasons* and *evaluating*, which recorded the lowest achievements. These findings suggest the need for interactive and visually engaging media to support their thinking processes.

Table 1: Pre-test Scores of Children's Critical Thinking Skills

No	Initials	Critical Thinking Indicators					Total
		Observe	Analyzing	Comparation	Evaluting	Giving reason	
1.	EG	3	3	3	2	3	14
2.	DT	2	3	2	2	3	12
3.	KR	2	2	1	1	2	8
4.	KH	3	3	3	3	3	15
5.	NH	3	3	2	2	3	13
6.	DV	3	2	2	2	2	11
7.	AQ	3	3	2	1	2	11
8.	SQ	2	2	2	1	2	9
9.	CA	3	3	2	2	3	13
10.	CT	3	2	2	2	2	11

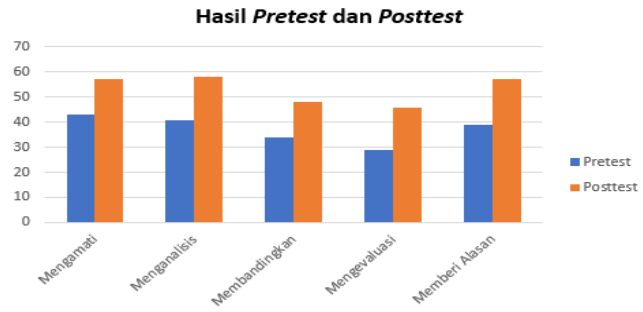
11.	ZY	3	2	2	2	2	11
12.	AS	2	2	2	2	2	10
13.	NM	3	3	2	2	2	12
14.	NJ	2	2	1	1	2	8
15.	SY	3	3	3	2	3	14
16.	AB	3	3	3	2	3	14

After three treatment sessions using the POPBUL media, post-test scores revealed an improvement across all critical thinking indicators. Most children reached scores in the expected or excellent categories, especially in the *analyzing* and *observing* indicators.

Table 2: Post-test Scores of Children's Critical Thinking Skills

No	Nama	Indikator Berpikir Kritis					Total
		Mengmati	Menganalisis	Membandingkan	Mengaluasi	Memberi lasan	
1.	EG	4	4	4	3	4	19
2.	DT	3	4	3	3	4	17
3.	KR	3	3	2	2	3	13
4.	KH	4	4	4	4	4	20
5.	NH	3	4	3	3	4	17
6.	DV	4	3	3	3	4	17
7.	AQ	4	4	3	3	3	17
8.	SQ	3	3	2	2	3	13
9.	CA	4	4	3	3	4	18
10.	CT	3	3	3	3	3	15
11.	ZY	4	3	3	3	3	16
12.	AS	3	4	3	3	4	17
13.	NM	4	4	3	3	3	17
14.	NJ	3	3	2	2	3	13
15.	SY	4	4	4	3	4	19
16.	AB	4	4	3	3	4	18

Picture 1: Bar Graph of Pre-Test vs Post-Test per Indicator



This improvement shows that POPBUL supports cognitive stimulation through concrete visual experiences and interactive elements. It aligns with Facione's (2011) framework, which emphasizes analysis, evaluation, and explanation as foundational components of critical thinking. Children showed greater ability to interpret and explain ideas based on visual cues and hands-on activities, indicating that the book successfully fostered reflective engagement with the content.

The normality test using the Shapiro–Wilk method showed that both pre-test and post-test scores were normally distributed.

Table 3: Shapiro–Wilk Normality Test Results

Result	N	Statistic	Sig.
Pre-test	16	0,945	0,415
Post-test	16	0,894	0,064

Following this, a normalized gain (N-Gain) analysis was conducted to determine the effectiveness of the media in improving each critical thinking indicator. The average N-Gain score across all indicators was 0.6312, categorized as moderate effectiveness. The highest gains were seen in the indicators *explaining equipment and its function* and *giving reasons*, while the lowest were in *comparing* and *evaluating*.

Table 4: N-Gain Scores by Indicator

N	*Pretest - Posttest*	Indikator 1	Indikator 2	Indikator 3	Indikator 4	Indikator 5
N *Gain Score*	.6312	.7188	.8125	.5104	.5104	.7813
N *Gain* Persen	63.1209	71.8750	81.2500	51.0417	51.0417	78.1250
Kriteria	Sedang	Tinggi	Tinggi	Sedang	Sedang	Tinggi

This result suggests that while POPBUL effectively supports conceptual understanding and observation-based reasoning, further scaffolding is needed for more abstract processes like evaluation. It confirms that critical thinking at the early childhood stage develops progressively and benefits from structured, repeated exposure to reasoning tasks.

A paired-sample *t*-test was then conducted to determine the significance of the score differences. The result showed a p-value of 0.000 ($p < 0.05$), indicating a statistically significant improvement in children's critical thinking after the intervention.

