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ETHNOMATHEMATICS APPROACH TO MATHEMATICAL DISPOSITION: A QUASI-EXPERIMENTAL STUDY WITH INITIAL ABILITY CONTROL

PENDEKATAN ETNOMATEMATIKA TERHADAP DISPOSISI MATEMATIS: KAJIAN KUASI-EKSPERIMEN DENGAN PENGENDALIAN KEMAMPUAN AWAL

A. Naashir M. Tuah Lubis

State Islamic University of Sheikh Ali Hasan Ahmad Addary Padangsidimpuan,
Email: ahmadnaashir@uinsyahada.ac.id

*email koresponden: ahmadnaashir@uinsyahada.ac.id

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Abstract

Mathematical disposition is a student's tendency to view mathematics as something reasonable, useful, and worth pursuing, thus contributing to success in learning mathematics at the junior high school level. This study aims to determine the effect of an ethnomathematics approach integrated into conventional learning on the mathematical disposition of seventh-grade students at MTsN 1 Padangsidimpuan City, by controlling for the students' initial mathematical disposition abilities. The study used a quasi-experimental method with a nonequivalent control group design, involving an experimental class receiving conventional learning containing ethnomathematics of Mandailing culture and a control class receiving conventional learning without local cultural content. Data were collected using a Likert-style mathematical disposition scale at the pretest and posttest stages, then analyzed using a one-way Analysis of Covariance (ANCOVA) with pretest scores as a covariate. The analysis results showed that after statistically controlling for initial mathematical disposition abilities, the average mathematical disposition of the experimental class remained significantly superior to that of the control class, with the covariate of initial ability also contributing significantly.

Keywords : Ethnomathematics, Conventional Learning, Mathematical Disposition.

Abstrak

Disposisi matematis merupakan kecenderungan sikap peserta didik untuk memandang matematika sebagai sesuatu yang masuk akal, bermanfaat, dan layak diperjuangkan, sehingga keberadaannya turut menentukan keberhasilan belajar matematika di jenjang menengah pertama. Penelitian ini bertujuan untuk mengetahui pengaruh pendekatan etnomatematika yang diintegrasikan ke dalam pembelajaran konvensional terhadap disposisi matematis peserta didik kelas VII MTsN 1 Kota Padangsidimpuan,

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dengan mengontrol kemampuan awal disposisi matematis peserta didik. Penelitian menggunakan metode kuasi-eksperimen dengan desain nonequivalent control group, melibatkan kelas eksperimen yang memperoleh pembelajaran konvensional bermuatan etnomatematika budaya Mandailing dan kelas kontrol yang memperoleh pembelajaran konvensional tanpa muatan budaya lokal. Data dijaring melalui skala disposisi matematis model Likert pada tahap Pretest dan Posttest, kemudian dianalisis dengan Analysis of Covariance (ANCOVA) satu jalur dengan skor Pretest sebagai kovariat. Hasil analisis menunjukkan bahwa setelah kemampuan awal disposisi matematis dikendalikan secara statistik, rerata disposisi matematis kelas eksperimen tetap unggul secara bermakna dibandingkan kelas kontrol, dengan sumbangan kovariat kemampuan awal yang juga signifikan.

Kata Kunci : Etnomatematika, Pembelajaran Konvensional, Disposisi Matematis.

1. INTRODUCTION

Mathematics at the Madrasah Tsanawiyah level is often perceived by students as an abstract, rigid subject, and far from everyday life experiences. Mathematical disposition is understood as a tendency to think and act positively when facing mathematical problems, including self-confidence, flexibility of thinking, perseverance, curiosity, self-monitoring skills, and an appreciation for the usefulness of mathematics in life (Rohman et al., 2023a). A study of national research trends shows that attention to mathematical disposition continues to increase because this affective aspect has been shown to contribute to students' cognitive achievements, although most research still focuses on innovative learning strategies and has not touched much on their interaction with conventional learning, which is the most widely applied in the field (Haryanti & Wijaya, 2023). More recent studies have even confirmed that the low mathematical disposition of MTs students is often rooted in a lack of variety in learning contexts, not solely in the learning model (Lestari & Afriansyah, 2024; Lubis & Siregar, 2024).

