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Effectiveness of Project-Based Flipped Learning Model in Improving Early Childhood Cognitive Development

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Abstract: This research has not been widely implemented at the early childhood education level because early childhood education often applies a game-oriented learning model. On the other hand, the level of understanding, comprehension, focus and interest in early childhood is also different from the level of education of children above if a project-based flipped learning model is applied. The advantage of applying this learning model is that it integrates information and communication technology with project-based learning, which is very much in line with the direction of the Merdeka Curriculum. This

study aims to analyse the effectiveness of the project-based flipped learning model on early childhood cognitive development. Methods: This study uses quantitative research methods with experimental research types. The research subjects were 30 children in the experimental class and 20 children in the control class. The experimental class carried out learning activities using a project-based flipped learning model, and the control class carried out learning as usual—test data analysis techniques to measure children's cognitive development. Data analysis used a homogeneity test with the Levene Statistic test, a normality test with the Kolmogorov-Smirnov test and a hypothesis test using an Independent Sample T Test Results: Based on the results of the study, the research data is homogeneous and statistically normally distributed. The results of hypothesis testing show that H0 is rejected and H1 is accepted. The conclusion is that the project-based flipped learning model is effective in early childhood cognitive development. It is also expected that further research can examine more deeply the application of project-based flipped learning models in various subjects and in analysing or improving the abilities or skills of students at other levels of education; the main thing is to improve the quality of education. It can also be a combination of different learning models that can be applied to provide innovative learning models that are useful in supporting the teaching and learning process in the classroom.

Keywords: Project Based Flipped Learning, Early Childhood, Cognitive Development

Introduction

Through learning and teaching, individuals and communities can develop mature attitudes, behaviours, and thoughts, a crucial starting point for developing quality human beings through education. Children can be inspired to actively explore their potential through well-planned schooling and a supportive environment. Human resources must be primed early to produce the best possible future generation. The process of establishing the initial framework for developing the six components of child development takes place throughout early childhood, known as the "golden period" of human development. For children's growth and development to proceed as best in these circumstances, they require stimulation and environments that meet their demands. Early childhood (0–6 years) is commonly called the "golden age" since it is the most favourable time in a person's developmental trajectory. A child grows and develops extraordinarily at this time in all physical, motor, emotional, cognitive, and psychosocial (Nurkamelia, 2019). The period where all the child's potential develops rapidly (Prasetyo, 2020).

Cognitive development is a critical stage of early childhood development. From early infancy, in the primary education environment, until children reach college, the role of cognitive development will continue to help support the academic portion of children's learning process. Therefore, to ensure even better development in the future, we must pay close attention to this child's cognitive development during the early childhood years. Bloom's Theory states that intellectual development happens relatively quickly throughout a child's early years (Trenngonowati & Kulsum, 2018). Children's brains, thinking, learning, and memory all start to grow during this stage of cognitive development. Children this age have a creative, liberated, and unique cognitive universe. As children grow, so does their imagination and cognitive grasp of the world. One facet of human growth that has to do with comprehension (knowledge) is cognitive development. A sort of ability, this cognitive growth can be understood as evolving from reflexive to goal-directed activities, improving memory, thinking, and imitation skills, as well as understanding sharpness in an item (Suryana et al., 2022).

Early childhood education creates an environment where children's development is well-supported in all facets, with integrated collaboration between educators and parents in a learning

setting. Learning, playing, and singing are used in early childhood education (Sugandi et al., 2021). Early childhood education focuses on the individual figure developing quickly and is essential to the child's future (Yusuf et al., 2023). Early learning should be approached to give young children foundational ideas that make sense to them through authentic experiences that best support their curiosity and let them demonstrate their activities (Cecep et al., 2022).

Early childhood education is implemented to promote children's happiness, activity, and freedom of choice. Children learn through interacting with people, play materials, and equipment. Kids pick up knowledge while having pleasure while playing. Children learn more effectively when learning exercises involve all of the senses (Musyadad et al., 2021). Early childhood education is a coaching program designed for kids ages one to six to assist with their growth and development on both a physical and spiritual level so they can proceed with additional education (Ashfarina et al., 2023). Implementing education that emphasises different facets of physical growth and development, emotional intelligence, spiritual intelligence, social-emotional development, language, and communication through the stages of early childhood development should be guided by this time frame.

