Project-Based Innovative Learning to Enhance Linguistic Intelligence and Motor Skills

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ABSTRACT

The aim of this study is to determine the effectiveness of project-based learning (PjBL) in enhancing the linguistic and motor intelligence of early childhood students. A mixed-method approach was employed, combining quantitative data from child development rubrics with qualitative data from observations, interviews, and activity documentation. An experimental design was used, with a control group following conventional learning methods and an experimental group receiving project-based learning. The findings indicate that PjBL techniques significantly improve linguistic and motor intelligence. Through creative activities such as creating picture stories and collaborative play, children in the experimental group demonstrated enhanced speaking, writing, and fine and gross motor skills. Qualitative analysis during the project also revealed increased confidence, teamwork abilities, and emotional engagement among the children. Teacher training, parental involvement, and a supportive learning environment were identified as key factors contributing to the program's success. However, further policy development and training are needed to ensure the of PjBL implementation, sustainability particularly regarding time and resource These findings constraints. encourage innovation in early childhood education and promote project-based learning as an effective method for supporting children's holistic development.

Keywords: Innovative Learning, Project-Based, Linguistic Intelligence, Motor Skills

INTRODUCTION

Early childhood education (ECE) plays a crucial role in cognitive, affective, and psychomotor development. The period between ages 0 and 6, often referred to as the golden age of child development, is when learning experiences significantly shape future growth (Khaironi, 2017; Amalia & Khoiriyati, 2018; Parsons & McCormick, 2024). Research has shown that during this period, children's brains develop optimally, enabling them to process and absorb information effectively (Khaironi, 2017; Brown & Jernigan, 2012; Collins, 1984; Mou et al., 2024; Merlo et al., 2024; Li, 2024). Education systems must holistically designed to cater be to children's developmental needs, particularly in motor and linguistic intelligence, two interrelated components essential for overall growth (Angrist et al., 2024; Beerannavar & Pancrasius, 2024; Pyle et al., 2024; Scaling and Sustaining Pre-K-12 STEM Education Innovations, 2024).

Linguistic intelligence refers to a child's ability to understand, use, and process language as a communication tool (Rahmi & Septiana, 2023; Najjar et al., 2025; Gluck et al., 2025; Johri et al., 2025). This component includes listening, speaking,

reading, and writing skills (Tang et al., 2024; Jiménez et al., 2024; Wilson, 2024). Meanwhile, motor skills, categorized as fine and gross motor skills, reflect a child's ability to coordinate small and large muscle movements. These two aspects are interconnected and contribute to overall child development. Writing, as a form of language expression, is influenced by fine motor skills (Gonzalez et al., 2019).

However, many young children face linguistic challenges in and motor intelligence. These difficulties stem from various factors, including limited social interaction, conventional teaching methods, and inadequate learning tools. Therefore, innovations in teaching methodologies are essential to ensure all children have the best opportunities for development (Razi et al., 2025; Early Childhood Development: Global Strategies for Implementation, 2025; Raise the Bar: Overview, 2025). Project-Based Learning (PjBL) is an emerging approach gaining attention. This method is based on the principle that children learn more effectively when actively engaged in projects or activities related to real life (Kogan & Pin, 2009; Shue, 2008). PjBL enhances not only conceptual understanding but also real-life skills such as teamwork. problem-solving, and communication (Razi et al., 2025; Early Childhood Development: Global Strategies for Implementation, 2025; Bousetouane, 2025). PjBL has great potential in improving young children's linguistic intelligence. Through projects as writing simple storybooks, such observing animals, or role-playing, children actively engage in speaking and sharing ideas (Razi et al., 2025; Gluck et al., 2025; Mushtag et al., 2025). These activities directly enhance their language skills in engaging meaningful and contexts. Additionally, PjBL fosters motor skill development. Activities like cutting and pasting during a collage project strengthen fine motor skills, while outdoor play-based projects, such as building a miniature garden, improve gross motor abilities (Era et al., 2025).

Despite its benefits, implementing PjBL in early childhood education presents challenges. Many teachers lack confidence or proper training to apply this method. Furthermore, empirical research—especially in Indonesia-on PjBL's effectiveness in developing linguistic and motor intelligence in early childhood is still limited (Razi et al., 2025; Era et al., 2025). More studies are needed to determine the best strategies for local implementation. Extensive research has demonstrated the benefits of PjBL in primary and secondary education, yet there is a gap in studies focusing on early education. childhood Current research primarily emphasizes cognitive and socioemotional aspects, with less attention given to linguistic and motor intelligence (Raihan, 2024; Rahmi & Septiana, 2023; Kurniati, 2021). However, these components are crucial in establishing the foundation for children's future learning abilities.