Table 5: Paired Sample T-Test Results

Statistic	*Pretest*	*Posttest*	Deviation (*Posttest – Pretest*)
Mean (Average)	11,63	16,63	5,00
Total of Respondents (N)	16	16	-
Standard Deviation	2,156	2,156	0, 816
Sig. (2-tailed)	-	-	0,000

These findings support the notion that media combining visual appeal with interactive learning can enhance young children's cognitive skills. POPBUL not only provides attractive visuals but also engages children in meaningful learning tasks such as identifying, analyzing, and reasoning. Furthermore, teachers reported that the media was helpful in facilitating material delivery, increasing children's enthusiasm, and sustaining their engagement. These results are consistent with previous studies (Florea & Hurjui, 2015; Mahmud et al., 2023; Rohita et al., 2023) that emphasize the importance of interactive media in developing children's higher-order thinking.

Thus, POPBUL has proven to be an effective, engaging, and pedagogically sound media for enhancing critical thinking skills in early childhood education. However, improvements can be made in supporting more abstract reasoning through guided discussion and reflection, especially in evaluation-type tasks.

Conclusion

Based on the results and discussion, it can be concluded that the development of POPBUL (Pop-Up Bulutangkis) is effective in improving the critical thinking skills of children aged 5–6 years at TK Darma Siwi III Surabaya. The validity of the media was confirmed through expert validation, with results showing that the product is highly feasible. The media design features engaging illustrations, bright colors, and interactive pop-up components that are visually appealing to young learners. In terms of content, the material is structured to

support the development of critical thinking skills such as observing, analyzing, and reasoning. Validation scores reached 87.5% from media experts (very feasible) and 68.75% from material experts (feasible), indicating strong quality standards for early childhood education.

The practicality of POPBUL was demonstrated through its ease of use during classroom implementation. Despite the limited number of book copies, teachers found it easy to use and effective in facilitating active learning. Teachers responded positively to POPBUL, noting its ability to make learning more enjoyable and to stimulate children's critical thinking.

In terms of effectiveness, POPBUL showed a significant impact on children's learning outcomes. The average pre-test score of 11.63 increased to 16.63 in the post-test. The results of the normality test indicated a normal data distribution, and the Paired t-Test yielded a significance value of 0.000 ($p < 0.05$), confirming a significant difference before and after the intervention. Additionally, the average N-Gain score was 0.6667 or 66.67%, categorized as moderate effectiveness. These findings indicate that POPBUL is moderately effective in improving children's critical thinking, particularly in the indicators of analyzing and reasoning. Overall, POPBUL proved to be a meaningful and engaging learning medium that enhances both cognitive development and classroom interaction for early childhood learners.

References

Agil, H. M., Gowinda, D., Zulviana, T., & Nurdiantami, Y. (2023). The

Effectiveness of Game-Based Education "ICANDO" to Empowering Children to Do Oral Hygiene. *SYSTED 2023*, 43.

Aisyah, S., Agustin Ningrum, M., Matheos Malaikosa, Y., & Rinakit Adhe, K. (2024). Pengembangan Media GAMAKE (Game Pemadam Kebakaran) untuk Meningkatkan Keterampilan Berpikir Kreatif Anak Usia 5-6 Tahun. *Generasi Emas*, *7*(1), 76–91. https://doi.org/10.25299/ge.2024.vol7(1).17868

Chamim, M. N., & Adhe, K. R. (2020). Pengembangan Media Rubik'S Cube Color Fuld Terhadap Kemampuan Pengenalan Warna Anak Usia Dini. *Pendidikan Islam Anak Usia Dini*, *4*(1), 1–17. http://jurnal.radenfatah.ac.id/index.php/raudhatulathfal/article/view/4428/3097

Chresty Anggraeni. (2015). Peningkatan Kemampuan Berpikir Kritis Melalui Metode Eksperimen Berbasis Lingkungan. *Jurnal Pendidikan Anak Usia Dini*, *9*(2), 245–347. https://doi.org/10.21009/JPUD.092

Dewanti, H., Toenlioe, A. J. E., & Soepriyanto, Y. (2018). Pengembangan Media Pop-Up Book untuk Pembelajaran Lingkungan Tempat Tinggalku Kelas IV SDN 1 Pakunden Kabupaten Ponorogo. *Jurnal Kajian Teknologi Pendidikan*, *1*(3), 221–228.

Dewi, M. P., Adhe, K. R., Maulidiyah, E. C., & Simatupang, N. D. (2023). Pengembangan Media Pop Up Book Mitigasi Bencana Banjir Terhadap Kemampuan Berfikir Logis Anak Usia 5-6 Tahun. *Lencana: Jurnal Inovasi Ilmu Pendidikan*, *1*(2), 121–144.

