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# Improving the Critical Thinking Skills of Early Childhood Through the Application of the STEAM Method with Loose Parts in the Independent Curriculum

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**ABSTRACT**

This study aims to identify factors that influence the improvement of critical thinking skills of early childhood through the application of the STEAM method with Loose Parts in the context of the Independent Curriculum. This study uses a qualitative method with a literature review approach and thematic analysis to explore these factors. This research shows that critical thinking skills in early childhood are influenced by three main groups of factors, namely internal, external factors and learning approaches. These factors influence each other, where motivation and support from teachers increase children's involvement in the learning process, while the availability of resources enriches learning. Thus, improving early childhood critical thinking skills requires a holistic approach that takes into account the internal factors of the child as well as the role of the teacher and the learning environment. The supporting curriculum is the flexibility of the independent curriculum and integration with thematic learning. This research provides an overview of how these factors contribute to the effectiveness of applying the STEAM method with Loose Parts in improving early childhood critical thinking skills in the context of the Independent Curriculum.



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## 1. INTRODUCTION

The Partnership for 21st Century Skills identified four main skills that must be mastered, namely: creativity, critical thinking, communication, and collaboration. These skills are known as the 4Cs (Nurjanah, 2020). Critical thinking is increasingly considered important in early childhood development and education (O'Reilly et al., 2022). Research shows that interventions can improve critical thinking skills in young children. Key characteristics of critical thinking in childhood include reasoning and problem-solving skills (English, 2023). Research shows that interventions can improve critical thinking skills in young children. Key characteristics of critical thinking in childhood include reasoning and problem-solving skills. The lack of critical thinking skills in young children can be caused by various factors, one of which is the suboptimal development of critical thinking skills, which is seen in children who are reluctant to express ideas or provide reasons (Rahmi et al., 2022).

To overcome these problems, appropriate learning methods are needed. Relevant and modern learning models need to be applied by educators because based on the 2018 PISA study by the OECD, it shows that the average score of Indonesian students in reading (371), mathematics (379), and science (389) is still below the OECD average. Although the achievement of Indonesian students is relatively low, the achievement gap between students from various socio-economic backgrounds is quite small, indicating high equity in opportunities (Yusmar & Fadilah, 2023). To achieve the highest score in every subject, it is important for students to start preparing since early childhood education. This preparation is needed in order to increase the average score of students in Indonesia, one of which is by implementing the right learning model from the beginning.

One of the learning models that can be used to improve critical thinking in early childhood education in developing critical thinking skills is the STEAM-based learning model with loose parts materials that promote critical thinking through exploration of the social environment, developing skills such as attention to detail and active problem solving (Susan et al., 2023). This learning model uses a learning approach that integrates elements of Science, Technology, Engineering, Arts, and Mathematics using loose parts, which is considered effective in developing 21st century skills. Because STEAM learning encourages children to have 4C skills, namely critical thinking and problem solving skills, communication, collaboration and creative and innovative thinking skills (Yuliasri & Faruq, 2022). The STEAM learning model is directly integrated with loose parts, which are open materials that can be combined, moved, or mixed and matched to make games from similar or non-similar materials, so that children can play according to their interests (Maarang et al., 2023).

A good learning model requires a lot of support, one of which is government support by issuing a learning curriculum. The latest curriculum issued by the government is the Merdeka curriculum. The Merdeka Curriculum, a new innovative curriculum in Indonesia, aims to develop critical thinking skills in students through contextual learning, emphasizing creativity, collaboration, and problem solving (Kollo & Suciptaningsih, 2024). The implementation of the Independent Curriculum in early childhood education emphasizes child-centered learning and integrates the concept of STEAM (Science, Technology, Engineering, Arts, Mathematics). This learning is tailored to the needs, interests and abilities of each child, so that they are more active and involved in the learning process. In addition, the STEAM concept is applied by combining elements of science, technology, engineering, art and mathematics in learning activities, which aim to develop critical, creative and problem-solving abilities from an early age (Motimona & Maryatun, 2023). The Independent Curriculum gives schools, teachers and students the freedom to learn independently with a creative approach. In this curriculum,

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teachers act as drivers who create a pleasant learning atmosphere, with a focus on improving the quality of education, forming students with Pancasila character, and preparing them to face future challenges and development of Pancasila learning content at the preschool-aged children's education level to foster the character of love for the country, Indonesia (Wahyuningsih et al., 2024).