Additionally, empirical data on the effectiveness of PjBL in early childhood settings, particularly in resource-limited environments, remains insufficient (Ros et al., 2025; Gajderowicz et al., 2025). Many parents and teachers are unaware of how to implement this method to support child development. Therefore, critical questions arise: How does PjBL enhance linguistic and motor intelligence in young children? What factors contribute to its successful application in early childhood education? This empirical study investigates the effectiveness of PjBL in fostering linguistic and motor development in early childhood. mixed-methods approach combining А quantitative and qualitative data is used to evaluate learning outcomes (Rahmi & Septiana. 2023). Observations. child development rubrics, and interviews with teachers and parents serve as assessment tools.

METHOD

This study employed a mixed-methods approach, incorporating both quantitative and qualitative data (Barry, 2020; Najjar et al., 2025). This method was chosen to

provide a comprehensive understanding of the effectiveness of project-based learning (PiBL) in enhancing early childhood linguistic and motor intelligence. Qualitative data were collected through direct observation, interviews with teachers and parents, and documentation of children's activities during the project. Quantitative data were obtained by measuring learning outcomes using a child development rubric (Laoli, 2021; Halim & Zulkefli, 2021). The combination of these data types enabled researchers to analyze both the learning process and the final outcomes of the intervention. This approach allowed for a deeper understanding of the impact of project-based learning on overall child development.

An experimental design was used in this study, involving two groups-an experimental group and a control group. The experimental group received projectbased learning (PjBL) designed to enhance linguistic and motor intelligence, while the received control group conventional learning (Gluck et al., 2025; Era et al., 2025). The study lasted for six weeks, with activities aligned with early childhood (ECE) themes. Data were education collected at the beginning (pre-test) and the end (post-test) of the study to evaluate changes. To ensure internal validity, subjects were randomly selected. Each group consisted of fifteen children of similar ages and socioeconomic backgrounds. The experimental group engaged in creative projects such as writing illustrated stories or constructing simple structures, whereas the control group learned through books and worksheets. This design allowed researchers to compare PiBL with conventional learning using inferential statistical analyses such as t-tests or analysis of variance (ANOVA) (Gajderowicz et al., 2025; Khalil et al., 2025; Mesghina et al., 2024; Lehmann et al., 2024; Layman et al., 2024). This analysis facilitated the identification of significant differences between the two groups.

The study was conducted at an urban early childhood education center with adequate learning facilities. This location was chosen as it represents young children who have access to formal education and provides a supportive environment for project-based learning. Thirty children, aged five to six years, were randomly assigned to either the experimental or control group. Selection criteria included appropriate age, active participation in school activities, and parental or guardian consent. To ensure group equivalency, socioeconomic background and initial abilities were also considered.

Teachers involved in the study received specialized training on implementing project-based learning. Additionally, parents assisted children at home by providing feedback on project assignments. The research subjects provided a comprehensive overview of the effectiveness of projectbased learning in improving early childhood linguistic and motor intelligence. The research procedure consisted of three main stages: preparation, implementation, and evaluation (Brushe, 2024; Yim & Su, 2024). During the preparation stage, researchers developed a project-based learning plan, determining themes and activities appropriate for early childhood needs. Over the six-week period, the experimental group engaged in project activities such as creating illustrated stories and playing creative games, while the control group received conventional instruction.

collected through Data were direct observation, structured and semi-structured interviews with teachers and parents, and child development rubrics. The evaluation stage involved analyzing data from both pre-tests and post-tests to assess significant changes in linguistic and motor intelligence (USPSTF Recommendation: Screening for Speech and Language Delay and Disorders, 2024; Ullman et al., 2024). This method ensured data accuracy and demonstrated the effectiveness of project-based learning. The research instruments included various tools designed for comprehensive data collection

(Designing, Implementing, Evaluating and Scaling up Parenting Interventions, 2024; Trifonas & Jagger, 2024; Alonzo et al., 2024; Collaborative Publication, 2024; Ga et al., 2024). The instruments used were:

Instrument	Function	Data Collection Method
Development	Assessing children's linguistic and motor intelligence	Direct observation
Rubric		
Interviews	Gathering information from teachers and parents	Structured and semi-structured
		interviews
Observation	Recording children's activities and interactions during	Field notes and checklists
	project-based learning	
Documentation	Supporting data with visual evidence	Photos and videos of children's
		activities

