

The Effect of Ethnomathematics-Based LKPD Using Kite Context on Students' Learning Outcomes in Lines and Angles

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ABSTRACT. This study investigates the effect of an ethnomathematics-based LKPD using a traditional kite context on students' learning outcomes in the topic of lines and angles. The study employed a quasi-experimental design with a pretest–posttest control group design. The sample consisted of 64 students divided into an experimental group and a control group, selected through cluster random sampling. The research instrument was a multiple-choice test consisting of 20 valid and reliable items (Cronbach's Alpha = 0.836). Data were analyzed using descriptive and inferential statistics, including an independent samples t-test. The results showed that the mean score of the experimental group increased from 35.31 (pretest) to 83.75 (posttest), while the control group improved from 35.00 to 74.06. The independent samples t-test revealed a statistically significant difference between the two groups ($t = 3.087$, $p = 0.003$). Furthermore, the effect size analysis using Cohen's d yielded a value of 0.77, indicating a moderate to large effect. In conclusion, the ethnomathematics-based LKPD using a kite context has a significant and meaningful effect on improving students' learning outcomes in learning lines and angles.

Keywords: ethnomathematics; LKPD; learning outcomes; lines and angles; quasi-experimental design

ABSTRAK. Penelitian ini mengkaji pengaruh Lembar Kerja Peserta Didik (LKPD) berbasis etnomatematika dengan konteks permainan tradisional layang-layang terhadap hasil belajar siswa pada materi garis dan sudut. Penelitian ini menggunakan desain quasi-eksperimen dengan *pretest–posttest control group design*. Sampel penelitian terdiri dari 64 siswa yang dibagi ke dalam kelompok eksperimen dan kelompok kontrol yang dipilih melalui teknik *cluster random sampling*. Instrumen penelitian berupa tes pilihan ganda yang terdiri dari 20 butir soal yang valid dan reliabel (Cronbach's Alpha = 0,836). Data dianalisis menggunakan statistik deskriptif dan inferensial, termasuk uji *independent samples t-test*. Hasil penelitian menunjukkan bahwa rata-rata nilai kelompok eksperimen meningkat dari 35,31 (pretest) menjadi 83,75 (posttest), sedangkan kelompok kontrol meningkat dari 35,00 menjadi 74,06. Hasil uji *independent samples t-test* menunjukkan adanya perbedaan yang signifikan secara statistik antara kedua kelompok ($t = 3,087$; $p = 0,003$). Selain itu, analisis *effect size* (ukuran pengaruh) menggunakan Cohen's d menghasilkan nilai sebesar 0,77 yang termasuk dalam kategori sedang hingga tinggi. Sebagai kesimpulan, LKPD berbasis etnomatematika dengan konteks layang-layang memiliki pengaruh yang signifikan dan bermakna dalam meningkatkan hasil belajar siswa pada materi garis dan sudut.

Kata kunci: etnomatematika; LKPD; hasil belajar; garis dan sudut; rancangan eksperimen-semu

INTRODUCTION

Mathematical literacy has become a major global concern in education, as reflected in international assessments such as the Programme for International Student Assessment (PISA), which consistently show that students' ability to understand and apply mathematical concepts remains relatively low, particularly in geometry (Asdarina & Ridha, 2020; OECD, 2023). Geometry learning, including topics such as lines and angles, requires not only procedural fluency

but also conceptual understanding and spatial reasoning, which are essential for solving real-life problems (Kurt et al., 2023; Yuliardi & Rosjanuardi, 2021). Without a solid conceptual foundation, students tend to experience difficulties in connecting mathematical ideas and applying them in meaningful contexts.

In the Indonesian context, similar challenges are evident. The results of the Minimum Competency Assessment (Asesmen Kompetensi Minimum/AKM) indicate that many students still struggle with mathematical reasoning and conceptual understanding (Pratiwi et al., 2024; Solihin & Hindriana, 2023). One contributing factor is that mathematics learning is often delivered in an abstract and decontextualized manner, making it difficult for students to relate mathematical concepts to their daily experiences (Fauziah & Zaenuri, 2025; Gradini & Firmansyah, 2019). Consequently, students are more likely to memorize formulas rather than develop a deep understanding of the concepts being taught (Khairullah et al., 2025).

