

Strengthening 21st-Century Skills in the Early Childhood Education Curriculum Through Project-Based Learning

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Abstract: Project based learning reinforces 21st century skills in the early childhood education independent curriculum. However, much learning still focuses on academic achievement rather than 21st century skills. This study aims to explain the urgency of 21st century skills in the context of early childhood education, the characteristics of project-based learning in the independent curriculum, and the important role of project-based learning in strengthening 21st century skills. The method used in this study is a literature study method. The data collection technique used was to collect various sources of literature from national and international journal articles relevant to the research study. All sources of literature found were then carefully analyzed. This study found that project-based learning plays a significant role in strengthening 21st century skills in the early childhood education independent curriculum.

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INTRODUCTION

Early childhood, or the “golden age,” is a crucial and extremely important period, as it is during this time that rapid growth and development occur development that is fundamental to a child’s future life (Suryaningsih, 2024). If a child receives the attention and stimulation they need, all aspects of their development will flourish optimally. Therefore, early childhood education plays a fundamental role in preparing and stimulating all aspects of a child’s development.

Globalization marked by technological advancements, AI (artificial intelligence), and the rapid flow of information has brought about changes in various aspects of life, one of which is education. These developments require individuals not only to excel academically but also to possess the ability to innovate creatively, socialize, and collaborate. In this regard, 21st-century skills are essential for every individual and can begin to be developed at an early age. Maulidah (2021) states that 21st-century skills are commonly known as the “4Cs”: critical thinking, creativity, collaboration, and communication. The 4C skills enable children to become critical thinkers, generate innovative ideas, communicate effectively, and collaborate to complete the tasks at hand (Maulidah, 2021). The urgency of strengthening the 4C skills in early childhood is increasing due to the challenges arising from the rapid development of digital technology. The



challenges that have emerged include the gradual replacement of human labor by technology and the proliferation of misinformation within society. Therefore, it is crucial to strengthen 21st-century skills in early childhood education, thereby fostering individuals who not only master academic content but are also capable of creating new innovations, adapting to change, demonstrating good character, and working effectively both independently and in groups. In addition, strengthening 21st-century skills can also help children become more confident, independent, and creative individuals (Suryaningsih, 2024).

The Indonesian government has responded to these challenges by developing the “Merdeka” curriculum. The “Merdeka” curriculum emphasizes flexible, child-centered, and contextual learning that respects each child’s unique characteristics. In early childhood education, the “Merdeka” curriculum promotes mindful, enjoyable, and meaningful learning. In line with this, project-based learning is the approach that best meets children’s needs.

A number of previous studies have shown that project-based learning is relevant to the Merdeka Curriculum because it provides teachers with the space and flexibility to deliver learning materials to children. Furi, Harani, and Hidayati (2025) argue that project-based learning within the Merdeka Curriculum is effective in enhancing 21st-century skills in early childhood. In line with this research, Mulidah (2021) states that effective learning that stimulates the 4Cs is achieved through project-based or problem-based learning. Additionally, Wilda, Sofyan, & Amanda (2024) suggest that a project-based learning guidebook successfully stimulates the 4Cs in children aged 5–6 years. The findings of a study by Masjudin et al. (2024) show that the Merdeka Curriculum plays a role in developing 21st-century skills in children because its flexible learning approach fosters critical thinking and creativity and strengthens communication and collaboration. Thus, it can be concluded that previous research has focused more on the effectiveness or implementation of project-based learning in general, while research addressing the strengthening of 21st-century skills in the Merdeka Curriculum through project-based learning remains relatively limited.

Based on this background, the following research questions can be formulated: 1.) What is the urgency of 21st-century skills in the context of early childhood education? 2.) What are the characteristics of project-based learning in the “Merdeka” curriculum? and 3.) How important is the role of project-based learning in strengthening 21st-century skills?. The objectives of this study can be

outlined as follows: 1.) To determine the importance of 21st-century skills in the context of early childhood education, 2.) To identify the characteristics of project-based learning in the Merdeka Curriculum, and 3.) To determine the importance of project-based learning in strengthening 21st-century skills.

METHOD

This study employs a literature review method using a descriptive qualitative approach. This method was used to conduct an in-depth analysis of the urgency of 21st-century skills and the role of project-based learning in the PAUD independent curriculum through various relevant scientific publications.

The data collection method used involved gathering various literature sources from national and international journal articles relevant to research on the independent curriculum, 21st-century skills, and project-based learning. The initial search yielded a large number of sources, but the researcher filtered them based on the relevance of the material to the scientific literature review. After undergoing a phase of analysis and selection, 20 scientific publications were identified as the most relevant to the study. All of the sources found were then carefully analyzed.