Previous research states that the implementation of the STEAM learning method in early childhood education is carried out through several steps. These steps include: 1) Reflection, where children combine previous experiences with the concepts to be developed; 2) Research, children explore and collect the information needed; 3) Discovery, children formulate steps to solve problems; 4) Application, children design and revise the project they are working on; and 5) Communication, children present the results of their projects (Motimona & Maryatun, 2023). However, the study did not link this process to the play materials used during the conduct of the study, which could have provided deeper insight into the effectiveness of the method. Based on the explanation above, in this study the author wants to know what factors influence the improvement of students' critical thinking skills through the STEAM learning model with loose parts in the Independent Curriculum with the aim of identifying factors that influence the improvement of students' critical thinking skills through the application of the STEAM learning model with loose parts in the context of the Independent Curriculum. The results of the study are expected to contribute to the development of more effective learning in improving students' critical thinking skills.

## 2. METHODS

This research is a qualitative research method with a literature review approach because this method allows for in-depth study and analysis of various relevant literature, so that it can understand and synthesize various theoretical perspectives and empirical findings related to the research topic. This method also provides flexibility in exploring complex and dynamic concepts, which will enrich understanding and provide new insights in the context of the research I am doing. The research subjects in this study were students, teachers and early childhood observers.

The technique used in data collection by selecting and analyzing relevant literature, journal articles, books, reports, and other academic sources that are credible and recent sources. Data collected from various library sources are summarized and selected based on relevance to the research question. This data reduction is to help filter the most important information and related to the research objectives. The next step is to code, which is the process of grouping data into certain categories or themes that emerge from the literature. The findings that have been grouped by theme are further analyzed to identify key conclusions and develop logical and structured arguments, look at **Figure 1**.

Data analysis using thematic analysis (Khoirunissa & Winoto, 2022) by linking the findings to a previously established theoretical framework or research question. Synthesis is done by combining findings from various literatures to form a more comprehensive understanding of the research topic. After being interpreted and synthesized, conclusions are drawn from the analyzed data.

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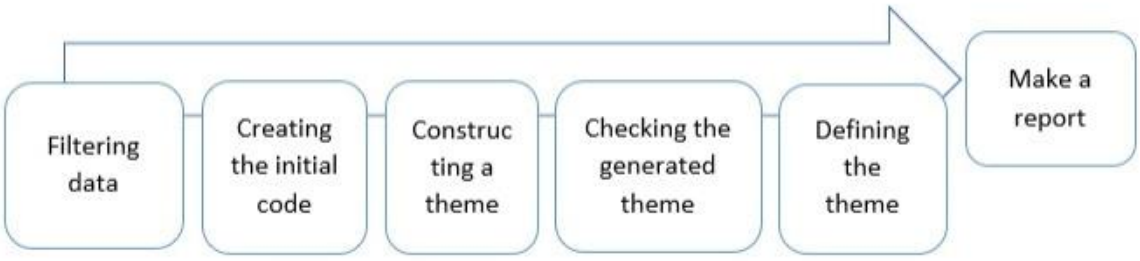


**Figure 1.** Technique Data Reduction

## 3. RESULTS AND DISCUSSION

This study analyzed 24 peer-reviewed journal articles published in the last five years, which focused on the implementation of the Independent Curriculum in early childhood education. The selected literature on critical thinking skills of early childhood, the STEAM learning model with loose parts and the Independent Curriculum of early childhood education was conducted to provide a broad perspective on this theme. The articles reviewed vary in methodological approaches, including qualitative, quantitative, and mixed studies, and use various educational theories as a framework. Inclusion criteria include literature that directly discusses learning strategies and challenges faced in the implementation of the Independent Curriculum. Thematic analysis was conducted to identify the main themes related to critical thinking skills of early childhood with the STEAM learning method with loose parts.