At the local level, preliminary observations conducted at Al Ulum School revealed that students' learning outcomes in the topic of lines and angles were relatively low. Interviews with teachers indicated that students had difficulties in identifying relationships between lines and angles and in applying these concepts to problem-solving situations. Furthermore, classroom observations showed that the learning process was predominantly teacher-centered, with limited opportunities for students to engage in meaningful and contextual learning activities.

To address these issues, one promising approach is the integration of ethnomathematics into mathematics learning. Ethnomathematics connects mathematical concepts with cultural practices, allowing students to learn mathematics in ways that are more meaningful and relevant to their lives (Fauziah & Zaenuri, 2025; Rosa et al., 2016; Zuhri et al., 2023). In this study, the cultural context of traditional kite games is utilized, as it inherently represents geometric concepts such as lines, angles, and symmetry (Kuswidi et al., 2021; Lestari et al., 2023). This cultural context is then integrated into a student worksheet (LKPD), which is designed to guide students through structured learning activities that promote active engagement and conceptual understanding.

Although previous studies have highlighted the potential of ethnomathematics in improving students' engagement and learning outcomes, empirical studies that specifically examine the effectiveness of ethnomathematics-based LKPD using a kite context in teaching lines and angles through a quantitative experimental design are still limited (Sigit et al., 2024). This indicates a research gap that needs to be addressed, particularly in the context of improving students' learning outcomes in geometry.

Based on these considerations, this study aims to investigate whether there is a significant difference in students' learning outcomes between those who are taught using ethnomathematics-based LKPD and those who are taught using conventional methods, to examine the extent to which the use of ethnomathematics-based LKPD influences students' learning outcomes in the topic of lines and angles, and to determine the magnitude of the effect size of the implemented learning approach.

METHODS

The research was conducted through several sequential stages, namely preparation, implementation, and data analysis. During the preparation stage, the researcher designed an ethnomathematics-based LKPD using a kite context, validated the research instruments through expert judgment, and conducted instrument trials to ensure their appropriateness (Cook & Hatala, 2016; Falani et al., 2020). Subsequently, the implementation stage began with the administration of a pretest in the first meeting to both the experimental and control groups in order to measure students' initial learning outcomes. This was followed by the treatment phase conducted over meetings two to four. In the experimental group, students observed the structure of traditional kites, identified lines and angles within the kite structure, and engaged in group

discussions to explore geometric relationships (Kuswidi et al., 2021; Lestari et al., 2023). Furthermore, they completed LKPD activities based on real-life contexts and presented as well as reflected on their findings. In contrast, the control group received conventional instruction in which the teacher explained the concepts directly, students took notes, and solved textbook problems with limited opportunities for contextual or collaborative learning (Abah, 2020; Rodríguez et al., 2022). At the end of the treatment, during the fifth meeting, both groups were given a posttest to measure students' learning outcomes after the intervention. Finally, in the data analysis stage, the collected data were analyzed using descriptive statistics, normality tests, homogeneity tests, and an independent samples t-test to determine the significance of differences between groups (Sari et al., 2023). The scoring system applied in this study followed a dichotomous approach in which each correct answer was assigned a score of 1, while each incorrect answer received a score of 0, resulting in a maximum possible score of 20 for each student (Keats, 1995; May et al., 2023). The research instrument was validated through expert judgment and empirical testing procedures. From an initial pool of 30 items, a total of 20 items were selected as valid based on the results of the validity analysis. In addition, the reliability coefficient was calculated to be 0.836, indicating a high level of reliability and confirming that the instrument was suitable for measuring students' learning outcomes (Falani et al., 2020). Further analysis of the test items was conducted by examining both the difficulty level and the discrimination index. The results showed that the items were distributed across categories of easy, medium, and difficult levels. Moreover, the discrimination index indicated that most items fell within the good to very good categories, suggesting that the instrument was effective in differentiating between students with varying levels of ability (Utama et al., 2020).

