LAPORAN KEGIATAN PENELITIAN

ENHANCING CRITICAL THINKING SKILLS OF CHILDREN AGED 5–6 YEARS THROUGH A PROJECT-BASED LEARNING (PJBL) MODEL

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Enhancing Critical Thinking Skills of Children Aged 5–6 Years Through a Project-Based Learning (PjBL) Model

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Abstract:

This study aims to develop a Project-Based Learning (PjBL) model to enhance critical thinking skills in children aged 5–6 years. The research is based on the urgency of fostering 21st-century skills from early childhood and the limited availability of specific learning models for Early Childhood Education (ECE). Using a Research and Development (R&D) approach with the 4D model (Define, Design, Develop, and Disseminate) by Thiagarajan, Semmel, and Semmel, this study involved expert validators, teachers, and children aged 5–6 years from a ECE institution. The findings revealed that the developed PjBL model and the accompanying teacher guidebook demonstrated high feasibility. Expert validation using Aiken's V technique produced a high coefficient, indicating strong content validity and internal consistency. Teachers responded positively, stating that the model was easy to understand, relevant, and effective in stimulating children's critical thinking. The PjBL model integrates syntax, teacher reaction principles, social collaboration systems, and contextual media to promote simple analysis, evaluation, and creation skills. Therefore, it is highly suitable for improving critical thinking in early childhood.

Keywords: *Constructivism; critical thinking; early childhood; learning models; Project-Based Learning (PjBL)*

INTRODUCTION

Early childhood education is an effort aimed at children from birth to six years old, carried out through the provision of educational stimulation to support physical and spiritual growth and development, so that children are prepared to enter further education (Permendikbudristek, 2022). Early childhood education helps children develop the foundational skills necessary for success in school and in life (Fitri & Ummah, 2022). Essentially, early childhood education encompasses all efforts and actions in the process of care and education, enabling children to explore learning experiences from their environment. Children learn from what they experience, feel, do, see, and hear (Fitri et al., 2024). They do not learn in the same way adults do. During this golden age, children should enjoy playtime, as play is the primary means through which they learn. Early childhood education thus serves as a platform for developing the potential that children already possess. The stimulation provided must be creative and innovative to ensure children's developmental aspects grow maximally and optimally.

A joyful learning process will foster the development of cognitive, physical, socio-emotional, language, moral, and religious aspects. Cognitive development refers to the ability to learn, think, and acquire intelligence for mastering new skills and concepts, understanding events in their environment, as well as using memory skills to solve simple problems (Fitri, 2016; Laksana et al., 2021).

Cognitive ability is closely related to the process of thinking. According to Bloom's taxonomy, as revised by Anderson and Krathwohl (Laksana et al., 2021), cognitive processes are hierarchical, with categories arranged according to their level of complexity. Understanding is more complex than remembering; applying is more complex than understanding; and likewise, analyzing, evaluating, and creating represent higher levels of thinking. Children's thinking ability can therefore be observed through these cognitive levels, ranging from the lowest to the highest: remembering, understanding, applying, analyzing, evaluating, and creating. These levels directly influence children's critical thinking abilities in the teaching and learning process (Fitri & Triana, 2022).

Critical thinking is a key skill for approaching situations or problems with systematic and rational methods (Rahmasari et al., 2021). This process involves clear identification, in-depth analysis, and critical evaluation of information, situations, or problems encountered (Fajar et al., 2020). Critical thinking enables individuals to face the complexities of the world in a structured and effective way (Hidayat et al., 2020). In early childhood, critical thinking can be developed by using materials and methods appropriate to their concrete stage of thinking (Smetanová et al., 2015). Critical thinking in early childhood differs from that of adults, particularly due to differences in knowledge structures. Young children who think critically tend to exhibit high levels of curiosity (Kusuma et al., 2023).

Research conducted revealed that most children still face limitations in developing critical thinking skills (Handayani & Sinaga, 2022). Many have difficulty understanding teachers' explanations without repeated instruction and frequently ask questions about tasks that have already been explained. Their ability to draw detailed conclusions is also limited. Critical thinking skills may be reflected in questioning behavior, although most children have not yet demonstrated the ability to ask questions directly related to lesson content (Rahmasari et al., 2021).