The use of STEAM and loose parts in early childhood education is based on a strong foundation of learning theory. These two approaches complement each other and provide significant benefits for early childhood critical thinking skills (Syafi'i & Dianah, 2021). Some theories that are relevant to the STEAM learning model using loose parts are as follows: a. Constructivism: 1) Understanding: The theory of constructivism, pioneered by Jean Piaget, argues that children construct their own knowledge through active interaction with the environment. Children are not just passive recipients of information, but actively seek meaning from their experiences (Muflich & Nursikin, 2023). Relevance: STEAM and loose parts strongly support constructivism because: 3) Active learning: Children are encouraged to explore, experiment, and discover STEAM concepts themselves through play with loose parts. 4) Meaningful learning: Children connect their learning experiences to the real world, so that the knowledge gained is more meaningful and long-lasting. b. Project Based Learning (Kamaruddin et al., 2023): 1) Understanding: Project-based learning engages children in completing authentic tasks or projects. Children learn in more meaningful and motivated ways when they are involved in projects that are relevant to their interests. 2) Relevance: STEAM and loose parts are great for project-based learning because: 3) Flexibility: Loose parts give children the freedom to create projects that are unique and in line with their imaginations. 4) 21st-century skills: STEAM projects help children develop 21st-century skills such as creativity, problem solving, and collaboration. c. Cognitive Development Theory (Rahmaniar & Mahmudah, 2022): 1) Understanding: This theory emphasizes the importance of sensorimotor experiences in children's cognitive development. Through interaction with the physical environment, children build an

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understanding of the world around them. 2) Relevance: Loose parts provide many opportunities for children to use their five senses and develop fine and gross motor skills through the manipulation of materials. d. Game Theory (Hayati & Putro, 2021): 1) Understanding: Play theory emphasizes the importance of play in child development. Through play, children learn about the world, develop social skills, and explore their identities. 2) Relevance: STEAM and loose parts make play an effective learning tool. Children learn through play, making the learning process more fun and engaging.

### 3.1. STEAM (*Science, Technology, Engineering, Arts, Mathematics*)

Critical thinking is an important skill that must be developed from an early age. Critical thinking involves the ability to investigate, analyze, and evaluate information independently. Teachers play an important role in facilitating critical thinking through effective communication strategies and language use (Aeni & Setiasih, 2024). The development of critical thinking skills can be stimulated through various approaches, including STEAM-based learning and simple daily activities at home. This approach helps children develop attention to detail, memory, active learning, and problem-solving skills Even during distance learning, parents can foster critical thinking through effective communication and opportunities to explore in everyday activities. Cultivating critical thinking from an early age prepares children to face future challenges and helps them become more conscientious, persistent, and responsible individuals (Itsna et al., 2022).

The application of STEAM and loose parts learning models can support the development of creative, collaborative, and cognitive skills in children. In addition, this learning model can also be applied in various educational contexts, both in formal and informal environments (Rachmah et al., 2022). STEAM and loose parts learning models are effective in various aspects of child development, such as problem-solving skills, creativity, and collaboration (Putri et al., 2021). STEAM (Science, Technology, Engineering, Arts, Mathematics) is an integrated learning approach that combines five disciplines to develop critical thinking skills in children (Rahayu et al., 2023). A study conducted on students showed a significant increase in critical thinking skills after implementing the STEAM model, with the success rate increasing from 20% before the intervention to 80% after two cycles of implementation (Lubis et al., 2023).This approach fosters creativity, problem-solving skills, and scientific inquiry. STEAM is a great fit for early childhood education, as it integrates the hard and soft skills that children need (Priyanti et al., 2023). The application of STEAM in one of the educational subjects such as mathematics can improve students' cognitive, affective, and psychomotor abilities in dealing with technological advances (Nurhikmayati, 2019). Research shows that STEAM-inspired learning, such as through video tutorials, can effectively develop critical thinking skills in young children (Rahayu et al., 2023). In addition, STEAM experiences can boost children's self-confidence and encourage them to build knowledge about the world around them through observation, investigation, and questioning (Priyanti et al., 2023).

STEAM (Science, Technology, Engineering, Arts, and Mathematics) is an innovative educational approach that integrates various disciplines to improve critical thinking skills and creativity in students (Iffiani et al., 2024). Research shows that STEAM-based learning can effectively develop critical thinking skills in early childhood education, one of which is through the use of video tutorials and practical activities (Rahayu et al., 2023). The STEAM learning model with loose parts is one option to stimulate children's creativity and problem-solving abilities (Nurhalizah & Yuwafik, 2020). STEAM-based curriculum and teaching methods can be effectively applied at various levels of education to prepare

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students for the challenges of the 21st century, including technological advances and the need for effective communication skills (Iffiani et al., 2024).