The data were analyzed using both descriptive and inferential statistical techniques. Descriptive statistics were employed to summarize the data in terms of mean, standard deviation, minimum, and maximum scores. Subsequently, the normality of the data distribution was tested using the Kolmogorov-Smirnov and Shapiro-Wilk tests, which indicated that the data were normally distributed ($p > 0.05$). The homogeneity of variance was then assessed using Levene's test, yielding a significance value of 0.262, which confirmed that the variances between groups were homogeneous. For hypothesis testing, an independent samples t-test was conducted, resulting in a t-value of 3.087 and a significance level of $p = 0.003$, indicating a statistically significant difference between the experimental and control groups. Furthermore, the magnitude of the treatment effect was calculated using Cohen's d, which yielded a value of 0.77, indicating a moderate to large effect size (Alwahaibi et al., 2020; Maksum et al., 2025).

RESULTS AND DISCUSSION

RESULTS

Descriptive Statistics

The descriptive statistics of students' learning outcomes are presented in **Table 1**. The findings of this study reveal a clear difference in learning outcomes between students who were taught using ethnomathematics-based LKPD and those who received conventional instruction. Prior to the intervention, both groups demonstrated comparable initial abilities, as indicated by the pretest mean scores of 35.31 for the experimental group and 35.00 for the control group. This similarity suggests that the two groups were equivalent at baseline, thereby strengthening the validity of subsequent comparisons.

Table 1. Descriptive Statistics of Students' Learning Outcomes

Group	N	Pretest Mean	Posttest Mean	Std. Deviation (Posttest)
Experimental	32	35.31	83.75	11.29
Control	32	35.00	74.06	13.70

In reviewing Table 1, the unequivocal comparability of initial abilities across both groups becomes profoundly apparent: the pretest mean scores, specifically 35.31 for the experimental group and 35.00 for the control group, exhibit striking similarity. After the intervention, the experimental group demonstrated a higher posttest mean score compared to the control group, indicating a greater improvement in learning outcomes.

N-Gain Analysis

To further examine the improvement in students’ learning outcomes, the normalized gain (*N-Gain*) was calculated.

Table 2. N-Gain Scores

Group	N-Gain	Category
Experimental	0.75	High
Control	0.60	Medium

In this context, the analysis of the results clearly indicates the experimental group's attainment of a superior level of improvement (0.75, categorized as high) compared to the control group (0.60, categorized as medium), thus underscoring the profound efficacy of the ethnomathematics-based LKPD in the enhancement of learning outcomes.

Inferential Analysis

Prior to hypothesis testing, the assumptions of normality and homogeneity were examined. The results indicated that the data were normally distributed ($p > 0.05$) and that the variances between groups were homogeneous ($p = 0.262$), satisfying the requirements for parametric testing.

Table 3. Independent Samples t-Test Results

t-value	df	Sig. (2-tailed)	Mean Difference
3.087	62	0.003	9.688

Undoubtedly, the conducted independent samples t-test unequivocally demonstrated a statistically significant and undeniably crucial divergence between the experimental and control groups ($p < 0.05$); this pivotal finding decisively evidences the profound enhancement of students' learning outcomes achieved through the judicious implementation of ethnomathematics-based LKPD.

Effect Size

To determine the magnitude of the treatment effect, Cohen’s *d* was calculated, yielding a value of 0.77, which is categorized as a moderate to large effect. This finding indicates that the intervention not only produced statistically significant results but also had meaningful practical implications. The effect size value of 0.77 indicates that the ethnomathematics-based LKPD had a substantial impact on students’ learning outcomes, reinforcing the practical importance of the findings.

DISCUSSION

The findings of this study demonstrate that the use of ethnomathematics-based LKPD significantly improves students’ learning outcomes in the topic of lines and angles. The higher posttest mean scores and N-Gain values in the experimental group indicate that integrating cultural contexts into learning can enhance students’ understanding of mathematical concepts (Hartoyo et al., 2025).