The researcher carried out observations on the application of learning models to foster critical thinking in children aged 5–6 years. Although essential for holistic cognitive development, these skills are often not optimally stimulated in early childhood education. Observations were conducted in two institutions: PAUD Al-Kautsar and RA Al Fatah 2. Limited concrete experiences and a lack of varied stimuli emerged as the main barriers. At this stage, children are still in the concrete thinking phase; therefore, abstract learning or lessons that provide few opportunities for direct, multi-sensory exploration hinder their ability to form concepts, observe details, and understand cause-and-effect relationships.

Observations at RA Al Fatah 2 revealed that learning was dominated by conventional, teacher-centered approaches, often encouraging children to remain passive, wait for predetermined answers, and show little initiative in asking questions or seeking solutions independently. This issue was worsened by teachers' tendency to provide direct answers rather than facilitating discovery. Limited opportunities for collaboration and discussion posed significant barriers. Teachers' lack of understanding regarding critical thinking in early childhood caused lessons to focus mainly on rote memorization or gross/fine motor skills. The teaching

methods used were monotonous and lacked variety, such as lectures, one-way instructions, and activities that did not engage children actively (e.g., simply coloring or pasting without thought-provoking questions). Observations at PAUD Al-Kautsar showed children's dependence on teachers' instructions, which restricted the development of independent critical thinking. Fragmented and less meaningful learning made it difficult for children to integrate knowledge. When material was presented separately without clear connections or personal relevance, children struggled to build a holistic understanding and apply their knowledge in broader contexts. The lack of challenges and tolerance for mistakes also contributed to this limitation. Lessons that were overly easy or focused solely on "correct answers" without allowing room for trial-and-error hindered experimentation, creative thinking, and learning from mistakes—elements essential to critical thinking and problem-solving. Children also experienced difficulties in cooperative learning environments and often engaged in incomplete learning activities.

The learning models applied at KB Al-Kautsar Banjarnegara and RA Al Fatah 2 Banjarnegara indicate that the development of critical thinking skills in children aged 5–6 years still requires improvement. This is particularly significant for achieving the Standar Tingkat Pencapaian Perkembangan Anak (STPPA), which serves as a national milestone standard for early childhood development in Indonesia, as mandated by the Ministry of Education and Culture Regulation No. 137 of 2014. This regulation divides the scope of cognitive development into three domains: Learning and Problem-Solving, with indicators such as the ability to solve simple problems and engage in exploratory activities; Logical Thinking, which is closely related to exploration and indirectly supports the emergence of new ideas; and Symbolic Thinking, which lays the foundation for abstract thought necessary for critical thinking in later stages.

Based on the results of observations, children's critical thinking skills at KB Al Kautsar Banjarnegara showed that on the indicator of exploratory activities, they achieved 62.5%, problem-solving skills 58.3%, the ability to generate new ideas 58.3%, and collaborative problem-solving skills 58.3%. At RA Al Fatah 2 Banjarnegara, the indicator of exploratory activities reached 60.4%, problem-solving skills 58.3%, the ability to generate new ideas 56.2%, and collaborative problem-solving skills 58.3%. The observations were carried out by observing the results of children's activities and conducting interviews with teachers. Furthermore, the observation process was conducted for one week in order to obtain optimal results. Finally, the results of observations at the two institutions indicated that the use of less effective learning models affects children's ability to develop critical thinking skills optimally.

The selection of inappropriate learning models in the teaching and learning process causes educators to fail in communicating learning materials. This mistake affects learning objectives and results in the failure to achieve the intended goals (Lutvaidah, 2016). Selecting and applying the right learning model will yield maximum results in line with the predetermined objectives or targets (Lasaiba, 2018). Educators must be able to design learning that equips students both theoretically and practically (Bjorklund, 2012).

Project-Based Learning (PjBL) becomes an alternative to be applied to early childhood education because it is directly related to real-life contexts, allowing children to learn through the help of others and from their own experiences (Sari et al., 2023). This aligns with Vygotsky's view that educators should plan activities not only based on what children can do independently but also what they can learn with the help of others (Muhibin & Hidayatullah, 2020). Moreover, children can learn to regulate themselves, work together with peers in solving problems, and develop a work ethic (Purba & Sinaga, 2020).