Introducing the Merdeka Curriculum significantly improves the early childhood education field in Indonesia. In contrast to the previous curriculum, the Merdeka Curriculum gives instructors and educational institutions more latitude and flexibility to customise instruction to the needs and traits of their students. Given this, it represents a significant advancement in Indonesia's efforts to raise the standard of early childhood education. In early childhood education, the term "freedom of learning" also refers to "freedom to play" (Retnaningsih & Khairiyah, 2024). Independent learning can be implemented and expanded in early childhood education if connected to early childhood learning and linked explicitly to playing and learning while playing. Will enjoy the benefit of not having to learn through memorisation, children's worksheets, or daily curriculum instruction, which appears to limit children's development since play is fundamentally still the formative years for children. This is something that every child in an early childhood education unit will experience. This independent curriculum reinforces the idea that early childhood education units are no longer places where children are expected to perform reading, writing and arithmetic; however, they are locations to engage pupils in enjoyable activities that introduce pre-reading, pre-math, and pre-writing tasks (Shalehah, 2023). A defined procedure and framework exists for creating an autonomous curriculum in early childhood education institutions. Depending on how prepared each early childhood education unit is to administer the independent curriculum, the government—in this case, the Ministry of Education and Culture has given alternatives for each unit to adopt a different version of the curriculum (Ashfarina et al., 2023).

Early childhood learning objectives and visions are comparable in the Merdeka curriculum for early childhood education and the project-based learning model. Both stress the significance of play-based, holistic, integrative, child-centred, meaningful, and contextual learning and the use of technology in education. Instructors can customise lessons based on students' needs, interests, and skill levels with the flexibility offered by the Merdeka Curriculum. Teachers facilitate learning and development to support children's best interests. Among the learning approaches that work well for learning with the finished result is project-based learning, such as creating educational media. From elementary school through college, this concept is appropriate for pupils (Jacques, 2017). Project-based learning enables students to work together to develop conceptual understanding, apply past knowledge, acquire new abilities, and integrate several disciplines to produce a project. Project-based learning is a pedagogical strategy that centres learning around a well-defined project and is led by students with assistance from teachers (Ummah et al., 2019).

Project-based learning is an inquiry-based teaching approach involving students in producing knowledge by having them finish worthwhile tasks and create valuable products (Guo et al., 2020). It is

based on constructivist learning theory, which holds that learning is context-specific; students actively build their understanding by working on pertinent problems in the real world, and they accomplish their objectives by interacting with others and exchanging information (Haatainen & Aksela, 2021). Children are tasked with addressing real-world, contextualised problems as part of the project-based learning approach. Kids can use what they've learned and experienced, work with classmates, and acquire various skills necessary for the twenty-first century through PjBL. Based on constructivist concepts, problem-solving, research inquiry, integrated studies, and reflection, project-based learning is an instructional style that prioritises theoretical research and application. Children can work individually or in groups to construct a project to generate a product using the project-based learning technique. We can, therefore, conclude that project-based learning is a child-centred approach to education.

The flipped learning model is an innovative learning approach that can benefit holistic early childhood learning significantly. Flipped learning involves flipping, lecturing in class, and working on questions. At home, everything is flipped (Kocour, 2019). Flipped learning is one type of blended learning model that belongs to the rotation model category. Because this type of model rotates learning activities that were initially in the classroom and learning activities anywhere, with the help of information and communication technology that is developing today, it will significantly help the learning process improve. Flipped learning is an innovative high-level blended learning model (Zhang et al., 2021). It is a high-level fusion of different teaching concepts, learning concepts, and teaching modes and a high-level integration of traditional classroom instruction and online learning in form, method, and content. Through reading assignments, films, recordings, and other instructional resources from teachers, students can better comprehend the subject matter.

In flipped learning, homework is done at home and in class. While the teacher utilises the teaching materials to organise learning objectives or projects in class, students use them to work on assignments at home (Shamad & Wekke, 2019). Davies et al.'s opinion, cited by Xu and Shi (2018), illustrates how flipped learning works. Rather than having teachers provide synchronous or in-person group instruction in the classroom, students are expected to use video resources and other materials to learn concepts and complete assignments independently at their own pace and in a location of their choosing. By concentrating on their unique learning requirements, each student can avoid falling behind in class discussions or getting disinterested from spending too much time reviewing content they already understand.

