

The Effect of the Traditional Papuan Game Patah Kaleng on the Numeracy Skills of Children Aged 5–6 Years

1) Yul Fitriana, 2) Syamsul Rizal, 3) Alman

^{1,2,3)} Pedagogy, Muhammadiyah University of Education, Sorong

Email: yulfitriana@unimudasorong.ac.id

*Correspondence Author: yulfitriana@unimudasorong.ac.id

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ABSTRACT

This study aims to analyze the effect of the Papua traditional game *Patah Kaleng* on the numeracy skills of children aged 5–6 years at TK UNIMUDA Alam Mentari. The background of this research is the low level of early childhood numeracy skills, which are still dominated by conventional learning approaches that are less contextual and lack play-based activities. This study employed a quantitative approach with a quasi-experimental design using a one-group pretest-posttest model. The research subjects consisted of 15 children in the experimental class and 16 children in the control class. Data were collected using a numeracy observation instrument based on 10 indicators with a Likert scale.

The results showed that both groups experienced an improvement in numeracy skills; however, the increase in the experimental class was more significant. The mean score of the experimental class increased from 20.53 to 31.47 with a gain (Δ) of 10.93, while the control class increased from 19.81 to 23.44 with a gain (Δ) of 3.63. The results of the paired sample t-test indicated a significance value ($p < 0.05$), meaning that the research hypothesis was accepted.

In conclusion, the Papua traditional game *Patah Kaleng* has a significant effect on improving early childhood numeracy skills. These findings imply that traditional game-based learning can serve as an effective and contextual strategy to enhance numeracy skills while supporting the development of culturally responsive learning in early childhood education

Informasi Artikel

Kata Kunci:

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh permainan tradisional Papua *Patah Kaleng* terhadap kemampuan numerasi anak usia 5–6 tahun di TK UNIMUDA Alam Mentari. Permasalahan yang melatarbelakangi penelitian ini adalah rendahnya kemampuan numerasi anak usia dini yang masih didominasi oleh pembelajaran konvensional yang kurang kontekstual dan kurang melibatkan aktivitas bermain. Penelitian ini menggunakan pendekatan kuantitatif dengan desain *quasi-experimental* tipe *one group pretest-posttest*. Subjek penelitian terdiri dari 15 anak pada kelas eksperimen dan 16 anak pada kelas kontrol. Pengumpulan data dilakukan melalui instrumen observasi kemampuan numerasi berbasis 10 indikator dengan skala Likert.

Hasil penelitian menunjukkan bahwa terdapat peningkatan kemampuan numerasi pada kedua kelompok, namun peningkatan pada kelas eksperimen lebih signifikan. Nilai rata-rata kelas eksperimen meningkat dari 20,53 menjadi 31,47 dengan selisih (Δ) sebesar 10,93, sedangkan kelas kontrol meningkat dari 19,81 menjadi 23,44 dengan selisih (Δ) sebesar 3,63. Hasil uji *paired sample t-test* menunjukkan nilai signifikansi ($p < 0,05$), sehingga hipotesis penelitian diterima.

Kesimpulan penelitian ini adalah permainan tradisional Papua *Patah Kaleng* berpengaruh signifikan terhadap peningkatan kemampuan numerasi anak usia dini. Temuan ini memberikan implikasi bahwa pembelajaran berbasis permainan tradisional dapat menjadi strategi efektif dan kontekstual dalam meningkatkan kemampuan numerasi serta mendukung pengembangan pembelajaran berbasis budaya lokal pada pendidikan anak usia dini.

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✉ **Corresponding Author:** (1) Yul Fitriana, (2) Department of Pedagogy, (3) Institution of Muhammadiyah University of Education, (4) Sorong, Indonesia, (5) Email: yulfitriana@unimudasorong.ac.id

1. Introduction

Early numeracy skills constitute a fundamental foundation for children's cognitive development and future academic success. Globally, numerous studies have demonstrated that early numeracy competence is strongly associated with later achievement in mathematics and problem-solving abilities. Recent research further confirms that early numeracy stimulation contributes to the development of executive functioning, logical reasoning, and school readiness among young children (Adawurah, 2025; Raghavan & Sharma, 2025). Therefore, early childhood education (ECE) represents a critical stage for fostering children's foundational numeracy skills.

Despite this importance, findings from various studies indicate that numeracy achievement among young children remains suboptimal, particularly in developing countries. Conventional teacher-centered instructional approaches are frequently identified as one of the primary factors contributing to children's limited engagement in the learning process (Mariyana et al., 2025). Moreover, the lack of contextualized and enjoyable learning methods often makes it difficult for children to comprehend abstract numerical concepts.

A similar situation exists in Indonesia. Previous studies have shown that numeracy instruction in early childhood education is still largely dominated by worksheet-based activities and rote memorization of numbers, approaches that are inconsistent with children's developmental characteristics (Hamidah et al., 2025). According to Piaget's theory of cognitive development, children aged 5–6 years are in the preoperational stage, during which they require concrete experiences and play-based activities to develop meaningful mathematical understanding.