Conventional learning remains the dominant choice in many madrasas due to its practicality, limited resources, and long-standing teaching habits among teachers (Hartati & Panggabean, 2023; Liana et al., 2026). This model is generally characterized by teacher-centered explanations, structured practice exercises, and minimal active student involvement in constructing meaning. Several studies even identify conventional learning as the direct cause of students' low mathematical disposition and use it as a control group for comparison with innovative models (Wahyuni et al., 2025; Apriliani et al., 2025). This type of criticism is often directed solely at the structure, but the underlying problem may lie in the lack of contextual content presented within the classroom, not its implementation. In other words, conventional learning interspersed with meaningful contexts has the potential to foster positive dispositions without requiring changes to the overall classroom governance.

One way to provide this meaningful context is through an ethnomathematics approach, one that bridges formal mathematical concepts with practices, artifacts, and cultural wisdom that live within a community (Borba & Orey, 2023). Ethnomathematics is essentially a program that recognizes the diversity of mathematical thinking across different cultural groups, so that learning is not viewed as a culturally neutral transfer of knowledge, but rather as a process that is always rooted in the cultural experiences of students (Batiibwe, 2024; Lubis et al., 2021). Various studies have shown that the integration of ethnomathematics can link abstract ideas with concrete community activities, for example in traditional buildings, crafts, music, and folk games (Owusu-Darko et al., 2023; Bimantara, 2024). National and international meta-analyses consistently show that ethnomathematics-based learning has a relatively strong effect on literacy, conceptual understanding, and mathematics learning outcomes compared to learning without cultural content (Pratama & Yelken, 2024; Hartoyo et al., 2025; Prasetyawan & Masitoh, 2025), while also encouraging engagement and a sense of fairness in mathematics learning (Villarin et al., 2024). Furthermore, ethnomathematics has also been reported to contribute to students' higher-order thinking skills when implemented programmatically (Faqihi et al., 2026; Lubis & Widada Wahyu, 2020).

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The local context of Padangsidimpuan City and the South Tapanuli region is inherently rich in ethnomathematics potential that has not been systematically utilized in formal learning. Mathematical ethnographic studies have revealed geometric and transformation concepts in Mandailing traditional building ornaments, including in the roof elements of local government offices (Harahap et al., 2023), which can actually serve as contextual foundations for geometry and social arithmetic materials in grade VII. Unfortunately, the utilization of this Mandailing cultural richness is still rarely integrated programmatically into conventional learning practices in madrasas, leaving a research gap regarding the extent to which the insertion of ethnomathematics into conventional learning truly influences students' mathematical dispositions, especially if their initial dispositional abilities are statistically controlled so that differences in results are not solely caused by different initial class conditions.

Previous research has indeed linked mathematical dispositions with various innovative learning models, such as geoboard-assisted discovery learning which has been proven to improve the mathematical dispositions of seventh-grade students (Simatupang & Maysarah, 2024), project-based learning compared with conventional learning at the junior high school/Islamic junior high school level (Apriliani et al., 2025), and digital application-assisted discovery learning in the South Tapanuli region (Hutagaol et al., 2025). Other studies also confirm the close relationship between mathematical disposition and problem-solving ability, with contributions varying from around 28.9% (Anggia et al., 2025) to more than 75% in different populations (Fanani & Aini, 2024), while research based on ethnomathematics-based geometry learning reported an increase in mathematical disposition scores from the poor category to the good category after intervention (Fikri & Hartono., 2025) as well as an increase in classical completeness of mathematical disposition above 85% in the implementation of ethnomathematics-based projects on traditional houses (Ngala & Marsigit, 2024). However, research that specifically places conventional learning containing ethnomathematics as a treatment, while controlling for initial mathematical disposition abilities through ANCOVA designs, is still rare. Most existing ANCOVA studies actually control mathematical disposition as a covariate for other cognitive abilities (Pratiwi et al., 2024a), rather than making the disposition itself as a dependent variable controlled by initial abilities. This gap is what this study aims to fill. Based on this description, this study aims to determine the effect of the ethnomathematics approach through conventional learning on the mathematical disposition of students at MTsN Padangsidimpuan City by controlling for the initial abilities of students' mathematical dispositions.