Children's progress in linguistic and motor skills was assessed using a structured developmental rubric (Vong et al., 2024; Norbury al., 2024; Designing, et Implementing, Evaluating and Scaling up Parenting Interventions, 2024; Kunth & Terlevich, 2024; Ga et al., 2024). Interviews teachers with and parents provided insights children's additional into developmental contexts effective and learning strategies. Observations were conducted in real-time to record children's behaviors, abilities, and interactions in natural settings. Photographic and video documentation complemented the data, offering a visual representation of the learning process. To obtain comprehensive results, this study applied both quantitative and qualitative data analysis techniques. Quantitative data were analyzed using descriptive statistics. including mean. median, and standard deviation, to describe children's linguistic and motor development outcomes. Inferential analysis, such as twas conducted to determine tests. significant differences between the experimental and control groups in pre-test and post-test results (Rocha et al., 2024; Bando et al., 2024; Koga, 2024; Djaker et al., 2024).

Thematic analysis was employed for qualitative data. After transcribing interviews and observations, researchers identified key themes related to the success of project-based learning. This process involved categorizing, coding. and interpreting data to gain deeper insights (Horne & Rakedzon, 2024; Allouche, 2024). To ensure the validity of findings, data triangulation was used to compare results from different sources, such as rubrics, interviews, and documentation. This analytical approach enabled researchers to draw conclusions on the overall impact of project-based learning on early childhood linguistic and motor intelligence (Nyqvist & Guariso, 2024; Yim & Su, 2024; Waheed et al., 2024; Djaker et al., 2024).

RESULT AND DISCUSSION

Result

The analysis of pre-test and post-test results for the experimental and control groups is included in the quantitative data description of this study. Compared to the control group, the experimental group showed a significant increase in post-test scores, particularly in language and motor intelligence. To illustrate the distribution of research results, descriptive statistics were used to analyze the quantitative data, including the calculation of mean, median, and standard deviation.

The results of inferential statistical analysis, such as the t-test, indicate that at a probability level of 0.05, there is a significant difference between the two groups. This suggests that project-based learning is beneficial for the development of early childhood language and motor intelligence. The post-test results were also distributed more evenly within the experimental group, indicating a more consistent level of success among

participants. Further analysis was conducted to evaluate how the independent variable (learning method) and dependent variables (language and motor intelligence) interact with each other. The findings showed a strong positive correlation, supporting the hypothesis that project-based learning is an effective method for fostering early childhood development.

The following pie chart illustrates the total comparison of pre-test and post-test results for the experimental group, showing a significant improvement in language and motor intelligence.



Figure 1. Pre-Test and Post-Test Results of the Experimental Group in Language and Motor Intelligence

The graph above compares the average pretest and post-test scores of the experimental group in language and motor intelligence. This visualization highlights a significant increase in both aspects following projectbased learning. The qualitative data analysis indicate positive changes results in children's behavior and engagement during project-based learning. Observations children revealed that showed high enthusiasm for the designed projects, such as creating picture stories or engaging in collaborative play activities. They appeared more confident in expressing ideas and speaking in front of groups. Interviews with teachers revealed that this approach successfully enhanced children's social skills, such as cooperation and respecting their peers' opinions. Parents also reported changes their children's positive in communication including at home. improved ability their to recount experiences during project activities. Additionally, visual documentation in the

form of photos and videos supports these findings, demonstrating children actively engaged in every stage of the project. These overall qualitative results indicate that project-based learning provides an environment that effectively supports the integrated development of language and motor skills.

This study found that project-based learning has a significant positive impact on the development of early childhood language and motor intelligence. In the experimental group, the average post-test scores showed a significant improvement compared to the control group. Creative projects, such as creating picture stories and building miniatures, were proven to enhance language skills through active communication writing practice. and Additionally, fine and gross motor activities, such as cutting, drawing, and playing, reinforced children's motor skills. Qualitative analysis revealed that children became more confident, collaborative, and emotionally engaged during the projects. Teachers and parents reported improvements in children's social skills, including their ability to work together and others' opinions. Visual respect documentation also demonstrated active participation in every activity, supporting the quantitative analysis results. These findings strengthen the evidence that project-based learning is an effective approach to fostering the holistic development of young children.

The findings of this study indicate that project-based learning (PjBL) has а significant positive impact on early childhood language and motor development. Children engaged in creative projects, such as collaboratively creating storybooks or designing group games, demonstrated improvements in writing, speaking, and social interaction skills, which align with previous research (Era et al., 2025; Roe et al., 2025). Additionally, these projects helped children enhance their motor skills through activities such as drawing, cutting, and active outdoor play. The benefits of

this study extend beyond early childhood educators to policymakers and parents as well (Wu et al., 2025; Hardin, 2025; Ma et al., 2025). Integrating PiBL into early childhood curricula can foster a more environment supportive learning that promotes holistic child development. Furthermore, this study provides practical recommendations for teachers on how to and implement engaging design and effective learning projects, even with limited resources.