Play-based learning has been widely recognized as an effective approach for improving young children's numeracy skills. Previous research has demonstrated that educational games significantly enhance children's engagement, learning motivation, and academic achievement compared with conventional instructional methods (Gianan, 2025; Sari et al., 2025). Furthermore, game-based learning has been shown to reduce mathematics anxiety while fostering children's confidence in learning numeracy concepts (Adawurah, 2025).

Traditional games also offer considerable potential as culturally contextualized learning media for numeracy education. Beyond promoting cognitive development, traditional games incorporate social, motor, and emotional dimensions, thereby supporting children's holistic development (Irwanti & Azizah, 2025). The integration of traditional games into classroom instruction is also consistent with the principles of culturally responsive teaching, which emphasizes the importance of incorporating cultural values into educational practices (Nurhayati & Judijanto, 2025).

Several previous studies have demonstrated that traditional games, such as *congklak* and role-playing games, significantly improve children's numeracy skills (Suwandayani & Ananda,

2025; Afianti & Maryatun, 2025). These games help children understand numerical concepts, classification, and basic arithmetic operations through direct hands-on experiences. Such findings indicate that traditional games can serve as effective alternative instructional strategies for early numeracy learning.

Nevertheless, most previous research has focused primarily on nationally recognized traditional games, such as *congklak*, or on modern digital game-based learning. Empirical studies investigating traditional games that are unique to specific regions, particularly those originating from Papua, remain scarce. Yet each region possesses rich cultural heritage that has the potential to serve as meaningful and contextually relevant learning media for young children.

One such traditional Papuan game is *Patah Kaleng*, which involves counting activities, strategic thinking, and motor coordination. This game has considerable potential to be developed as a numeracy learning medium because it incorporates concepts of counting, sequencing, and basic logical reasoning. However, to date, few empirical studies have examined the effect of *Patah Kaleng* on the numeracy skills of young children.

Furthermore, previous studies have predominantly employed qualitative or descriptive approaches, providing limited quantitative evidence regarding the causal relationship between traditional games and improvements in children's numeracy skills. Consequently, quantitative research is needed to objectively measure the effect of traditional games on early childhood numeracy development.

This research gap highlights the need for more specific and contextual investigations concerning the use of traditional Papuan games in early childhood numeracy instruction. The present study is expected to contribute to the growing body of literature on culturally based learning while providing an innovative instructional alternative for early childhood educators.

Based on these considerations, this study aims to examine the effect of the traditional Papuan game *Patah Kaleng* on the numeracy skills of children aged 5–6 years at UNIMUDA Alam Mentari Kindergarten. A quantitative research approach was employed to examine the relationship between the independent variable (the *Patah Kaleng* game) and the dependent variable (children's numeracy skills).

The study was guided by the hypothesis that the use of the traditional Papuan game *Patah Kaleng* has a significant positive effect on improving the numeracy skills of children aged 5–6 years. Specifically, the study addressed the following research questions: (1) How do children's numeracy skills differ before and after the implementation of the *Patah Kaleng* game? and (2) Does the implementation of the *Patah Kaleng* game have a statistically significant effect on children's numeracy skills? Accordingly, this study is expected to provide both theoretical and practical contributions to the development of culturally responsive numeracy instruction in early childhood education.

2. Literature Review

Early childhood numeracy is recognized as one of the fundamental competencies that determine children's readiness for subsequent levels of education. Within the field of early childhood education, numeracy extends beyond the ability to recite numbers; it encompasses the ability to recognize quantities, classify objects, match items, sequence, compare, and apply numerical concepts in everyday situations [11], [12]. For children aged 5–6 years, appropriate numeracy stimulation is particularly important because, at this developmental stage, they begin to construct symbolic representations and establish connections between concrete experiences and early mathematical concepts.

The dependent variable in this study is the numeracy skills of children aged 5–6 years. Conceptually, early childhood numeracy refers to children's capacity to understand number concepts, count objects, recognize numerical symbols, distinguish between greater and smaller quantities, and solve simple quantitative problems in concrete contexts [12], [13]. In early childhood education, numeracy develops most effectively when children participate in meaningful, enjoyable, and developmentally appropriate learning experiences rather than being exposed to abstract mathematical exercises at an early age. Consequently, numeracy instruction for young children should be contextualized, hands-on, and centered on play-based activities.

The independent variable in this study is the traditional Papuan game *Patah Kaleng*. Traditional games are generally defined as play activities passed down across generations that incorporate rules, social interaction, physical movement, strategic thinking, and local cultural values [14], [15]. Within educational settings, traditional games are regarded as valuable learning media because they provide direct experiences, encourage children's active engagement, and connect learning with their socio-cultural environment. Therefore, traditional games function not only as recreational activities but also as pedagogical tools that support children's cognitive, social, motor, and affective development.