### 3.2. *Loose Parts*

Loose parts media used as a companion to the STEAM learning model in this study are defined as open materials that can be manipulated by children, have received attention in early childhood education. These materials promote creativity, critical thinking, and problem-solving skills by utilizing items in the surrounding environment in, because when integrated into STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning, loose parts can improve children's logical and systematic thinking (Maarang et al., 2023). Examples include making photo frames from used invitation cards or making toy airplanes from recycled bottles. showed that loose parts-based STEAM learning significantly increased creativity in preschool children, with the percentage of children demonstrating creative skills increasing from 20% before the intervention to 90% after two implementation cycles. The use of loose parts as a learning medium in early childhood education institutions has been recognized for its potential to optimize child growth and development (Umami & Afnida, 2023).

Loose parts are versatile materials without special instructions that can be used in STEAM-based learning for early childhood education. These materials, such as rocks, seeds, and used items, can encourage children's creativity and imagination (Nurhayati, 2022). STEAM learning with loose parts has been shown to improve not only creativity and critical thinking, but also cooperation, communication, and imagination in early childhood (Maarang et al., 2023). Examples of loose parts activities include making photo frames from used invitation cards, making toy airplanes from plastic bottles, and making trees from cardboard. This approach encourages children to explore materials, think creatively, and maximize their potential when solving problems. STEAM-based learning with loose parts is considered revolutionary for teachers and is important for developing logical and systematic thinking in children (Mariana et al., 2022).

### 3.3. Independent Curriculum

The STEAM learning model combined with loose parts is one of the main programs and characteristics of the Merdeka Curriculum, known as the Pancasila Student Profile Strengthening Project (P5). This program aims to provide a more informal and flexible learning experience for students, allowing them to interact more intensely with their surroundings. In addition, this learning is designed to improve competencies related to the Pancasila student profile, making P5 one of the main objectives in its implementation (Andhianto et al., 2024; Nikmah et al., 2023). STEAM is one of the learning approaches that is in line with the objectives of the Independent Curriculum in children's learning achievements. Through the STEAM learning model, children are encouraged to develop science and technology-based ideas and concepts by thinking critically and exploring to find solutions (Motimona & Maryatun, 2023).

The use of STEAM learning models with loose parts materials should be easily adapted to existing curricula. The current Merdeka Curriculum is in line with the concept of "independent learning", aiming to reform education in Indonesia, especially in early childhood education. This curriculum emphasizes student-centered learning, allowing children to explore their environment under the guidance of teachers (Shalehah, 2023). The Merdeka curriculum combines project-based learning and focuses on developing Pancasila student profiles, which include six dimensions. The Merdeka curriculum

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prioritizes religious values, character development, self-identity, and basic literacy and STEAM skills (Fadillah & Yusuf, 2022). Implementation challenges exist, as educators need time to adapt and understand the new curriculum (Daulay et al., 2023). However, the Independent Curriculum is expected to accelerate character formation in early childhood and balance the global education system. The role of teachers in the Independent Curriculum shifts from being a determinant to a facilitator, supporting children's character and the development of psychomotor skills (Yang & Suhendah, 2023).

Based on the explanation above, to find out the factors that influence the improvement of critical thinking skills of early childhood through the application of the STEAM method with Loose Parts in the context of the Independent Curriculum, it can be explained as follows as **Table 1**:

**Table 1.** Factors that influence the improvement of critical thinking skills of early childhood through the application STEAM

| **FINAL CLARIFICATION OUTPUT** |
|---|
| Factors that influence the improvement of critical thinking skills of early childhood through the application of the STEAM method with Loose Parts in the context of the Independent Curriculum |
| **1. Internal factors,** apart from the child's interests, motivation, initial abilities, learning style (Hasanah et al., 2023). Some internal factors that can influence are as follows:<br>a. Emotional Intelligence (EQ) is the ability to recognize, understand, and manage one's own and other people's emotions that can influence the way children think and solve problems. This intelligence can enable children to control impulses, empathy, and teamwork, all of which are important components of critical thinking.<br>b. Self-confidence, is the level of self-confidence of children in influencing how willing children are to take risks, try new things, and defend their opinions. Self-confidence tends to make children more active in the learning process and more open to new ideas.<br>c. Cognitive: Other cognitive aspects such as memory, thinking speed, and cognitive flexibility can also affect critical thinking skills. Good cognitive skills tend to process information, make connections, and find solutions more quickly.<br>d. Personality in the form of personality traits such as curiosity, openness to new experiences, and perseverance can also affect critical thinking skills. These traits tend to be more motivated to learn and more persistent in facing challenges.<br>e. A child's physical and mental condition can significantly affect their ability to learn and think effectively. Healthy and fit children tend to be more focused, have higher energy, and are more ready to learn. |
| **2. External factors,** in the form of teacher support, availability of resources, learning environment, characteristics of loose parts used (Nur & Nugraha, 2023).<br>1. Some external factors that can influence include:<br>a. Education Policy: Curriculum: In addition to the Independent Curriculum, other curriculum policies that apply in schools or regions can also influence the implementation of the STEAM method. Graduate Competency Standards |