One plausible explanation for this improvement is the contextual nature of ethnomathematics, which connects abstract mathematical concepts to students’ real-life experiences (Hartanti & Ramlah, 2021; Sunzuma et al., 2021). By using the traditional kite context, students were able to visualize geometric concepts such as lines and angles more

concretely, thereby facilitating deeper understanding (Kuswidi et al., 2021; Lestari et al., 2023). This finding is consistent with constructivist learning theory, which posits that knowledge is actively constructed through meaningful experiences (Fouze & Amit, 2018; Sunzuma & Maharaj, 2020).

Furthermore, the structured use of LKPD provided guided learning experiences that encouraged students to actively engage in the learning process. Through observation, discussion, and problem-solving activities, students were able to construct their own understanding, which aligns with the principles of *Contextual Teaching and Learning* and *scaffolding* approaches (Calvani et al., 2023; Ramadhani et al., 2023). These approaches emphasize gradual support and contextualization in learning, which are critical in developing conceptual understanding.

The relatively high N-Gain value (0.75) obtained by the experimental group further confirms the effectiveness of the intervention. Compared to the control group (0.60), this difference suggests that culturally relevant learning materials can significantly enhance students' learning performance (Hartoyo et al., 2025) (Hartoyo et al., 2025; Wirawan et al., 2024). Additionally, the effect size ($d = 0.77$) indicates that the impact of the ethnomathematics-based LKPD is not only statistically significant but also practically meaningful in educational settings.

These findings are in line with previous studies that highlight the effectiveness of ethnomathematics in improving students' engagement and learning outcomes, with meta-analyses showing strong positive effect sizes ranging from 0.94 to 1.22 (Apriatni & Nindiasari, 2022; Putri et al., 2024; Wirawan et al., 2024). However, this study contributes to the existing literature by specifically integrating the kite context into LKPD and examining its effectiveness using a quantitative experimental design.

Despite these positive findings, several limitations should be acknowledged. First, the study was conducted in a single school with a relatively small sample size, which may limit the generalizability of the results. Second, the duration of the intervention was relatively short, which may have introduced a *novelty effect* where participants show increased enthusiasm simply due to the new experience (Taber, 2019; Weber et al., 2023). Third, the use of multiple-choice tests may not fully capture students' deeper conceptual understanding, as students might select correct answer. Therefore, future research is recommended to involve larger and more diverse samples, longer intervention periods, and more comprehensive assessment instruments.

CONCLUSION

Undoubtedly, through the focused demonstration of the profound utility inherent in ethnomathematics-based LKPD, particularly when robustly framed within a traditional kite context, a significant and measurable effect on students' learning outcomes within the critical domain of linear and angular relationships has been clearly observed. The experimental group showed higher improvement compared to the control group, as compellingly indicated by several metrics: the posttest mean scores (83.75 vs. 74.06), a statistically significant difference ($p = 0.003$), a high N-Gain (0.75), and a moderate to large effect size (Cohen's $d = 0.77$). These findings unequivocally affirm that the integration of cultural context into mathematics learning can foster a truly meaningful enhancement of student achievement. From a practical perspective, we can therefore assert that teachers must utilize ethnomathematics-based LKPD as an instrument of crucial pedagogical efficacy, designed to render abstract mathematical concepts more tangible and accessible. The strategic implementation of culturally relevant contexts, exemplified by structures like traditional kites, is critical to catalyzing profound student engagement and deepened conceptual understanding, particularly within the challenging domain of geometry. For future scholarly endeavors, it is imperative that researchers prioritize several strategic considerations for comprehensive inquiry: 1. Conduct studies with larger and more diverse samples, ensuring broader generalizability. 2. Implement extended intervention periods, judiciously designed to minimize potential novelty effects. 3. Employ a wider array of assessment

instruments, including qualitative, open-ended tasks, to holistically apprehend the intricate nuances of students' conceptual understanding.

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