RESULTS AND DISCUSSION

The Importance of 21st-Century Skills in the Context of Early Childhood Education

The increasingly rapid pace of change in today's world is bringing about significant changes in various aspects of life. This situation requires individuals to possess critical thinking and creative skills, as well as the ability to communicate and collaborate. Twenty-first-century skills play a fundamental role in early childhood education, as they serve as the foundation for the development of children's character and competencies. Therefore, strengthening 21st-century skills in education has become an urgent necessity. The skills needed in the 21st century are not limited to academic knowledge alone, but also include critical thinking, creativity, communication, and collaboration-commonly known as the 4Cs.

The first urgent issue is the gradual replacement of human labor by machines, robots, and AI (artificial intelligence) a stark contrast to the past, when everything was still done manually by human labor. This digital transformation demands human resources with critical and creative thinking

skills so they are not easily replaced by AI (artificial intelligence). These skills involve critical thinking to find creative solutions and generate new innovations. In the face of the challenge posed by the gradual replacement of human labor by machines, robots, and AI, early childhood education must equip children with experiences that foster critical thinking, problem-solving, and creative thinking skills as a foundational basis. In the context of early childhood education, critical thinking is not understood as abstract thinking and analysis, but rather as a child's ability to observe, ask questions, and understand things.

Second, the overwhelming volume of information makes it difficult to distinguish between valid information and hoaxes. As we all know, young children are often given electronic devices by their parents to keep them from acting up. In reality, however, it is very risky for children to be exposed to unfiltered information. According An official government document also reported that in 2023, the Ministry of Communication and Information Technology (Kominfo) handled 1,615 hoax contents, an increase from 1,528 cases in 2022. The document cites the Bureau of Public Relations of the Ministry of Communication and Information Technology, Press Release No. 02/HM/KOMINFO/01/2024. Without critical thinking skills, children will not be able to distinguish between valid information and hoaxes. This is because young children are still at a stage of cognitive development where their thinking is not yet complex, so they tend to accept information at face value. Therefore, early childhood education needs to strengthen the foundations of critical thinking and communication skills so that children become accustomed to asking questions of adults.

Third, the need to develop character in line with the Pancasila Student Profile. The Pancasila Student Profile is a program designed by the government to instill good character in students in accordance with Pancasila (Uktolseja, et al., 2022). Character refers to the traits, morals, disposition, nature, or ethics that distinguish one individual from another. Social progress that is not balanced by character development can lead to a weakening of the values outlined in the Pancasila Student Profile, namely: having faith and reverence for God the Almighty; possessing noble character; embracing global diversity; practicing mutual cooperation; being

self-reliant; thinking critically; and being creative. In this regard, strengthening 21st-century skills cannot be separated from the character development of children in accordance with the Pancasila student profile. With this reinforcement, children will be prepared to face future challenges because they will have developed a character that is intellectually rich, creative, collaborative, and self-confident. Project-based learning is well-suited for the Merdeka Curriculum, as it stimulates 21st-century skills that reflect the Pancasila learner profile (Nurhasanah, et al., 2024).

Characteristics of Project-Based Learning in the Merdeka Curriculum

Project-based learning is a form of learning that involves children's active participation and emphasizes tangible products or works as the output of the learning process (Nababan, Marpaung, & Koresy, 2023). The characteristics of project-based learning in the Merdeka Curriculum are that it is flexible, differentiated, meaningful, and child-centered. "Flexibility" here refers to the fact that, during the learning process, teachers can present the same material to the children while tailoring it to their needs, abilities, and interests. For example, when teaching children how to make mosaics from seeds, all children receive the same materials but are given the freedom to choose their own shapes based on their creativity and are allotted varying amounts of time according to each child's individual abilities. This is consistent with the findings of Asiati and Hasanah in the study by Syaikh, A. (2025), which states that the "Merdeka" curriculum gives teachers the flexibility to adapt teaching methods to students' needs, abilities, and interests. Consequently, the instruction provided can enhance students' engagement and motivation in learning.

Differentiation means recognizing that every child is unique. In the learning process, children are free to learn according to their own styles. For example, if a teacher conducts a role-playing activity with the theme "future aspirations," the children will take on the roles of various professions based on their individual interests. As a result, some children might play the roles of police officers, members of the military, teachers, doctors, pilots, train conductors, business owners, and so on. This type of learning can provide children with a deeper understanding compared to other forms of learning (Alhayat et al., 2023). Through these learning activities, it becomes evident

how children identify problems, seek out, and consider creative solutions (Hatuwe, Syobah, & Idris, 2023). To encourage this, teachers can pose thought-provoking questions to help children think critically. In addition, project-based learning can also serve as a means of instilling the values of Pancasila in children. For example, when one child chooses to become a doctor, while another chooses to become a pilot or a police officer, the teacher can help the children understand that every profession has its own role and benefits in life. Furthermore, through project-based learning conducted in groups, children can learn to share tasks, help one another, and work together. This indicates that the values of Pancasila can be instilled through learning tailored to children's needs. In line with this, Veryawan et al. (2023) state that project-based learning that integrates the values of Pancasila can help teachers manage and create a conducive learning environment.