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(SKL): The SKL that is set can influence the focus of learning and the types of activities carried out.

1) Evaluation: The evaluation system used can influence the way teachers assess students' critical thinking skills.

b. Socio-Cultural Environment:
   1) Cultural values: Values adopted in society can influence how students view learning and problem solving.
   2) Family support: Family support for children's learning is very important, including in developing critical thinking skills.
   3) Social interaction: Students' interactions with peers and adults outside of school can influence their social and cognitive development.

c. Economic Conditions:
   1) Access to technology: The availability of technology such as computers and the internet can enrich students' learning experiences.
   2) School financial resources: An adequate school budget allows schools to provide a variety of resources that support learning.

d. Technological Development:
   1) Utilization of technology in learning: The use of technology such as learning applications, simulations, and games can increase student engagement in learning.
   2) Development of loose parts tools and materials: The emergence of new types of loose parts with various functions can expand the possibilities of student exploration.

3. **Curriculum factors,** flexibility of the independent curriculum, integration with thematic learning are two main factors that support the implementation of the STEAM learning model with loose parts (Cholimah et al., 2024). Some other curriculum factors to consider:

a. Learning Objectives:
   1) Core Competency Achievement: how the STEAM learning model with loose parts can help students achieve the Learning Outcomes (LO) that have been set in the curriculum.
   2) Character Development: How the STEAM learning model with loose parts can contribute to the development of student character, such as creativity, critical, communicative, and collaborative.

b. Subject Matter:
   1) Relevance to Context: the relevance of the subject matter taught to students' daily lives and contemporary issues.
   2) Depth of Material: the material taught is deep enough to stimulate students' critical thinking.

c. Time Allocation:
   1) Learning duration: time allocated for learning activities using the STEAM learning model with loose parts.
   2) Learning frequency: this activity is carried out in one semester or academic year.

d. Assessment:
   1) Assessment Instrument: the assessment instrument used is in accordance with the learning objectives and can measure students' critical thinking skills.

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2) Assessment Criteria: assessment criteria used to measure student success in STEAM learning with loose parts.

e. Teacher Professional Development:
   1) Training: Teacher readiness in implementing the STEAM method with loose parts, whether teachers have received adequate training.
   2) Ongoing Support: There is ongoing support from the school or education office to improve teacher competence.

This study shows that the implementation of the STEAM method with Loose Parts contributes significantly to improving critical thinking skills in early childhood. Children are encouraged to think analytically, explore solutions, and use their imagination more freely.

The Independent Curriculum as a context is more flexible and allows for the use of this method more effectively, because teachers can adjust their approach according to the needs of students.

## 4. CONCLUSION

This study has explored various factors that influence the improvement of critical thinking skills in early childhood through the application of the STEAM learning model with loose parts in the context of the Merdeka Curriculum. Based on the results of the analysis, it can be concluded that the application of the STEAM learning model combined with loose parts significantly contributes to developing children's critical thinking skills.

This study confirms that the STEAM learning model with loose parts, if implemented effectively in the Independent Curriculum, can be a powerful tool for developing critical thinking skills in early childhood. However, the success of this learning model is highly dependent on the support of the learning environment, teacher skills, and parental participation.

Factors that influence the improvement of critical thinking skills of early childhood through the application of the STEAM method with loose parts in the context of the Independent Curriculum, include: Internal factors, consisting of children's interests, motivation, initial abilities, learning styles, External factors, in the form of teacher support, availability of resources, learning environment and Curriculum Factors, Two important factors that support the application of the STEAM learning model with loose parts are the flexibility of the independent curriculum and integration with thematic learning.

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## 6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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