The relationship between traditional games and children's numeracy skills can be explained through play-based learning theory. This approach positions play as the primary medium for learning because children acquire knowledge through exploration, experimentation, repetition, and meaningful social interaction [16], [17]. In numeracy learning, games provide opportunities for children to experience concepts of quantity, sequence, patterns, and comparison in concrete ways. When children count steps, distinguish positions, estimate quantities, or follow game rules, they are naturally constructing foundational mathematical concepts through authentic experiences.

From a theoretical perspective, this study is grounded in Piaget's theory of cognitive development. Children aged 5–6 years are in the preoperational stage, during which they begin to use symbols but continue to rely heavily on concrete experiences to understand concepts [13], [18]. Accordingly, numeracy concepts are more readily understood when presented through tangible objects, physical movement, and observable play situations. The *Patah Kaleng* game, which involves physical activity, observation, counting, and sequencing, aligns well with the learning characteristics of children at this developmental stage because it bridges concrete experiences with basic numerical concepts.

In addition to Piaget's theory, Vygotsky's sociocultural theory provides another relevant perspective for explaining the influence of play on children's numeracy development. According to this perspective, cognitive development occurs through social interaction, language, and environmental support within the Zone of Proximal Development (ZPD) [14], [19]. Traditional games create collaborative learning environments in which children learn from peers, teachers, shared rules, and continuous feedback during play. Within this context, teachers serve as facilitators who provide appropriate scaffolding to help children connect their play experiences with numeracy concepts, for example, by asking questions about quantities, turn-taking sequences, or game outcomes.

The final theoretical foundation of this study is culturally responsive pedagogy. This approach emphasizes that learning becomes more meaningful when instructional materials, learning media, and classroom activities are rooted in learners' local cultural contexts [14], [20]. In early childhood education, integrating traditional games into classroom instruction enables children to learn through cultural symbols, language, and practices that are familiar to them. This is particularly important because the use of local cultural contexts enhances children's sense of belonging, motivation, and participation in learning activities. Therefore, the use of the traditional Papuan game *Patah Kaleng* is not only pedagogically appropriate but also strengthens the contextual and cultural dimensions of early childhood numeracy instruction.

From the perspective of early childhood pedagogy, traditional games are also consistent with the principles of holistic-integrative learning. Play activities do not separate cognitive development from motor, social, and emotional development; rather, they foster these developmental domains simultaneously [15], [17]. Through the *Patah Kaleng* game, children not only practice counting but also learn to follow rules, wait for their turn, regulate their emotions, cooperate with peers, and coordinate body movements. These characteristics are particularly important because early numeracy development is often more effective when it is integrated with motor activities and authentic social experiences.

Within the operational framework of this study, the *Patah Kaleng* game is positioned as an instructional stimulus that is

expected to influence children's numeracy skills. Conceptually, this influence may occur because the game requires children to recognize sequences, count objects or turns, estimate quantities, and distinguish positions and outcomes [14], [15]. Such activities reinforce early numeracy concepts through direct experiential learning. Therefore, it can be theoretically assumed that the more systematically traditional games are incorporated into classroom instruction, the greater the potential for improving the numeracy skills of children aged 5–6 years.

The first relevant previous study is that of Irwanti and Azizah, which found that the traditional game *congklak* improved kindergarten children's numeracy skills, particularly in counting and understanding numerical quantities [15]. These findings support the hypothesis that traditional games can serve as effective instructional media for early mathematics learning. A major strength of this study lies in its demonstration that culturally rooted learning media can enhance children's engagement in learning. However, the study focused exclusively on *congklak*, and therefore does not represent the diversity of traditional games found in other regions of Indonesia, particularly Papua.

The second relevant study, conducted by Musi and Sugiarti, reported that the traditional game *congklak* had a positive effect on young children's numeracy skills while simultaneously promoting contextualized learning experiences [18]. These findings further support the assumption that children understand numerical concepts more effectively when learning occurs through concrete and repetitive play activities. Nevertheless, this study focused on a traditional board game in which numerical structures are explicitly embedded. This differs from *Patah Kaleng*, where numeracy concepts are more likely to emerge through physical movement, game rules, turn-taking, and strategic play.

A third previous study offers a somewhat different perspective. Mariyana et al. argued that role-playing games and educational games can improve children's numeracy skills; however, their effectiveness depends largely on the design of the learning activities, teachers' guidance, and the alignment of the games with instructional objectives [12]. Rather than contradicting the present study's hypothesis, these findings suggest that games do not automatically improve numeracy skills without careful pedagogical planning. In other words, the effectiveness of traditional games as numeracy learning media depends substantially on how teachers intentionally integrate numeracy indicators into play activities.