The four pillars applied in the PjBL model are learning to know, learning to do, learning to live together, and learning to be (Amelia & Aisya, 2021). The findings revealed that PjBL could improve children's achievement by 87.5%, indicating that children's development falls into the "very good" category (Rusmayadi et al., 2023). These results show that using learning models for children aged 5–6 years provides meaningful learning experiences through play and makes learning more enjoyable and child-centered (Namaskara et al., 2023).

The PjBL model is a teaching approach developed based on the principles of constructivism, problem-solving, inquiry research, integrated studies, and reflection, which emphasizes both theoretical and applied aspects (Sari, 2018). Learning through the PjBL model involves developing projects, individually or in groups, to produce a product. It can be concluded that the principle of the PjBL learning model is child-centered. The characteristics of child-centered learning are: (1) activities initiated by children; (2) children

select materials and decide what they want to do; (3) children actively express materials with all their senses; (4) children discover cause-effect relationships through direct experiences with objects; (5) children use gross motor skills while learning; and (6) children have opportunities to share their experiences (Sari, 2018).

PjBL is important for children because it fosters knowledge by encouraging curiosity to find solutions to problems they encounter (Purba et al., 2024). Implementing PjBL allows children to feel directly involved, making learning more meaningful. PjBL also provides opportunities for children to communicate, express, and develop their ideas into real works (Kokotsaki et al., 2016). This learning model is applied in early childhood education because it is believed to enhance children's critical thinking skills (Hayati & Syaikhu, 2020).

From the explanation above, it can be concluded that to encourage critical thinking skills in children, both individually and in groups, it is highly recommended to use the PjBL model. The PjBL model is very effective in developing various skills in early childhood. This approach emphasizes active, meaningful, and contextual learning designed to provide direct experiences to children, thereby improving their critical thinking skills. Therefore, this study is formulated to enhance the critical thinking skills of children aged 5–6 years through a Project-Based Learning (PjBL) model.

The novelty of this research lies in the implementation of the Project-Based Learning (PjBL) model that is specifically adapted for early childhood (ages 5–6). While PjBL has previously been widely applied at the elementary and secondary education levels, this study introduces an innovation by integrating PjBL principles into contextual play-based activities aligned with children's real-life experiences. In addition, this research emphasizes the measurement of children's critical thinking skills through indicators of exploration, problem-solving, idea generation, and collaboration, which are rarely the primary focus in early childhood education studies. By aligning the PjBL model with developmental characteristics and national competency standards, this study offers a pedagogically relevant and contextually grounded contribution to improving instructional quality in ECE institutions.

METHODS

Type of Research

The type of research used is Research & Development (R&D) with the 4D model (Define, Design, Development, Disseminate). The 4D model was chosen because of its advantages in not requiring a long time, as its stages are relatively not too complex (Maydiantoro, 2021). The first stage is Define, often referred to as the needs analysis stage. The second stage is Design, which involves preparing the conceptual framework of the model and learning tools. The third stage is Develop, which refers to the development stage involving validation tests or assessing the feasibility of the media. Finally, the fourth stage is Disseminate, which is the implementation on the actual target, namely the research subjects.

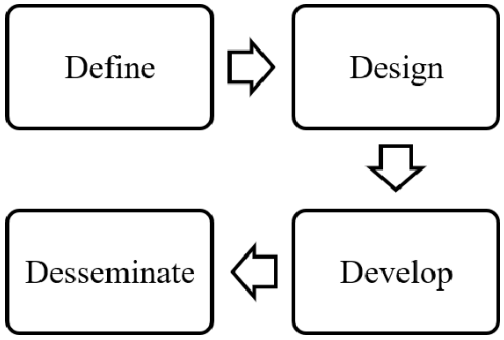


Figure 1. 4D Learning Model Development Model

Research Subjects

Expert validation involved two validators, one material expert in early childhood learning and ne language expert. The material expert for early childhood learning models was Mr. Luthfi Aji Ramdani, M.Pd, a lecturer in Early Childhood Education, and the language expert was Ms. Prissilia Prahesta

Waningyun, M.Pd, a lecturer in Indonesian Language Education at Universitas Ma'arif Nahdlatul Ulama Kebumen. Meanwhile, user validation involved early childhood teachers from institutions at the research sites. The focus of the validation process was to determine the feasibility of the PjBL learning model and to obtain teacher responses regarding its clarity, relevance, and applicability for enhancing critical thinking skills in children aged 5–6 years. Teachers were involved in evaluating the learning model product used in the study.