Children can participate more actively and artistically in class when encouraged to learn independently before class. The following justifies the flipped learning model's necessity for comprehensive education in early childhood settings: Flipped learning allows kids to learn independently by giving them access to resources before class, which fosters creativity and independent thinking. It also helps kids become more independent, responsible, and capable of learning independently. Additionally, kids can concentrate on subjects they are interested in and study at their own pace using flipped learning. This motivates children to actively engage with teachers and classmates and increases their involvement in learning activities. Giving kids the chance to use their knowledge and abilities to solve problems and complete projects can help them develop critical and creative thinking abilities. This aids children's ability to think critically, be creative, and solve problems. Both use technology to help and improve education for kids. Kids can access various Internet learning resources, including instructional apps, web pages, and videos. Under the flipped learning paradigm, kids watch movies, complete modules, or engage in other interactive activities at home to acquire fundamental ideas. More in-depth and participatory activities, such as discussions, problem-solving, and group projects, take up more time in the classroom. The advantages of PjBL and flipped learning for young children raise kids' motivation and interest in learning. Enhances one's capacity for critical

thought, problem-solving, and teamwork. Enhances the capacity for self-learning and concept comprehension. Develops in kids a strong sense of morality and character (Halili & Razak, 2018).

Based on observations made at Aisyiyah 66 Surabaya Kindergarten, most Aisyiyah 66 Surabaya Kindergarten students are still low in cognitive development. This occurs because of misconceptions in communication between children and teachers; educators still do conventional learning that makes students objects, not subjects. Educators become the centre of the role in learning or children's play activities and seem to be the only source of knowledge. Educators are still reluctant to move from their comfort zone. Learning in the classroom is more about mastering knowledge about reading and writing to meet the demands of parents and society. Providing child-centred, engaging, meaningful, and fun learning that can improve children's literacy and numeracy skills is still not optimal, which is one of the learning outcomes in the Merdeka curriculum. In preparing learning plans and strategies, there is still no innovation by 21st-century skills; activities are still often given the task of compiling according to the prepared learner activity sheets. Facts in the field show that learning carried out by educators is still less inspiring and tends to be monotonous and not varied. Educators lack the knowledge and skills to implement creative and innovative learning in the classroom. One learning model considered relevant to the world of education, seen in line with the development of learning, and can overcome the problems that arise today is the project-based flipped learning model. With this model, students are expected to improve early childhood cognitive development as a developer of learning media in the 21st century.

Research Problem

Since it is the most advantageous time in a child's growth trajectory, early infancy is known as the "golden age." Children's growth and development require extra care to prepare them for the future. An essential developmental stage in early life is cognitive development. The role of cognitive development will continue to support the academic portion of the child's learning process from early infancy in the primary education environment until the child attends college. Therefore, we must pay attention to children's cognitive growth during the early years of life to ensure more significant development in the future.

However, the objectives and vision of early childhood education are similar to those of project-based learning approaches and the Merdeka curriculum. Technology advancements have led to the development of a flipped learning approach, which can enhance learning when combined with project-based learning or a project-based flipped learning model.

However, according to research, the majority of students still have low levels of cognitive development, teachers continue to use traditional teaching methods that treat students like objects rather than subjects, teachers take centre stage in lessons or children's play activities, and they appear to be the only people with knowledge. Teachers still find it difficult to leave their comfort zones. Learning in the classroom focuses more on developing reading and writing skills to satisfy the expectations of parents and society. As one of the learning objectives in the Merdeka curriculum, improving children's reading and numeracy skills is still not the best way to provide child-centred, engaging, meaningful, and enjoyable learning. It is thought that this combination of learning experiences will enhance the critical cognitive development of young children.

Research Focus

Based on the research problem and objectives as well as related research questions, this study focused on assessing the effect of a project-based flipped learning model, which is a combination of several learning models, on early childhood cognitive development. Specifically, this study investigated

how implementing the project-based flipped learning model affects early childhood cognitive development.

Previous research shows the results showed that project-based learning is effective on children's creative thinking skills (Illahi et al., 2022), improve students' concept understanding, retention, and social attitudes (Berhиту et al., 2020), collaboration skills (Rasyid & Khoirunnisa, 2021), learning motivation and science process skills (Safaruddin et al., 2020), science literacy (Wardah et al., 2022), critical thinking (Issa & Khataibeh, 2021; Nawangsari et al., 2022; Sudrajat et al., 2023), learning achievement (Kızkapan & Bektaş, 2017), engaging students in learning (Almulla, 2020). Based on the description of the research results regarding project-based learning, there are many benefits and positive things that effectively improve the ability or skills of children; this is also considered to support the growth and development of early childhood.

Previous research shows the results showed that flipped classroom learning is effective in learning achievement and learning motivation (Campillo-Ferrer & Miralles-Martínez, 2021; Zheng et al., 2020), improving learning outcomes (Cheng et al., 2019; Jdaitawi, 2019; Khumairah et al., 2020), math performance (Wei et al., 2020), concept understanding (Savitri & Meilana, 2022), learning independence ('Azah & Abror, 2023; Mirlanda et al., 2019), creative thinking skills (Khoirotunnisa & Irhadtanto, 2020), problem-solving ability (Sari et al., 2020). The description of the research results on flipped learning shows various benefits and things that can be applied to early childhood education, and improving learning that integrates the internet will significantly help innovate learning.