Meaningful learning, in which the material children receive is not merely rote memorization, but knowledge whose benefits they can experience firsthand. In the learning process, the material presented must be relatable to the child, engaging, concrete, and meaningful (Tumbel, 2024). Furthermore, learning must be child-centered, with the teacher serving solely as a facilitator. If learning remains teacher-centered, the child's creativity and developmental aspects will not flourish optimally.

Based on these characteristics, it is evident that project-based learning and the Merdeka Curriculum are interrelated in strengthening 21st-century skills in early childhood. Project-based learning gives teachers the flexibility to present material, making this approach highly compatible with the Merdeka Curriculum (Rasmani, et al., 2023). Project-based learning can have a positive impact on children, as it allows them to actively participate in the learning process, enabling them to gain a deeper understanding of the material (Priantika et al., 2024).

The Importance of Project-Based Learning in Strengthening 21st-Century Skills

Project-based learning plays a role in strengthening 21st-century skills in early childhood, as it optimally stimulates the 4C skills. Wilda, Sofyan, and Amanda (2024) state in their research that one of the most

suitable learning methods for stimulating 21st-century skills in early childhood is project-based learning. In accordance with the theory of experiential learning proposed by David Kolb, as cited in Suryaningsih (2024), which states that the most effective learning for young children—leading to a deeper understanding—is achieved through direct experience. In this learning process, teachers do not merely serve as conveyors of material; they also act as designers, facilitators, evaluators, and administrators who prepare lessons, guide, and support students (Anggraini et al., 2022).

Stimulating the 4C skills in early childhood can be achieved by designing learning activities that are purposeful, enjoyable, and meaningful. One example of a learning activity to be explored is the “I Love Plants” project, in which children will plant and observe vegetables in the school garden. During the critical thinking phase, the teacher will pose thought-provoking questions to the children, and the children will answer them.

Teacher: “Kids, let’s see why some plants are wilting.”

Children: “Because you didn’t water them, Mom.”

Next, the teacher can explain several factors that cause plants to wilt, such as not getting enough water and sunlight. At this stage, children will understand the concept of cause and effect—that if a plant is not watered, it will wilt, and vice versa. Thus, the teacher’s guiding questions and the children’s observational experiences can stimulate their critical thinking skills and ability to solve simple problems.

The second stage is creativity: the children will plant vegetables using recycled items, such as bottles, as substitutes for pots. Before planting, the children will be free to decorate the bottles according to their own creativity. This freedom allows the children to express their creativity. Aisyah, E., et al. (2025) argue that when children are given the freedom to choose, organize, and use materials in project-based activities, this not only stimulates their creative thinking and problem-solving skills but also fosters their motor and social development through exploration and social interaction.

In the third stage of collaboration, the children work together to plant all the vegetables in pots. The teacher can assign simple tasks to each child,

such as having Child A water the plants, Child B apply fertilizer, Child C arrange the pots, Child D plant the vegetables, and so on. Through this division of labor, the children will learn that each member has a specific role to play in completing the learning activity. In addition, children will also learn to help one another, take turns, share tools and materials, and work together.

The fourth stage is communication. In this stage, children will discuss or share their reflections on what they have learned. Teachers can prompt questions such as, “Kids, what did we learn today?” or “How did we plant the vegetables earlier?” The children will then begin to share what they remember, such as why plants wilt, the steps for planting vegetables, and how to decorate pots. Through this learning activity, children will learn to express their opinions and listen when others are speaking. Thus, this reflection activity can help develop the children’s communication skills.

Based on this mini-project, it is evident that project-based learning can stimulate children to develop the 4C skills in an integrated manner. This stimulation can also be applied through other activities, such as the group activity of assembling a jigsaw puzzle. In this activity, children will think critically to determine the correct order of the pieces and will strive to solve problems because the shapes of the pieces are nearly identical. Then, in terms of creative thinking skills, children will try out various possible sequences of each puzzle piece until they find the correct arrangement of the image. In addition, this game gives children the opportunity to collaborate and communicate with their friends. They can work together to find and try each puzzle piece until it fits into the correct place. Thus, the activity of assembling puzzle pieces in groups can be one way to stimulate the 4Cs. In line with this, it can be said that instruction delivered through project-based learning can encourage children to develop creativity, critical thinking, collaboration, and communication with their peers in solving problems (Zulkarnaen, et al :2023,Purnamasari,et.al :2026)).