Dores ,S.Pd., M.Pd, O. J., Wibowo, D. C., & Susanti, S. (2020). Analisis Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Matematika. *J-PiMat : Jurnal Pendidikan Matematika*, *2*(2), 242–254. https://doi.org/10.31932/j-pimat.v2i2.889

Fauziyah, S. N., Ningrum, M. A., Malaikosa, Y. M., Rinakit, K., Guru, P., Anak, P., Dini, U., Surabaya, U. N., Ningrum, M. A., & Malaikosa, Y. M. (2024). *Meningkatkan Keterampilan Berpikir Kreatif Anak Usia 5-6*. *8*(2), 425–432. https://doi.org/10.29313/ga

Ilhafa, U., & Rakhmawati, N. (2022). Analisis Pelaksanaan Pembelajaran Sains Dalam Kemampuan Berpikir Kritis Anak Usia 5-6 Tahun. Indonesian Journal Of Instructional Technology, 03, 36–51. Https://Journal.Kurasinstitute.Com/Index.Php/Ijit/Issue/View/30

Muchamad Arif Al Ardha, M., Chang-Bin Yang, C., Adhe, K., Putra, K., Khory, F., & Harianto, T. (2018). *Physical Education Curriculum for Early Childhood: Developing Students' Manipulative Skills in Soccer*. *173*(Icei 2017), 226–229. https://doi.org/10.2991/icei-17.2018.59

Muhammad, Y. (2017). Media pembelajaran: Pengertian, fungsi, dan urgensinya bagi anak milenial. *Seminar Nasional Tentang Pemanfaatan Media Bagi Anak Milenial Kerjasama Antara Pascasarjana Universitas Muhammadiyah Pare-Pare Dengan Pascasarjana UIN Alauddin Makassar Tanggal*, 14–15.

Natalia, I., Grecia, D., Widayanti, M. D., Setyowati, S., & Agustin, M. (n.d.). *Pengembangan Media Damkar Untuk Meningkatkan Kemampuan Berpikir Kritis Anak Usia 5-6 Tahun*. *13*(2), 248–258.

Natasyah, A., Rinakit Adhe, K., Cahya Maulidiyah, E., & Dorlina Simatupang, N. (2023). Development of Big Book Learning Media in Sex Education for Children Aged 4-5 Years at DWP Banjaran Kindergarten (Pengembangan Media Pembelajaran Big Book pada Pendidikan Seks untuk Anak Usia 4-5 Tahun di TK DWP Banjaran) in Indonesia. *SELING, Jurnal Program Studi PGRA*, *9*(2), 182–197.

Ningrum, M. A., Ningrum, L., & Hamidah, M. (2023). Meningkatkan Kemampuan Motorik Kasar melalui Permainan Halang Rintang pada Anak Usia Dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *7*(5), 5133–5142.

Ningrum, M. A., & Nur, N. R. (2023). Pengembangan Buku Interaktif ARBO Berbasis Augmented Reality Dalam Menstimulasi Kemampuan Mengenal Angka Anak Usia Dini. *Jurnal Caksana: Pendidikan Anak Usia Dini*, *6*(1), 21–36. http://trilogi.ac.id/journal/ks/index.php/PAUD/article/view/1668

O'Reilly, C., Devitt, A., & Hayes, N. (2022). Critical thinking in the preschool classroom - A systematic literature review. *Thinking Skills and Creativity*, *46*(August). https://doi.org/10.1016/j.tsc.2022.101110

Pane, B. S. (2015). Peranan Olahraga Dalam Meningkatkan Kesehatan. *Jurnal Pengabdian Kepada Masyarakat*, *21*(79), 1–4. https://jurnal.unimed.ac.id/2012/index.php/jpkm/article/view/4646

Pratiwi, K., Sugito, S., & Subandowo, M. (2020). The Development Pop-Up Books To Improve Children's Language Skills. *JKTP: Jurnal Kajian*

Teknologi Pendidikan, *3*(4), 408–414. https://doi.org/10.17977/um038v3i42020p408

Winda, P., Pangestu, W. T., & Malaikosa, Y. M. L. (2022). Pengaruh Penggunaan Media Pop-Up Book Terhadap Hasil Belajar Siswa Kelas V Di Sekolah Dasar. *Jurnal Holistika*, *6*(1), 1. https://doi.org/10.24853/holistika.6.1.1-7

Yuliandi, R., Hariansyah, S., Bina, U., Getsempena, B., & Kecil, P. B. (2024). *Jurnal Ilmiah Mahasiswa Tingkat Pengetahuan Siswa Tentang Permainan Bulutangkis Siswa Kelas Viii Smp Muhammadiyah 1*. *5*(1), 1–16.

Yunita, H., Meilanie, S. M., & Fahrurrozi, F. (2019). Meningkatkan Kemampuan Berpikir Kritis melalui Pendekatan Saintifik. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *3*(2), 425–432.

Zubaidah, S. (2010). Berpikir Kritis: kemampuan berpikir tingkat tinggi yang dapat dikembangkan melalui pembelajaran sains. *Seminar Nasional Sains*, *6*(8), 1–14.