Research Aim and Research Questions

This study aims to determine whether or not there is an effect of the project-based flipped learning model on early childhood cognitive development, as the main objective of the research process. It also aims to answer the questions below: Is there an effect of the project-based flipped learning model on early childhood cognitive development?

Materials and Methods

The research method used in this research is a quantitative method with an experimental research type. Experimental research is part of quantitative research, with its characteristics, especially with a control group (Asriningsih et al., 2015). Experimental research aims to determine whether or not there is a causal relationship and how significant the causal relationship is by giving specific treatments to the experimental group and preparing a control for comparison (Akbar et al., 2023). Most experiments in education are conducted to make innovations to improve the quality of learning. Therefore, they are usually concerned with testing the effect of new educational materials, media, methods or practices on student learning outcomes (Arib et al., 2024).

Sample and Participants

In this study, the research subjects were 60 kindergarten students at Aisyiyah 66 Surabaya. Thirty children were in the experimental group, and thirty others were in the control group. The experimental group applied project-based flipped learning, while the control group did the usual learning activities.

Data Collection

The data analysis technique used is a test to measure children's cognitive development. With the following test item instrument guidelines: Recognizing patterns, symbols, and data (numbers and letters), Counting with objects 1-20, Recognizing number symbols 1-20, Predicting and continuing sequence patterns of symbols or images, Recognizing cause and effect about their environment,

Classifying objects or objects based on characteristics (shape, size, distance, and so on), Recognizing differences from the information presented (real and unreal, or true and false), Knowing the cause and effect relationship of an event or event, Bringing up new ideas or ideas in daily activities, Collaborating in solving problems encountered through discussion.

Data Analysis

The data analysis technique was a test to measure children's cognitive development. The data analysis used a homogeneity test with Levene's Statistic test, a normality test with Kolmogorov-Smirnov's test, and hypothesis testing using the Independent Sample T Test.

Results

After the research data test results were collected from both groups through the post-test process, the next stage was data analysis. The following results are the initial analysis of the homogeneity test on the number of research subjects using Kolmogorov-Smirnov.

Table 1

Normality Test Output: One-Sample Kolmogorov-Smirnov Test

		Post-test Experiment	Post-test Control
N		30	30
Normal Parameters	Mean	84.00	78.33
	Std. Deviation	6.747	6.609
Most Extreme Differences	Absolute	.192	.167
	Positive	.120	.167
	Negative	-.192	-.166
Kolmogorov-Smirnov Z		1.053	.915
Asymp. Sig. (2-tailed)		.217	.372

Table 1 shows that the Kolmogorov-Smirnov test obtained a significance of 0.217 and 0.372 > 0.05, which means that both experimental and control group data are statistically normally distributed. Next are the homogeneity test results on the number of research subjects using the Levene Statistic.

Table 2

Test of Homogeneity of Variances (Post-test)

Levene Statistic	df1	df2	Sig.
.336	1	58	.565

Table 2 shows that the Levene Statistic test obtained a significance of 0.565 > 0.05, which means that both experimental and control group data are statistically homogeneous. Next is the hypothesis test on the number of research subjects using the Independent Samples Test; here are the results.

Table 3*Group Statistics*

	Class	N	Mean	Std. Deviation	Std. Error Mean
Post-test	Experiment	30	86.17	5.972	1.090
	Control	30	78.33	6.609	1.207

Table 4*Independent Samples Test Output (Post-test)*

		Equal variances assumed	Equal variances are not assumed.
Levene's Test for Equality of Variances	F	.336	
	Sig.	.565	
t-test for Equality of Means	t	4.817	4.817
	df	58	57.414
	Sig. (2-tailed)	.000	.000
	Mean Difference	7.833	7.833
	Std. Error Difference	1.626	1.626
	95% Confidence Interval of the Difference	Lower Upper	4.578 11.089

Table 3 explains the difference in group statistics results by looking at the mean of the experimental class, 86.17 higher than the control group, 78.33. Table 4 demonstrates that the significance value is $0.000 < 0.050$. It can be said that H_0 is rejected and H_1 is accepted, or there is the effectiveness of project-based flipped learning in improving early childhood cognitive development.