Table 1. Trial Participants

No	Institution Name	Number of Children	Number of Teachers
1	KB Al-Kautsar	22	2
2	RA Al Fatah 2	12	2
Total		34	4

Data Collection Instruments

The instrument used in this study was a questionnaire designed for data collection, which was completed by several lecturers and teachers. The first questionnaire was intended for both experts and users. The product evaluation questionnaire for experts aimed to determine whether the developed learning model was feasible for further research. Meanwhile, the teacher response questionnaire was used to gather data regarding teachers' responses to the use of the product. The results of the teacher questionnaire would indicate the practicality of the product. Furthermore, a language expert questionnaire was employed to determine and ensure whether the language used in the instrument adhered to proper linguistic rules, was easily understood by the target audience, and was free from ambiguity.

Data Analysis Techniques

Content Validity Analysis

Validity refers to the degree of accuracy of a test. Content validity was conducted to examine the extent to which the content of an instrument measures what it is supposed to measure. In this study, content validity was determined using expert agreement. The use of expert consensus was chosen because it has been proven accurate when experts believe that the instrument is capable of measuring the validity required for the feasibility of a product. Data collection was carried out by distributing questionnaires to expert validators, and the resulting data were then analyzed. Content validity analysis was performed to obtain data from the assessments made by material expert validators and language expert validators. The validity analysis in this study applied Aiken's V formula, which measures the degree of content validity of instruments (such as questionnaires, tests, or statements) based on expert judgment, to determine the extent of agreement among experts regarding the validity of each item in the instrument, whether the item is valid or not, thus producing a feasible product. The assessment was conducted using a Likert scale, with criteria presented in Table 2.

Table 2. Criteria for Instrument Item Assessment by Validators

Value	Description
1	Not Suitable
2	Less Suitable
3	Fair
4	Suitable
5	Very Suitable

The data obtained from this assessment is quantitative data. This data can be converted into qualitative data in the form of intervals using the following formula:

$$V = \frac{\sum s}{n(c-1)} \qquad S = R - Lo$$

Note:
V = Aiken's Index
S = Score given by the rater minus the lowest score
R = Score given by the rater
Lo = Lowest rating score [1]
C = Highest rating score [5]
n = Number of validators (raters)
If Aiken's Index is less than 0.4, validity is considered low; an index between 0.4 – 0.8 is considered moderate; and if greater than 0.8, it is considered high.

Table 3. Aiken's Index Criteria

Aiken's Index	Validity Level
0,4	Low
0,4 – 0,8	Moderate
> 0,8	High

Teacher Response Data Analysis

Teachers' responses to the implementation of the PjBL learning model on children's critical thinking skills will be analyzed using a 5-point Likert scale instrument and descriptive statistics to provide an overview of the percentage, mean, and standard deviation of each item.

$$\bar{X} = \frac{\sum X}{N}$$

Note:
X = average score ($X\ bar$)
$\sum X$= total sum of all scores
N= number of respondents

Table 4. Criteria for Teacher Response Scale

Interval	Criteria
1.00 – 1.80	Not appropriate
1.81 – 2.60	Less appropriate
2.61 – 3.40	Fair
3.41 – 4.20	Appropriate
4.21 – 5.00	Very appropriate

RESULTS AND DISCUSSION

RESULTS

The process of expert judgment or validation was carried out by experts in early childhood education and learning model development, aiming to ensure the feasibility of the product before implementation. The data obtained from this expert validation instrument served as an important basis for revising and refining the product, so that the resulting learning model and guidebook are of high quality and ready for use in learning practice. At this stage, the researcher involved material experts, including Luthfi Aji Ramdani, M.Pd., an expert in early childhood learning models, and Prissilia Prahesta Waningyun, M.Pd., a language expert. The evaluation of the developed learning model by material experts focused on content validity and the level of agreement among the experts. If the learning model is deemed feasible based on this assessment, the process continues with the initial testing phase and quantitative testing phase. The detailed results of the material experts' assessment, obtained through the calculation of Aiken's V technique, are presented in the following table:

Table 5. Results of Material Experts' Assessment using Aiken's V Analysis

No	Value		S = r-lo		∑	No*(c-1)	V=S/n*(c-1)	Note
	1	2	1	2				
1	4	4	3	3	6	8	0,75	Valid
2	5	4	4	3	7	8	0,875	Valid
3	4	4	3	3	6	8	0,75	Valid
4	4	5	3	4	7	8	0,875	Valid
5	4	5	3	4	7	8	0,875	Valid
6	4	4	3	3	6	8	0,75	Valid
7	5	5	4	4	8	8	1	Valid
8	4	4	3	3	6	8	0,75	Valid
9	5	4	4	3	7	8	0,875	Valid
10	5	4	4	3	7	8	0,875	Valid
11	3	4	2	3	5	8	0,625	Valid
12	4	4	3	3	6	8	0,75	Valid
13	3	4	2	3	5	8	0,625	Valid
14	4	5	3	4	7	8	0,875	Valid
15	5	5	4	4	8	8	1	Valid
16	4	4	3	3	6	8	0,75	Valid
17	5	5	4	4	8	8	1	Valid

Based on the results of the material experts' assessment presented in Table 5, it can be seen that each assessment item obtained an Aiken's V value ranging from 0.625 to 1.00. The highest value of 1.00 was achieved in several aspects, such as the alignment of the content with learning objectives, the clarity of material presentation, and the coherence of the material with the characteristics of early childhood learners. This indicates a full level of agreement among the experts that these aspects are highly appropriate for use in the developed learning model.

Meanwhile, the lowest value of 0.625 was found in several indicators related to language clarity and the systematic presentation of material. Nevertheless, this value still falls within the valid and acceptable category, since according to Aiken's V criteria Hendriyadi (2017), values above 0.50 indicate adequate validity and a strong level of expert agreement on the assessed items. Overall, the average Aiken's V value from the material experts' assessment falls within the valid to highly valid category, meaning that the content of the developed Project-Based Learning (PjBL) model has met the criteria of content feasibility, alignment with learning objectives, suitability with early childhood characteristics, and relevance to the development of critical thinking skills. Therefore, this learning model is declared feasible to proceed to the initial (limited) trial phase to examine its practicality and effectiveness in the field.

Initial Testing

The initial testing was conducted to determine the feasibility of the product based on teachers' responses to the PjBL model designed to improve the critical thinking skills of children aged 5–6 years. The purpose of the initial testing was to obtain information on the feasibility of the Project-Based Learning model from the teachers' perspective, particularly regarding its effectiveness in enhancing children's critical thinking skills. This testing was carried out after the model had been validated and revised by a panel of experts. Referring to Thiagarajan's recommendation on testing efficiency, which suggests implementation in 1–5 institutions to facilitate the revision and further evaluation process, the initial testing involved PAUD Al-Kautsar with 1 teacher of TK B class (22 students) and PAUD Aisyiyah 2 with 1 teacher of class B (12 students). One day before implementing the learning model, the teachers were given a comprehensive explanation of how to apply it. The purpose was to ensure that teachers could maximize the use of the model and provide accurate and relevant evaluations. After applying the learning model, teachers completed a

response questionnaire. This questionnaire, in paper form, contained statements and a comment section designed to capture teachers' opinions on the developed PjBL learning model. The results of practitioners' evaluations of the PjBL learning model are presented as follows:

Table 6. Results of Material Experts' Assessment using Aiken's V Analysis

No	Question Item	Score	Assessment Criteria
1	Suitability of Background	3,5	Good
2	Suitability of Objectives	3,5	Good
3	Suitability of Learning Model Usage Instructions	4	Good
4	Suitability of Learning Model Explanation	4	Good
5	Suitability of PjBL Learning Explanation	4,5	Very Good
6	Suitability of the Explanation of Children's Critical Thinking Skills	4,5	Very Good
7	Suitability of the Explanation of Children Aged 5–6 Years	4,5	Very Good
8	Suitability of Steps/Syntax of PjBL Learning	4,5	Very Good
9	Suitability of Reaction Principles	4,5	Very Good
10	Suitability of Social System	4	Good
11	Suitability of Support System	4	Good
12	Suitability of Instructional Impact	4	Good
13	Suitability of Nurturant Effect	4	Good
14	The book is easy to understand for delivering material	4	Good
15	Clarity of learning step instructions through images	4	Good
16	Systematic writing is sequential and clear	4	Good
17	Attractive book design	5	Very Good
Total Assessment Score		**4,2**	**Very Good**

