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Developing a Congklak-Based Module to Enhance Early Childhood Number Recognition in the Independent Curriculum

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ABSTRACT

Number recognition is a crucial component of early childhood cognitive development and is a key focus in the Independent Curriculum. Traditional teaching methods often struggle to fully engage young learners, highlighting the need for innovative, developmentally appropriate learning media. This study aimed to develop a Congklak-based learning module to enhance early childhood number recognition within the framework of the Independent Curriculum. Using a Research and Development (R&D) approach with the ADDIE model, which includes stages of analysis, design, development, implementation, and evaluation, this study involved 4 teachers and 30 children from Group B at TK Mansurin, Tarakan City. Data were collected through expert validation, teacher practicality questionnaires, and pre-test and post-test assessments of number recognition. Expert validation of the module indicated high validity with an average score of 92.43%, and teacher assessments revealed the module was highly practical with a score of 89%. The effectiveness of the module was analyzed using the Wilcoxon test, which demonstrated a statistically significant improvement in number recognition ($p < 0.05$). The average N-Gain of 0.68 confirmed the module's moderate effectiveness. The study concludes that the Congklak-based module is a valid, practical, and effective tool for enhancing early childhood number recognition within the Independent Curriculum, suggesting that traditional games can play a valuable role in modern educational settings.

Keywords: *Congklak Game Module, Independent Curriculum, Number Recognition, Early Childhood Education*

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INTRODUCTION

Early childhood education (ECE) serves as a fundamental foundation for shaping children's cognitive abilities, social skills, and overall personality development (Qistina & Khadijah, 2025; Rohali & Sitorus, 2025; Shiddiq et al., 2021). This critical period, often referred to as the "golden age," is marked by rapid brain development and heightened sensitivity to environmental stimuli. Among the essential skills cultivated during early childhood, numeracy holds a pivotal role, as early number sense strongly predicts future academic achievement and complex problem-solving capabilities (Fisher et al., 2013; Lei & Hu, 2020; Lubis & Siregar, 2023).

Despite its importance, many traditional approaches to teaching numeracy in early education rely heavily on rote learning or abstract concepts that fail to engage young learners meaningfully or connect to their everyday experiences (Anatasya et al., 2023; Ilhami et al., 2019; Safitri et al., 2023; Wikaningtyas & Nasir, 2024). Such methods risk disengagement and missed opportunities to foster a deep, intuitive understanding of numbers (Fadhilah et al., 2022; Rosdiani & Warmansyah, 2021). Therefore, there is an increasing need for pedagogical tools that not only enhance learning outcomes but also resonate culturally and developmentally with children.

In this context, the Indonesian Kurikulum Merdeka promotes a progressive vision of education that prioritizes contextual, flexible, and child-centered learning (Algazira et al., 2025; Ridwanulloh et al., 2024; Warmansyah, Yuningsih, et al., 2023). This curriculum aligns with international trends emphasizing active engagement, meaningful interaction, and the integration of local culture in learning activities (Duncan et al., 2017; McClelland et al., 2013; Tominey & McClelland, 2011). Traditional games, such as congklak—a widely recognized and culturally significant tactile game—offer a promising avenue for delivering educational content in a manner that is both enjoyable and relevant.

Although play-based learning is theoretically acknowledged as an effective approach, empirical research focusing on the application of traditional games for early numeracy development remains limited. This gap highlights the urgent need to design, implement, and evaluate interventions that integrate cultural heritage with evidence-based educational strategies.Vygotsky's socio-cultural theory provides a robust theoretical foundation for understanding the learning potential embedded in play (Vygotsky, 1978).

Cognitive development occurs through social interaction within the Zone of Proximal Development (ZPD), where learners achieve higher levels of understanding with the support and scaffolding of peers or educators (Fitriana, 2022; Sukremi et al., 2013; Warmansyah, Utami, et al., 2023). Play serves as a critical medium in this process, facilitating exploration, problem-solving, and internalization of concepts (Gradini, 2016; Lestari, 2022; Smolucha & Smolucha, 2021). Congklak, with its interactive and social nature, aligns naturally with Vygotsky's framework. It encourages collaboration, guided discovery, and hands-on manipulation of counting objects, thereby supporting numeracy skills in a context that is concrete and culturally meaningful (Illahibaccus-Sona, 2023; Musdalifah et al., 2016; Susanti, 2018). Unlike purely digital or tactile tools, congklak also reinforces cultural identity and local wisdom, which are vital components of holistic early childhood education.

A preliminary needs assessment conducted at TK Mansurin Kota Tarakan reveals significant challenges with existing numeracy teaching methods. Conventional approaches appear insufficient in sustaining children's interest or participation. Teachers have observed that children show greater enthusiasm and engagement when lessons incorporate playful, interactive elements. However, the lack of culturally tailored and interactive media limits the practical application of play-based learning in the classroom. This situation underscores a pressing need for innovative learning modules that marry local cultural practices like congklak with contemporary pedagogical principles to optimize early numeracy education.