Overall, these three studies demonstrate a consistent trend indicating that game-based numeracy instruction produces positive learning outcomes. However, most previous research has focused on digital games, role-playing activities, or traditional games that are widely recognized across Indonesia [12], [15], [18]. Quantitative studies specifically examining local traditional Papuan games as instructional interventions remain limited. Another limitation is the lack of research

focusing specifically on children aged 5–6 years within particular early childhood education settings using structured measures of numeracy skills. Consequently, there remains a significant gap in the literature regarding the effectiveness of traditional Papuan games as instructional media for early childhood numeracy development.

The research gap addressed by this study can be summarized in three aspects. First, empirical research examining traditional Papuan games, particularly *Patah Kaleng*, in numeracy instruction remains limited. Second, previous studies have predominantly investigated games that are general, digital, or originate from regions outside Papua [11], [12], [16]. Third, there is still a need for more specific quantitative evidence concerning the relationship between culturally based traditional games and the numeracy skills of children aged 5–6 years in early childhood education settings. This study seeks to address these gaps by positioning *Patah Kaleng* as an instructional intervention whose effects on children's numeracy skills are examined at UNIMUDA Alam Mentari Kindergarten.

Drawing upon cognitive development theory, sociocultural theory, play-based learning, and culturally responsive pedagogy, this study proposes that the traditional Papuan game *Patah Kaleng* can serve as an effective instructional stimulus for improving the numeracy skills of children aged 5–6 years. The conceptual framework positions the traditional Papuan game *Patah Kaleng* as the independent variable (X) and children's numeracy skills as the dependent variable (Y). Conceptually, implementing a game that involves counting, sequencing, comparing quantities, and following turn-taking rules is expected to provide concrete learning experiences that strengthen children's early numeracy understanding. Accordingly, the conceptual model of this study proposes the following relationship: **Implementation of the traditional Papuan game *Patah Kaleng* → Improvement in the numeracy skills of children aged 5–6 years**, which is subsequently tested quantitatively through the hypothesis that the *Patah Kaleng* game has a statistically significant effect on children's numeracy skills.

3. Research Method

This study employed a quantitative research approach to objectively and systematically examine the effect of an independent variable on a dependent variable. A quantitative approach was selected because it enables researchers to collect numerical data that can be analyzed statistically to test research hypotheses and produce findings that may be generalized to a broader population [21]. In the context of this study, the quantitative approach was used to examine the effect of the traditional Papuan game *Patah Kaleng* on the numeracy skills of children aged 5–6 years.

The study adopted a quasi-experimental design, specifically

the **one-group pretest–posttest design**. This design involved a single group of participants whose numeracy skills were measured before (pretest) and after (posttest) receiving the intervention [21], [22]. This design was selected because field conditions did not permit the inclusion of a control group while still allowing the researcher to examine significant changes in children's numeracy skills following the intervention.

The study utilized primary data collected directly from the research participants through assessments of children's numeracy skills. The data consisted of pretest and posttest numeracy scores obtained before and after the implementation of the *Patah Kaleng* game. These primary data were quantitative in nature because they were expressed as numerical scores and subsequently analyzed using inferential statistical techniques [21].

Data were collected through numeracy tests and structured observations. The numeracy test was administered to assess children's numeracy skills before and after the implementation of the *Patah Kaleng* game, whereas structured observation was conducted to monitor the fidelity of the intervention and children's participation throughout the learning activities. The use of standardized tests as the primary research instrument is consistent with quantitative research, which emphasizes objective measurement of the variables under investigation [23].

The population of this study consisted of all children aged 5–6 years enrolled at UNIMUDA Alam Mentari Kindergarten. This population was selected because it corresponded to the characteristics of the target participants, namely young children in the early stages of numeracy development. Since the study was conducted within a formal early childhood education institution, the population was relatively homogeneous and limited in size.

The sample was selected from the population using purposive sampling. Participants were chosen based on predetermined criteria, including being 5–6 years of age, actively participating in classroom learning activities, and being available to complete all stages of the research [22]. This sampling technique was employed because not all members of the population met the characteristics required for the study.

The research sample consisted of one classroom of children aged 5–6 years at UNIMUDA Alam Mentari Kindergarten. Selecting a single class was consistent with the one-group pretest–posttest design, which requires only one experimental group. This decision also considered the efficiency of the research implementation and ensured that all participants received the same instructional intervention.

The primary research instrument was an early childhood numeracy assessment developed based on indicators of numeracy development, including number recognition, object counting, quantity comparison, and number sequencing. The instrument was designed as a scoring sheet with specific assessment criteria for each indicator. Its development was guided by early childhood developmental standards and

previous research on the assessment of young children's numeracy skills [12], [13].