Quantitative Testing

The final feasibility test (quantitative testing) was carried out after the researcher received revisions from the initial testing stage. This quantitative testing phase was aimed at refining the learning model materials based on the previous revisions to assess its feasibility. The quantitative testing involved 3 teachers and 56 children across three schools: BA Aisyiyah 2, PAUD Al-Fatah, and PAUD Al-Kautsar. A day before the implementation, teachers were explained how to apply the learning model. This was intended to ensure that teachers could maximize the implementation of the model and provide accurate and appropriate evaluations. The response questionnaire was distributed after teachers finished applying the learning model. The questionnaire was in paper form, consisting of statement items and a comment section for teachers to fill in, aimed at capturing their opinions on the developed learning model.

Table 7. User Validation of the PjBL Learning Model for Children's Critical Thinking Skills

No	Question Item	Score	Assessment Criteria
1	Suitability of Background	5	Very Good
2	Suitability of Objectives	5	Very Good
3	Suitability of Learning Model Usage Instructions	5	Very Good
4	Suitability of Learning Model Explanation	4,7	Very Good
5	Suitability of PjBL Learning Explanation	5	Very Good
6	Suitability of the Explanation of Children's Critical Thinking Skills	4,7	Very Good
7	Suitability of the Explanation of Children Aged 5–6 Years	5	Very Good
8	Suitability of Steps/Syntax of PjBL Learning	5	Very Good
9	Suitability of Reaction Principles	5	Very Good

No	Question Item	Score	Assessment Criteria
10	Suitability of Social System	5	Very Good
11	Suitability of Support System	4,7	Very Good
12	Suitability of Instructional Impact	4,7	Very Good
13	Suitability of Nurturant Effect	4	Very Good
14	The book is easy to understand for delivering material	5	Very Good
15	Clarity of learning step instructions through images	5	Very Good
16	Systematic writing is sequential and clear	4,7	Very Good
17	Attractive book design	5	Very Good
Total Assessment Score		**4,9**	**Very Good**

DISCUSSION

The implementation of the Project-Based Learning (PjBL) model in the classroom positions the teacher as the main facilitator who guides children through every stage of the project, from planning to reflection on the outcomes. In the initial stage, the teacher poses contextual, inquiry-based questions that are closely related to the children's real-life experiences, such as their surrounding environment, pets, or daily activities. These questions serve to stimulate curiosity and help children formulate ideas for the projects they will undertake. Next, the teacher assists children in designing the steps of the activity through group discussions, selecting materials, and determining the form of the final product to be created, such as posters, miniatures, or simple three-dimensional works.

Throughout the process, the teacher provides scaffolding tailored to each child's developmental level. Teachers encourage children to observe, ask questions, experiment, and find solutions to small problems that arise during the project activities. For example, when children struggle to combine materials or determine the correct sequence of steps, the teacher does not immediately provide the answer but instead guides them with reflective prompts such as, "What can you do to make this stick more firmly?" or "How about we try another way?" This strategy aligns with constructivist principles, which emphasize active learning and the discovery of meaning through direct, hands-on experiences.

This study aims to develop a PjBL (Project-Based Learning) model for fostering critical thinking skills in children aged 5–6 years. The findings confirm that the design of the PjBL model, grounded in essential questions and the process of creating tangible products, effectively stimulates and develops critical thinking skills in young children. These results are consistent with research indicating that PjBL promotes higher-order thinking skills by encouraging exploration, analysis, and synthesis of information within authentic problem contexts (Faridah et al., 2022). This is further supported by studies highlighting the effectiveness of PjBL in building reasoning and problem-solving abilities in preschoolers through active engagement in projects relevant to their lives (Sari et al., 2023).