These findings contribute to the existing body of knowledge on PjBL in early childhood education. By providing empirical evidence of its benefits, this study aims to encourage more education practitioners to adopt this method to support young children's development.

DISCUSSION

The study results indicate that early childhood language and motor intelligence are significantly enhanced through projectbased learning (PiBL). These findings support the theory that active participation in project activities enables children to improve their language skills by speaking in groups, sharing ideas, and storytelling (Vong et al., 2024; Jiménez et al., 2024). Children feel motivated to communicate and engage in verbal interactions because this process provides meaningful contexts. Activities such as creating picture stories encourage them to share ideas, construct narratives, and use new vocabulary, thereby enhancing their language abilities (Roe et al., 2025; Rahmi & Septiana, 2023). Physical activities such as cutting, drawing, and playing help develop both fine and coordination. gross motor This improvement highlights the importance of holistic learning, which allows children to integrate physical and cognitive skills (Pyle et al., 2024; Chen, 2024; Sanaeifar et al., 2024). For instance, building a miniature garden fosters children's problem-solving ability through gross motor activities such as lifting small objects and assembling simple structures. Qualitative analysis reveals that children become more creative, confident, and cooperative with others. conventional learning. Compared to teachers reported that children were more emotionally engaged in projects. Parents also observed positive changes in their children's communication at home, such as explaining what they did during the project. Additionally, children's involvement in projects provides opportunities to enhance their social skills. They learn to collaborate, listen, and respect their peers in team-based projects. This creates a learning environment that supports the overall development of children, including their cognitive, social, and emotional growth (Li et al., 2024; Pedersen et al., 2024; Pyle et al., 2024: Systemic Social and Emotional Learning: A Coordinated Approach to Student Success Across Settings, 2024).

Several key factors support project-based learning. First, teachers must be actively involved in designing and organizing project activities. Teachers who have received specialized training are more confident and creative in integrating projectbased activities into daily learning (Parrott et al., 2024; Pivovarova & Amrein-Beardsley, 2024). Second, parents who assist and encourage their children to participate can further reinforce their learning experience. Furthermore, а supportive learning environment, including adequate teaching aids and classrooms designed for collaborative activities, is essential for project-based learning. Additionally, documentation of activities through photos and videos helps teachers and parents conduct more comprehensive evaluations of children's development. Nevertheless, some challenges arise during implementation. One major challenge is the limited time teachers have to plan and execute projects, especially with strict teaching schedules. Additionally, some early childhood education (ECE) institutions lack the necessary resources, such as teaching aids, to support project activities. Continuous training efforts are also needed to enhance teachers' capabilities, as some

educators lack sufficient training or understanding of this method (Norhagen et al., 2024; Nguyen & Trần, 2024; Angrist et al., 2024).

Schools, parents, and communities must collaborate to overcome these challenges to ensure the sustainability and success of project-based learning (Parrott et al., 2024; Hwang & Lim, 2024). This study provides insights into how project-based new learning (PjBL) has been integrated into early childhood education in Indonesia. The results indicate that this method is not only effective in improving children's language and motor intelligence but also encourages them to participate more actively in the learning process. The key finding of this study is the application of PjBL in local settings, where it successfully utilizes limited resources while yielding significant benefits (Nyqvist & Guariso, 2024; Admawati & Mutia, 2023).

Therefore, teachers can use PjBL as an alternative method to create a more interactive and enjoyable learning environment. Additionally, policymakers may consider incorporating PjBL as part of the national early childhood education curriculum. To achieve this, policymakers should provide training for teachers who can effectively implement this method (Cağlar & Çalık, 2024; Stonewall et al., 2024; Pedersen et al., 2024). This study's findings encourage parents to actively also participate in their children's project activities at home to support their overall development. Hence, these research findings make a tangible contribution to changes in early childhood education.

CONCLUSION

This study demonstrates that project-based learning (PjBL) significantly enhances early childhood language and motor intelligence. Children participating in creative projects develop speaking, writing, and fine and gross motor coordination skills. Activities such as creating picture stories and building miniature gardens not only improve cognitive abilities but also enhance social aspects, such as collaboration and verbal interaction. The success of this method relies on the support of parents and welltrained teachers. This research highlights that PjBL effectively fosters interactive and meaningful learning, despite challenges such as time and resource limitations. Therefore, PjBL can serve as an innovative method to support children's overall development in early childhood education.

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