In addition to the numeracy assessment, a structured observation checklist was used to monitor the implementation of the *Patah Kaleng* game during classroom instruction. The observation instrument included indicators related to children's active participation, engagement during play, and the fidelity of implementation according to the planned instructional procedures. Observations were conducted by the researcher or a trained research assistant to ensure objectivity.

The content validity of the research instruments was established through expert judgment involving specialists in early childhood education. The experts evaluated the alignment of each instrument item with the indicators of children's numeracy skills. The instrument was considered valid when each item demonstrated a high level of correspondence with the construct being measured [21], [23]. This procedure ensured that the instrument accurately measured the intended aspects of children's numeracy skills.

Instrument reliability was assessed to determine the consistency of the measurement tool. Reliability was calculated using **Cronbach's alpha coefficient**. The instrument was considered reliable when the reliability coefficient exceeded 0.70, indicating satisfactory internal consistency [21]. Consequently, the measurement results were considered sufficiently reliable for subsequent statistical analysis.

The research procedure consisted of several stages. The preparation stage included instrument development, content validation, and obtaining research approval. A pretest was then administered to measure participants' initial numeracy skills. This was followed by the instructional intervention, during which children participated in learning activities incorporating the traditional Papuan game *Patah Kaleng* across several instructional sessions. Finally, a posttest was conducted to assess changes in children's numeracy skills following the intervention.

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics were used to summarize the mean scores, percentages, and score distributions of children's numeracy performance before and after the intervention. These analyses provided an overall description of changes in participants' numeracy skills [21].

To test the research hypothesis, a **paired-samples t-test** was employed to determine whether there was a statistically significant difference between participants' pretest and posttest scores within the same group [22]. The paired-samples *t*-test was selected because the research design involved repeated measurements of a single experimental group.

Hypothesis testing was conducted using a significance level of $\alpha = 0.05$. If the *p*-value was less than 0.05, the alternative hypothesis (H_a) was accepted, indicating that the traditional Papuan game *Patah Kaleng* had a statistically significant effect on children's numeracy skills. Conversely, if the *p*-value exceeded 0.05, the null hypothesis (H_0) was retained [21].

All statistical analyses were performed using **IBM SPSS Statistics**. The use of statistical software enhanced the accuracy of the calculations and facilitated quantitative data analysis, particularly the inferential statistical procedures. By following these systematic procedures, the present study provides a methodological framework that can be replicated by future researchers conducting similar investigations in comparable educational contexts.

4. Results and Discussion

4.1 Results

Based on the pretest and posttest data on children's numeracy skills in the control and experimental groups at UNIMUDA Alam Mentari Kindergarten, an improvement in numeracy performance was observed following the intervention. The data were collected using an observational assessment instrument consisting of **10 numeracy indicators** measured on a **Likert scale**, with a maximum possible score of **40**.

A. Descriptive Analysis

A summary of the descriptive statistical analysis is presented in **Table 1**.

Group	N	Pretest Mean	SD	Posttest Mean	SD
Control	16	19.81	4.09	23.44	3.81
Experimental	15	20.53	2.72	31.47	6.96

Based on the table above, it can be seen that:

- The mean numeracy score in the control group increased from 19.81 (BD category) to 23.44 (DE category).
- The mean numeracy score in the experimental group increased more substantially, from 20.53 (BD/DE category) to 31.47 (VWD category). These findings indicate that both groups experienced improvements; however, the improvement in the experimental group was considerably greater than that in the control group.

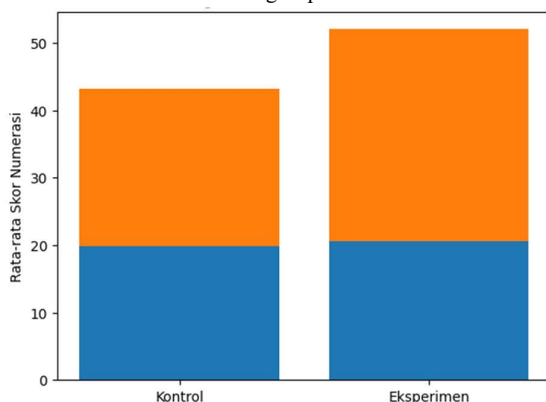


Figure 1. Comparison of Pretest and Posttest Scores

The figure above illustrates a comparison of the mean numeracy scores of children in the control and experimental groups before (pretest) and after (posttest) the intervention. Both groups demonstrated improvements in numeracy scores following the instructional process, indicating that both conventional instruction and instruction incorporating the intervention contributed to the development of children's numeracy skills. However, the pattern of improvement reveals a substantial difference between the two groups.

In the control group, the mean score increased from approximately 19.81 to 23.44. This improvement indicates that, even without a specific intervention, children's numeracy skills developed through the regular learning process. In terms of developmental categories, the improvement progressed from Beginning to Develop (BD) to Developing as Expected (DE). This suggests that the instructional approach implemented in the control group was able to promote numeracy development, although the improvement was relatively moderate.