Although project-based learning is very important for children, its implementation is not without challenges. The challenges faced in the project-based learning process include a lack of preparedness among early childhood education teachers, the availability of facilities and infrastructure,

and policy support from educational institutions. These challenges must be addressed through systematic solutions so that project-based learning is not viewed merely as a form of learning that produces a final product, but rather as a form of learning that fosters exploration, problem-solving, creativity, and collaboration.

The first issue is the lack of preparedness among early childhood education (PAUD) teachers. The solution lies not in a one-time training session, but in ongoing professional development. PAUD schools or institutions can conduct regular training sessions focused on developing project-based lesson plans, formulating probing questions, designing learning assessments, and techniques for providing scaffolding to children. In addition, teachers can also hold reflective discussions with their colleagues to evaluate the shortcomings of their instruction so that improvements can be made in the future. This approach is important because teachers do not merely serve as conveyors of material, but as facilitators who do not overlook students' interests and needs in the learning process. Lahe et al. (2026) emphasize that project-based learning requires teachers to possess knowledge, creativity, problem-solving skills, and the ability to transform exploratory activities into meaningful learning experiences. Through training, teachers become more creative in designing project-based learning activities tailored to students' characteristics (Herlina, Sukirdi, and Haryono, 2025). In project-based learning, the teacher acts as a motivator and facilitator, while positioning the student at the center of learning (Purnamasari & et.al, 2026)

The second issue is the limited availability of facilities and infrastructure. These limitations should not be used as an excuse for not implementing project-based learning, as lessons can be designed using easily accessible materials. One solution is for teachers to use "loose parts" in their lessons, such as used cardboard boxes, plastic bottles, twigs, stones, bottle caps, popsicle sticks, leaves, and so on. Thus, these limitations can actually serve as learning experiences for teachers as they innovate in designing and preparing lessons for students.

The third issue is the lack of optimal policy support from educational institutions. Therefore, educational institutions need to provide concrete

support in strengthening 21st-century skills by integrating project-based learning into the planning and policies of educational units, one way being through the Educational Unit Operational Curriculum (KOSP). This support can be provided by setting aside dedicated time for lesson planning, allocating funds, preparing materials, and designing assessments for evaluation so that assessment is based not only on outcomes but also on the process. This institutional support is crucial for project-based learning because it is not limited to classroom learning activities alone but requires coherence among learning objectives, the teacher's role, the learning environment, instructional materials, and assessment. Lahe, et.al (2026) describe these various components as a cohesive and interconnected system to ensure that learning proceeds in a relevant and optimal manner.

CONCLUSION

Project-based learning in the PAUD “Merdeka” curriculum is a strategic solution for strengthening 21st-century skills in early childhood. The urgency of these 21st-century skills stems from the challenge of human labor being increasingly replaced by machines, robots, and AI (artificial intelligence); the overwhelming flood of information, which makes it difficult to distinguish valid information from misinformation; and the need to foster character development in line with the Pancasila learner profile. Therefore, early childhood education should provide learning experiences that are not only knowledge-oriented but also give children the opportunity to observe, ask questions, explore, solve problems, collaborate, and communicate their ideas. Through flexible, differentiated, meaningful, and child-centered project-based learning, children can learn through direct experience.

The implementation of project-based learning has proven effective in strengthening 21st-century skills. Through a project to grow vegetables in the school garden, students not only gain an academic understanding of the material but also strengthen their 4C skills. However, the success of strengthening 21st-century skills in the PAUD independent curriculum through project-based learning depends heavily on teacher readiness, the availability of facilities and infrastructure, and policy support from educational institutions through the Educational Unit Operational

Curriculum (KOSP) framework. Therefore, it is necessary to continuously develop teachers' competencies, utilize learning resources and materials available in the local community, and provide institutional support through instructional planning and educational institution policies. With this support, project-based learning is understood not merely as a form of learning that produces a final product, but as a learning process that provides children with real-world experiences in developing 21st-century skills in an integrated and optimal manner.

Statement on Generative AI and AI-Assisted Tools

In preparing this manuscript, the authors employed an AI-powered language tool to refine the clarity, grammar, and readability of the text. Afterward, the authors thoroughly reviewed and revised all content and assume complete responsibility for the published version. Generative AI was not involved in data collection, analysis, or interpretation.

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