Responding to these findings, the present study aims to develop a congklak-based learning module designed to support the goals of the Kurikulum Merdeka and address the

specific educational needs of children at TK Mansurin. By blending cultural relevance with the socio-cultural learning theory of Vygotsky, this intervention aspires to enhance early numeracy skills while simultaneously preserving and promoting local cultural heritage. Such an approach not only advances academic outcomes but also nurtures children's cultural identity and social development, contributing to a more holistic model of early childhood education.

RESEARCH METHODOLOGY

Research Design

This study is a type of Research and Development (R&D) that utilizes the ADDIE development model, which consists of five main stages: Analysis, Design, Development, Implementation, and Evaluation. This model is applied to design, develop, and evaluate a product in the form of a congklak game-based learning module aimed at improving number recognition skills in early childhood. The purpose of this R&D study is to produce a specific educational product while systematically and scientifically testing its effectiveness.

Research Setting and Participants

The research was conducted in the even semester of the 2024/2025 academic year at TK Mansurin, located in Tarakan City, North Kalimantan Province. The research subjects consisted of 30 early childhood children from group B, selected using purposive sampling based on age criteria and active participation in the learning process at the kindergarten, as well as teachers involved in the implementation of the congklak module.

Procedure

The research procedure followed the ADDIE stages as described below:

Analysis. At this stage, the researcher conducted observations and interviews with teachers, as well as observed children's learning activities to identify challenges children face in recognizing numbers and to understand teachers' needs for supporting learning media. Additionally, an analysis was carried out on the relevance of the congklak game as an interactive and contextual learning medium suitable for the characteristics of early childhood learners.

Design. The design stage involved developing the module structure, including learning objectives, student worksheets, and evaluation instruments. The module was tailored to align with the principles of the Kurikulum Merdeka and the developmental characteristics of early childhood. The module design considered the use of child-friendly and easily accessible media such as small beads or plastic containers that serve as congklak boards.

Development. In this stage, the drafted module was validated by early childhood education experts and instructional media specialists. The validation covered content aspects, language clarity, and visual presentation. Based on expert feedback, revisions were made to enhance the module's quality to ensure it is engaging, interactive, and curriculum-appropriate.

Implementation. The revised module was field-tested in a classroom setting at TK Mansurin involving 30 participating children. The researcher observed the children's

engagement during the learning process and identified any challenges encountered during the implementation of congklak-based learning activities.

Evaluation. The evaluation stage included analyzing children's learning outcomes through pretest and posttest assessments to measure improvements in number recognition skills, as well as collecting teachers' feedback via questionnaires regarding the module. The evaluation results were used to refine the module so that the final product met the criteria of validity, practicality, and effectiveness.

Data Collection

Data were collected using several techniques, including observation (to monitor the learning process before and after using the module), interviews with teachers (to obtain perceptions and experiences related to the module), teacher response questionnaires, as well as documentation in the form of photos and children's work during the learning implementation. The instruments used included observation sheets to assess children's engagement, module validation forms completed by experts, teacher response questionnaires, and pretest and posttest instruments to measure the development of number recognition skills.

Data Analysis

The data analysis in this study was conducted using both qualitative and quantitative approaches to provide a comprehensive understanding of the effectiveness, validity, and practicality of the congklak-based learning module. Qualitative data from interviews and observations were analyzed using the Miles & Huberman model, which consists of three stages: data reduction, data display, and conclusion drawing. This process enabled the researcher to simplify raw data, present it in matrices or narrative form, and interpret it to identify relevant patterns and meanings. Quantitative Data Analysis Quantitative data were analyzed through several key tests as follows:

Validity Analysis: Conducted to assess the quality and accuracy of the developed module based on expert validation. The validator scores were averaged and compared against the following categories :

Table 1. Expert Validation Results Categories

No	RTV Interval	Category
1	$4 > RTV \geq 3.5$	Very Valid
2	$3.5 > RTV \geq 2.5$	Valid
3	$2.5 > RTV \geq 1.5$	Fairly Valid
4	$1.5 > RTV \geq 1$	Not Valid

This table explains the criteria used to determine the level of validity of the congklak-based learning module. A score of 3.5 or higher indicates that the module is considered "very valid," while scores below 2.5 suggest the module requires significant revision.

Effectiveness Analysis with N-Gain

Used to measure the improvement in children's number recognition skills after using the congklak module.

Table 2. N-Gain Interpretation

N-Gain Range	Category
N-Gain ≥ 0.7	Effective
0.3 ≤ N-Gain < 0.7	Moderately Effective
N-Gain < 0.3	Ineffective

This table shows the interpretation of the N-Gain results, indicating the level of effectiveness of the module in improving students' number recognition abilities. A non-parametric statistical test used to compare paired samples when the data do not meet normality assumptions. In this research, the Wilcoxon test was used to determine if there was a statistically significant difference between the pretest and posttest scores of children's number recognition skills after using the module. Through the combination of N-Gain and Wilcoxon analyses, this study provides quantitative evidence that supports the effectiveness of the developed congklak module in enhancing early childhood number recognition skills.