In contrast, the experimental group exhibited a much greater improvement, with the mean score increasing from 20.53 to 31.47. This increase reflects not only a quantitative improvement but also a shift in developmental category from Beginning to Develop/Developing as Expected (BD/DE) to Very Well Developed (VWD). These findings indicate that the intervention using the traditional Papuan game Patah Kaleng made a stronger contribution to improving children's numeracy skills.

A direct comparison between the two groups shows that the magnitude of improvement in the experimental group was substantially greater than that of the control group. This is clearly reflected in the considerably higher posttest bar for the experimental group compared with the control group. This difference further suggests that a traditional game-based instructional approach is more effective in stimulating early childhood numeracy skills than conventional teaching methods.

Overall, the figure provides visual evidence that the use of the traditional Papuan game Patah Kaleng more effectively enhances children's numeracy skills. These findings suggest that learning experiences involving concrete, interactive, and contextual play activities provide more meaningful learning opportunities, thereby making a significant contribution to children's cognitive development, particularly in the area of numeracy.

B. Developmental Category Analysis

Based on the distribution of developmental categories:

- In the control group, most children progressed from the Beginning to Develop (BD) category to the Developing as Expected (DE) category.
- In the experimental group, the majority of children reached the Very Well Developed (VWD) category after the intervention.

These findings indicate that the Patah Kaleng game

intervention was more effective in promoting children's numeracy skills to a higher developmental level than conventional classroom instruction.

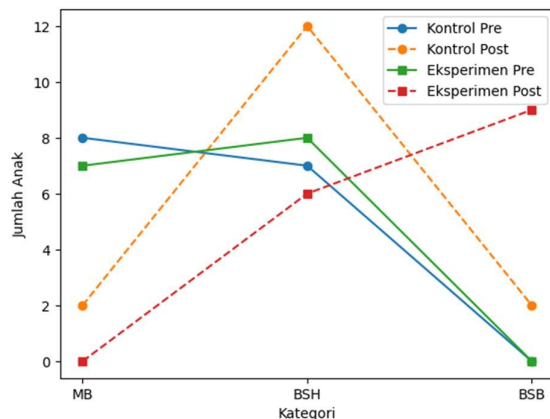


Figure 2. Changes in Numeracy Development Categories

The figure above illustrates the changes in the distribution of children's numeracy development categories in the control and experimental groups before (pretest) and after (posttest) the intervention. The categories used were Beginning to Develop (BD), Developing as Expected (DE), and Very Well Developed (VWD). Overall, the figure demonstrates a shift toward higher levels of numeracy development in both groups, although with different patterns of improvement.

In the control group, most children were classified in the BD and DE categories before the intervention, with a relatively high proportion remaining in the BD category. Following the learning activities, the number of children in the BD category decreased, while the number in the DE category increased. These findings indicate that the instructional activities contributed to improvements in children's numeracy skills; however, the gains were moderate, with relatively few children reaching the highest level of development.

In contrast, the experimental group exhibited more substantial changes. Prior to the intervention, the distribution of children was similarly dominated by the BD and DE categories, comparable to the control group. However, after participating in the Patah Kaleng game, a marked increase was observed in the VWD category, while the BD category declined to nearly zero. This finding suggests that the majority of children achieved an optimal level of numeracy development.

Overall, the shift in developmental categories was considerably more pronounced in the experimental group than in the control group. In the control group, improvement was primarily reflected in a transition from BD to DE, whereas in the experimental group, children's progress extended beyond DE to the VWD category. This difference indicates that the intervention had a stronger effect on enhancing the quality of children's numeracy skills.

Therefore, this figure reinforces the previous findings that the traditional Papuan game Patah Kaleng is effective in improving

early childhood numeracy skills. Contextual, interactive, and play-based learning was shown to be more effective in promoting higher levels of numeracy development than conventional instructional approaches.

C. Hypothesis Testing (Paired Samples t-test)

The results of the paired samples t-test revealed the following:

- Control Group: $t = -10,296$; $p = 0,000$ ($< 0,05$)
- Experimental Group: $t = -7,874$; $p = 0,000$ ($< 0,05$)

Since the significance value ($*p$ -value) was less than 0.05, there was a statistically significant difference between the pretest and posttest scores in both groups.

However, when the magnitude of improvement was examined, the results showed that:

- Control Group: $\Delta = 3,63$
- Experimental Group: $\Delta = 10,93$

This indicates that the improvement in the experimental group was nearly three times greater than that observed in the control group.