Discussion

The findings of this study support the opinion that the mean of the experimental class, 86.17, is higher than the control group, 78.33. In this case, the experimental class is superior to the control class. An independent sample test was used to determine the effectiveness of the project-based flipped learning model in improving early childhood cognitive development (Sig. count 0.000). It is considering that the Sig. Value is smaller than 0.05 ($0.000 < 0.05$), and H_0 is rejected. It can be concluded that project-based flipped learning is effective in improving early childhood cognitive development. Using digital technology and a project-based approach, project-based flipped learning creates an engaging and dynamic learning environment through practical projects that suit the needs of early childhood but still at the level of these early childhood students' individual needs and abilities.

The results of this study are also by previous research, which states that project-based learning on students' cognition (Apriany et al., 2020; Fikriyah & Sari, 2024; Mutoharoh et al., 2023). The results showed that flipped learning affects children's cognition (Wigati et al., 2023; Wulansari & Sutrisna, 2018). Research related to project-based flipped learning shows effective results in improving creative thinking. (Riyanti et al., 2024), Creative thinking and learning outcomes (Ekayana, 2022),

comprehension and critical thinking(Kamaruddin et al., 2022; Rapi et al., 2022). Thus, it is evident that the role of the combination of project-based flipped learning is very appropriate if it is chosen to be one of the learning models to support children's cognitive development, especially in early childhood.

The positive outcome of this study can only be attributed to the war-related combination of project-based flipped learning and learning. If we dissect the teaching, each offers a distinct benefit. Project-based learning has the following benefits: it challenges students to solve real-world problems and be good collaborators; it improves content knowledge; it meets the needs of students with different skills and learning styles; it allows students to collaborate in conceptual understanding, applying prior knowledge, and higher-order thinking skills; and it will enable students to demonstrate higher abilities (Coyne et al., 2016). Its benefits are also mentioned in other study findings, which include fostering creativity and innovation, critical thinking and problem solving, individual communication, information and media literacy, cooperation, teamwork, and leadership abilities (Chu et al., 2017).

Flipped learning allows students to study the material at home before the teacher presents it in class, fostering greater independence in the learners. With the capacity to acquire material, students can study the subject matter comfortably. Teachers give students their undivided attention when they have trouble understanding assignments or activities. Students can access Various learning resources via websites, books, and videos. Unlike traditional learning, which is less effective since students must repeat explanations from the teacher until they fully comprehend, learners can watch the video again until they truly get the content. Students can view the video from wherever they have a strong enough internet connection (Fauzan et al., 2021). With this flipped learning approach, students can easily access all information sources from anywhere. When using a flipped learning model, students can now access all of the references they previously had to locate through books, literature, and other printed materials that were difficult to obtain (Hamid & Hadi, 2020).

When implemented in teaching and learning activities, project-based flipped learning can yield significant improvements in learning outcomes related to cognitive, emotional, and psychomotor domains. It is essential to exercise caution while using learning models in early childhood education, as not all of them align with students' and subjects' unique needs and features.

Limitations of the Research

The limitations of the research on the effectiveness of the project-based flipped learning model on early childhood cognitive development include the following:

- a. Implementing the project-based flipped learning model is only applied at the early childhood education level if used at other education levels, requiring a deeper study.
- b. The project-based flipped learning model is implemented only for students at Aisiyah 66 Surabaya Kindergarten; if it is applied elsewhere, it requires deeper study.

Conclusions

Based on the research results and discussion, it can be concluded that the project-based flipped learning model is effective in early childhood cognitive development. This result is also supported by previous research on the effectiveness of the project-based flipped learning model, which shows positive results in supporting learning. The results of this study prove that at the early childhood education level, it does not have to use a game-based learning model but can be designed using a learning model that has been integrated with information and communication technology and is by the Merdeka Curriculum, namely the project-based flipped learning model. The results of this study also provide important information that teachers in early childhood education do not need to worry about

applying learning models that are difficult to apply to early childhood but can innovate with other learning models while still paying attention to learning needs, characteristics of materials and students and adjusting predetermined learning objectives. It is hoped that further research can examine more deeply the application of project-based flipped learning models in various subjects as well as in analysing or improving the abilities or skills of students; the main thing is to improve the quality of education.

Suggestions for Future Research

Future studies should consider and overcome a few of this study's limitations. One of its limitations is this study's narrow focus on determining if the project-based flipped learning approach impacts early childhood cognitive development. All additional parties participating in the teaching-learning process can be included in the sample in future studies. In addition, it can be used to examine various learning models for early childhood education, as well as the affective and psychomotor development of young children. It may evaluate the most appropriate learning model based on the requirements of the subject matter, the learners, and the established learning objectives.

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Conflict of Interest

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