The PjBL design, which encourages children to analyze simple information, evaluate options, and create new solutions, actively trains aspects of Higher Order Thinking Skills (HOTS). This aligns with recent literature suggesting that HOTS development can begin at an early age through activities that promote inquiry, discovery, and synthesis (Ahmad & TESOL, 2023). PjBL provides an ideal framework for integrating HOTS through meaningful learning experiences. Beyond enhancing critical thinking, the implementation of PjBL also yields significant collateral impacts on children's affective and social domains, such as increased self-confidence, independence, and collaboration skills. These findings reinforce the view that project-based learning facilitates essential socio-emotional development in addition to cognitive growth, in line with holistic education approaches recommended in modern curricula (Ayuningsih et al., 2022; Rusmayadi et al., 2023).

The integration of interactive learning media, such as loose parts, was found to significantly stimulate cognitive development underlying critical thinking, including logic, strategy, and problem-solving. The use of loose parts (flexible materials that can be combined and transformed) encourages children to create, experiment, and solve problems independently key indicators of critical thinking. Research demonstrated

that loose parts effectively enhance critical thinking skills in 5–6-year-olds by facilitating exploration and the creation of products based on children's ideas (Harun & Rahardjo, 2022). The developed PjBL model also demonstrated high adaptability to various themes and resource availability in school environments, including the use of recycled or locally sourced materials. This flexibility enables wider and sustainable implementation, supporting the findings (Sari et al., 2023), which emphasize that learning models must be adaptable to local contexts in order to achieve maximum effectiveness, particularly in diverse early childhood education settings.

Through PjBL, children are encouraged to actively ask questions, both to teachers and peers, as part of the project investigation process. The ability to ask questions is a critical foundation for developing critical thinking, as it reflects curiosity and the desire to understand. PjBL designs which place questioning at the center of projects significantly increased both the frequency and quality of preschoolers' questions an early indicator of emerging critical thinking skills (Nurhayati et al., 2025). Observations indicated that children's active participation in every stage of the project, from planning to presentation, correlated positively with their level of understanding and critical thinking development. This reinforces the principles of constructivism (Sunanik, 2014) and experiential learning theory (Utami, 2016), which remain highly relevant, asserting that the most effective learning occurs when children actively construct knowledge through exploration, interaction, and reflection on direct experiences (Fitri et al., 2024).

The implementation of the PjBL model fostered improved quality of interactions between teachers and children. Teachers became more facilitative, discussion triggers, and learning partners, while children felt more empowered to ask questions and express themselves. This role shift supports research findings indicating that high-quality teacher-child interactions are critical for both cognitive and socio-emotional development in early childhood (Handayani & Sinaga, 2022; Rahmasari et al., 2021). The teacher's active role as an adaptive scaffolder is vital in helping 5–6-year-old children overcome complex project challenges, enabling them to go beyond their independent capabilities. This confirms the enduring relevance of Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD), reaffirmed in modern contexts by research showing that structured adult support allows young children to engage in higher-level cognitive tasks (Trianto, 2010).

CONCLUSION

The Project-Based Learning (PjBL) model developed in this study demonstrates strong feasibility for enhancing the critical thinking skills of children aged 5–6 years by integrating constructivist principles, inquiry-based activities, and contextual learning. Validation results indicate high feasibility (Aiken's $V > 0.70$) and strong teacher approval (average score 4.9). The model provides a practical framework for teachers to implement meaningful learning experiences in ECE settings. It can serve as a reference for future curriculum development aligned with the Kurikulum Merdeka and the Pancasila Student Profile.

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Rincian Biaya

No.	Item	Harga	Total Biaya
1	Bahan-bahan penelitian		
	ATK	Rp. 350.000	**Rp. 350.000**
	Bahan Proyek	Rp. @150.000	**Rp. 750.000**
	Lembar observasu	Rp. 400.000	**Rp. 400.000**
2	Pengumpulan Data		
	Transportasi	Rp. @200.000	**Rp. 1.000.000**
	Konsumsi tim peneliti	Rp. @20.000	**Rp. 1.100.000**
	Honor Validator instrumen	Rp. 1.100.000	**Rp. 1.100.000**
	Honor Asisten	Rp. @450.000	**Rp. 900.000**
3	Analisis Data		
	Analisis Statistic	Rp. 700.000	**Rp. 700.000**
	Penggandaan arsip digital	Rp. 250.000	**Rp. 500.000**
	Biaya Publikasi	Rp. 350.000	**Rp. 350.000**
0	Jilid	Rp. @200..000	**Rp. 1.200.000**
	Total		**Rp. 8.000.000**