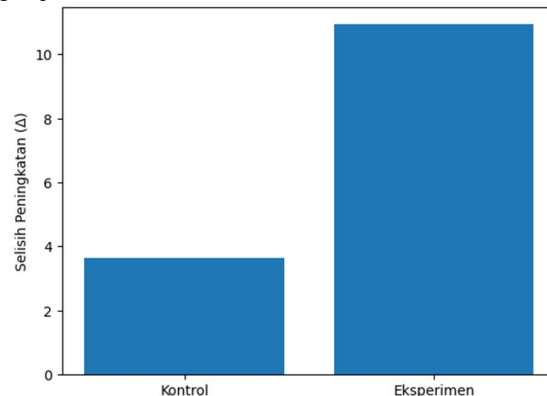


Figure 3. Comparison of the Improvement in Numeracy Scores (Paired-Samples t-Test)

The figure above illustrates the comparison of the improvement difference (Δ) in numeracy skills between the control group and the experimental group based on the results of the paired-samples t-test. The Δ value represents the difference between the mean posttest and pretest scores for each group. The control group demonstrated an improvement of 3.63 points, whereas the experimental group exhibited a substantially greater improvement of 10.93 points. This visualization clearly highlights the difference in the effectiveness of the interventions implemented in the two groups.

Statistically, these findings are supported by the paired-samples t-test, which revealed a significance level (p -value) of less than 0.05 for both groups. This indicates that both the control and experimental groups experienced statistically significant improvements from pretest to posttest. However, statistical significance alone is insufficient to reflect the magnitude of the intervention's effect. Therefore, examining the improvement difference (Δ) is essential to evaluate the practical significance of the observed changes.

A further comparison shows that the improvement in the

experimental group was nearly three times greater than that of the control group. This finding indicates that the intervention using the traditional Papuan game Patah Kaleng had a substantially stronger effect on enhancing children's numeracy skills than conventional instruction. In other words, although both groups demonstrated significant improvements, the magnitude and quality of improvement in the experimental group were considerably greater.

From a pedagogical perspective, these findings suggest that game-based learning provides a more effective learning experience for young children. The activities involved in the Patah Kaleng game actively engage children in counting, comparing, and sequencing tasks, allowing numeracy concepts to be acquired not only through theoretical understanding but also through direct experiential learning. This finding is consistent with the principles of constructivist learning and play-based learning, which emphasize the importance of concrete experiences in facilitating conceptual understanding.

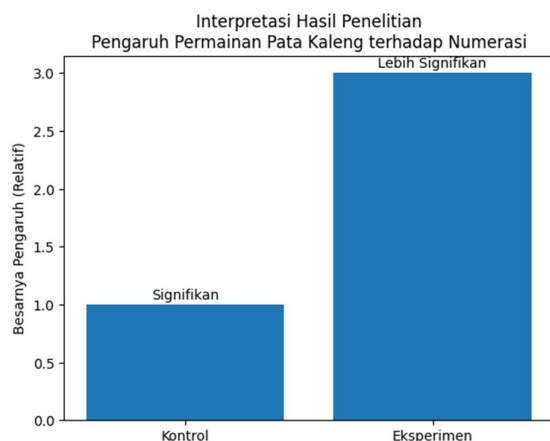
Overall, the figure not only reinforces the statistical findings but also provides empirical evidence that a culturally based learning intervention can produce significant and meaningful improvements in children's numeracy development. These findings underscore that integrating traditional games into classroom instruction can serve as an innovative and effective strategy for enhancing the quality of early childhood education, particularly in the development of numeracy skills.

D. Interpretation of the Results

Based on these findings, the research hypothesis stating that:

"The traditional Papuan game Patah Kaleng has a significant effect on the numeracy skills of children aged 5–6 years." is accepted.

The findings demonstrate that the Patah Kaleng game produced a greater improvement in children's numeracy skills than conventional instruction without the use of the game.



The interpretation of the research findings indicates that the proposed hypothesis has been empirically supported. Based on the statistical analysis, the significance value obtained was less than 0.05, leading to the acceptance of the alternative hypothesis

(H_a). This result demonstrates that the use of the traditional Papuan game *Patah Kaleng* has a statistically significant effect on the numeracy skills of children aged 5–6 years. Therefore, it can be concluded that the intervention implemented in this study was effective in improving children's numeracy skills.

Furthermore, the findings not only demonstrate a statistically significant effect but also reveal differences in the level of effectiveness between the control and experimental groups. The experimental group, which participated in the *Patah Kaleng* game, exhibited a substantially greater improvement in numeracy skills than the control group, which received instruction without the game. This finding suggests that game-based learning is more effective than conventional teaching methods in promoting young children's cognitive development.

Conceptually, these findings can be explained through the principles of play-based learning, whereby children construct understanding through direct experiences and active interaction with their environment. The *Patah Kaleng* game provides children with opportunities to engage in concrete activities involving counting, comparing, and sequencing. These hands-on experiences enable children to develop a deeper understanding of numeracy concepts than passive instructional approaches.