RESULTS ND DISCUSSION

This study employed the ADDIE development model, which consists of five systematic stages: Analyze, Design, Develop, Implement, and Evaluate. Each stage plays a crucial role in developing a congklak game-based learning module aimed at enhancing early childhood number recognition skills.

Analyze

The initial analysis phase involved identifying the needs of school principals, teachers, and parents regarding early numeracy learning, revealing a lack of interactive media tailored for young children. Through interviews and literature review, traditional games like congklak were recognized as promising tools to enhance number recognition through play-based learning. Stakeholders emphasized the need for structured modules with clear guidance, worksheets, and integration into the Merdeka Curriculum. A subsequent concept analysis was conducted to define key numeracy concepts, structure them systematically, and link them into a concept map to align with developmental aspects and measurable learning indicators for early childhood learners.

Design

In the design phase, the researcher developed an initial layout for the congklak-based learning module using Canva (canva.com). The process included two main steps: first, test standard preparation by designing validation instruments covering presentation aspects (validated by content experts) and graphic elements (validated by media experts). Second, the initial module draft was created, consisting of a cover, foreword, table of contents, and activity sheets incorporating congklak gameplay. All components were arranged to be child-friendly and practical for early childhood teachers, aiming to create an engaging, effective learning experience aligned with developmental needs.

Develop

This phase involved producing the initial draft of the module and guidebook, which were then validated by two experts—an early childhood education specialist and an instructional media expert. The validation assessed the relevance of the content, usability, design, and educational quality of the product. Validation results: 1) Media validation score: 3.3 (Valid category); 2) Guidebook validation score: 3.1 (Valid category); 3) Validity categories based on RTV intervals:

Table 3. Validation Results

RTV Interval	Category
4 > RTV ≥ 3.5	Very Valid
3.5 > RTV ≥ 2.5	Valid
2.5 > RTV ≥ 1.5	Fairly Valid
1.5 > RTV ≥ 1	Not Valid

During the development stage, the module and accompanying guidebook were validated by experts in early childhood education and instructional media. The media received a validation score of 3.3 and the guidebook 3.1, both categorized as valid. These scores suggest that while the module is feasible for use, there remains room for improvement, particularly in visual design and ease of implementation.

Figure 1. Congklak Game Module Usage Guidebook

Implementation

Implementation involved field testing the revised module with 30 children. Statistical analysis revealed a significant improvement in number recognition skills, with a Wilcoxon signed-rank test yielding p=0.003 and an N-Gain score of 0.68, categorized as moderate improvement. Previous research found who demonstrated that congklak-based number card games significantly improve children's numerical concepts (Budianti et al., 2021; Mawadah et al., 2022). Moreover, children's responses to different aspects of the congklak activities such as counting versus taking turns—indicated that the module also nurtures social-emotional skills like cooperation and patience.

Evaluate

The final evaluation involved collecting feedback from teachers and analyzing student learning outcomes. According to teacher questionnaires, the module received an effectiveness score of 94.06%, categorizing it as "Very Effective." Posttest scores showed a significant improvement over pretest scores, with no children remaining in the "Not Yet Developed" category, indicating the module's success in fostering number recognition skills.

Observations and interviews during the evaluation phase showed increased child engagement and enthusiasm, consistent with Piaget's theory emphasizing the importance of concrete and contextual learning for early childhood. The integration of local cultural values through congklak also enriched the learning experience supporting holistic child development (Butarbutar et al., 2019; Rafita & Puspa Juwita, 2025; Warmansyah, Zalzabila, et al., 2023). Nevertheless, challenges such as managing instructional time and accommodating diverse language abilities were identified, suggesting the need for the module to be further adapted to address learner variability.

The study's limitations include its focus on a single institution and a relatively small sample size, limiting the generalizability of the findings. Future research should involve a larger and more diverse sample across different geographic and cultural contexts. Additionally, digitizing the congklak module could provide a valuable innovation to support hybrid or online learning environments (Nafiqoh & Alam, 2024; Santi & Bachtiar, 2020; Susanti, 2018).

CONCLUSION

This study developed a congklak-based learning module to enhance early childhood number recognition within the Merdeka Curriculum. The module was validated by experts, deemed highly practical by teachers, and demonstrated significant effectiveness in improving children's numeracy skills. Qualitative data indicated increased student engagement and enthusiasm, with teachers finding the module both enjoyable and easy to implement. The use of the congklak game aligns with Piaget's cognitive development theory, promoting concrete learning while integrating local cultural values. However, the study's limitations, including the small sample size and short-term implementation, suggest that further research should test the module in diverse contexts, compare it with other numeracy tools, and explore digital adaptations for modern learning environments. Longitudinal studies are also recommended to assess the long-term impact on children's cognitive and numeracy development. Overall,

the module is valid, practical, and effective, contributing to the Merdeka Curriculum's goals and supporting local wisdom in early childhood education.

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