In addition, traditional games possess contextual and cultural value that further enhances the learning process. Children tend to be more enthusiastic and motivated when learning through activities that are familiar, meaningful, and enjoyable. In this context, *Patah Kaleng* serves not only as a learning medium but also as a means of integrating local cultural heritage into the educational process. This finding is consistent with the principles of culturally responsive teaching, which emphasize the importance of contextual relevance in enhancing learning effectiveness.

Overall, these findings have important implications for early childhood education practices. Teachers can utilize traditional games as an innovative instructional strategy to enhance children's numeracy skills. Moreover, this study highlights the importance of developing learning models that not only prioritize academic achievement but also foster meaningful, engaging, and enjoyable learning experiences for young children.

4.2 Discussion

The findings of this study demonstrate that the use of the traditional Papuan game *Patah Kaleng* has a significant positive effect on improving young children's numeracy skills. These results are consistent with the principles of play-based learning, which emphasize that children learn more effectively through play activities involving direct experiences and social interaction. Through play, children do not merely receive information; rather, they actively construct knowledge through exploration and meaningful engagement in learning activities.

The significant improvement observed in the experimental

group can be explained by Piaget's theory of cognitive development, which posits that children aged 5–6 years are in the preoperational stage. At this stage, children are better able to understand abstract concepts, such as numbers, when they are presented through concrete experiences. In the *Patah Kaleng* game, children directly count the number of cans, compare outcomes, and understand sequences, enabling numeracy concepts to be experienced concretely rather than remaining abstract.

Furthermore, these findings also support Vygotsky's sociocultural theory, which highlights the importance of social interaction in learning. Traditional games create collaborative learning environments in which children learn through interactions with peers and teachers. Activities such as taking turns, counting together, discussing strategies, and following game rules help children internalize numeracy concepts more effectively through social interaction and language.

The findings are also consistent with previous studies by Irwanti and Azizah, which reported that traditional games such as congklak can improve children's numeracy skills. Similarly, Musi and Sugiarti found that traditional games rooted in local culture have a positive impact on children's understanding of number concepts. The consistency of these findings strengthens the evidence that traditional games have considerable potential as effective and developmentally appropriate learning media for fostering numeracy skills in early childhood.

Moreover, one of the main strengths of the *Patah Kaleng* game lies in its integration of physical and cognitive activities. Children are not only required to think but also to move, observe, and respond to different situations during the game. This combination creates a more engaging and enjoyable learning experience, thereby increasing children's overall participation and involvement. Such active engagement is a key factor contributing to the successful development of numeracy skills.

Beyond cognitive development, traditional games also contribute to children's social and emotional growth. Through the *Patah Kaleng* game, children learn to cooperate, follow rules, regulate their emotions when winning or losing, and respect their peers. These experiences foster a positive and supportive learning environment, which indirectly enhances children's readiness to learn and understand numeracy concepts. Therefore, this study confirms that traditional game-based learning is not only effective in improving numeracy skills but also supports children's holistic development. Integrating traditional games such as *Patah Kaleng* into early childhood education can thus serve as an innovative instructional strategy that enhances learning outcomes while preserving local cultural heritage and creating more meaningful learning experiences for young children.

5. Conclusion

Based on the findings of this study, it can be concluded that the use of the traditional Papuan game *Patah Kaleng* has a significant effect on the numeracy skills of children aged 5–6 years at TK UNIMUDA Alam Mentari. This conclusion is supported by the results of the paired-samples t-test, which yielded a significance value (p-value) of less than 0.05, indicating that the research hypothesis proposing a significant effect is accepted. Furthermore, the improvement in numeracy scores observed in the experimental group ($\Delta = 10.93$) was substantially greater than that of the control group ($\Delta = 3.63$), demonstrating that the *Patah Kaleng* game was more effective than conventional instruction in enhancing children's numeracy skills.

These findings suggest that game-based learning, particularly through traditional games, can improve children's numeracy skills more effectively by providing concrete learning experiences, physical engagement, and meaningful social interaction. Therefore, the *Patah Kaleng* game can serve as an innovative and contextually relevant instructional strategy for early childhood education, particularly in the development of numeracy skills.

The practical implications of this study highlight the importance of integrating traditional games into daily learning activities in early childhood education settings. In addition to improving learning outcomes, this approach can enhance children's motivation and engagement while simultaneously preserving local cultural heritage. From a policy perspective, these findings may provide valuable evidence for the development of early childhood education curricula that are more culturally responsive and grounded in play-based learning.

Nevertheless, this study has several limitations. The sample size was relatively small and limited to a single educational institution, which restricts the generalizability of the findings. Furthermore, the study employed a quasi-experimental design, meaning that the potential influence of uncontrolled external variables cannot be entirely ruled out.

Therefore, future research is recommended to employ more rigorous experimental designs with larger sample sizes across diverse educational settings. Further studies may also investigate other traditional games from different regions and examine their effects on various domains of child development. Such research would contribute to a broader understanding of culturally based learning approaches and further enrich the literature on early childhood education.

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