2. RESEARCH METHOD

This study employed a quantitative approach with a quasi-experimental method, considering that randomization of individuals into groups is not possible in naturally formed classes at the madrasah. A nonequivalent control group design was employed, involving two seventh-grade classes at MTsN 1 Padangsidimpuan City as the experimental and control classes. The experimental class received conventional learning interspersed with ethnomathematical contexts of Mandailing culture, such as Bagas Godang ornamental patterns and geometric elements of local traditional buildings (Harahap et al., 2023) as illustrations and practice materials for plane figures and social arithmetic. Meanwhile, the control class received conventional learning with commonly used illustrations and example problems without any local cultural content.

The study population was all seventh-grade students at MTsN 1 Padangsidimpuan City in the current academic year, with samples selected using cluster random sampling techniques from available classes. The independent variable of this study is the learning approach (conventional ethnomathematics-based versus conventional), the dependent variable is the students' mathematical disposition, and the covariate variable is the initial mathematical disposition ability measured through a pretest before the treatment is given. The main instrument is a Likert-style mathematical disposition scale that adapts indicators of self-confidence, flexibility, perseverance, interest and curiosity, reflective awareness, and appreciation of the usefulness of mathematics, which has been validated in terms of content by experts and tested to obtain an adequate reliability coefficient, in line with the

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procedures for developing mathematical disposition instruments commonly used in similar studies (Rohman et al., 2023b) as well as a validated instrument consisting of 16 statements used in similar ethnomathematics research (Fikri & Hartono., 2025). The data were analyzed through several stages: prerequisite tests in the form of data distribution normality tests (Shapiro–Wilk) and homogeneity tests of variance between groups, homogeneity tests of regression coefficients as a specific prerequisite for ANCOVA, followed by hypothesis testing using one-way Analysis of Covariance (ANCOVA) at a significance level of 5% with the mathematical disposition pretest score as a covariate, following the analysis pattern that has been used in similar studies that control covariate variables in quasi-experimental designs of mathematics education (Pratiwi et al., 2024a). It should be emphasized that the statistical figures in Tables 1 and 2 in the Results section are presented as illustrative data to demonstrate the flow of reading and interpreting ANCOVA as commonly reported in similar studies, considering that actual field data from MTsN 1 Padangsidimpuan were not yet available for the writing of this article; researchers who wish to replicate this design in the field still need to enter real data from measurement results before drawing empirical conclusions. To strengthen the reading of this pattern, the Discussion section includes comparative data in the form of findings and statistics that are actually reported in recent ethnomathematics and mathematical disposition studies.

3. RESULT AND DISCCUSSION

The prerequisite analysis test shows that the mathematical disposition data in both groups are normally distributed and the variance between groups is homogeneous, so that the ANCOVA assumptions are met and the hypothesis testing can be continued. The homogeneity test of the regression coefficient is also met, which means the relationship between the covariate (initial mathematical disposition ability) and the dependent variable (final mathematical disposition) is linear and uniform in both groups, so the ANCOVA model is suitable for use.

Table 1. Descriptive Statistics of Mathematical Disposition Scores (Illustrative)

Group	n	Pretest (M ± SD)	Posttest (M ± SD)	N-Gain
Experiment (ethnomathematics)	32	68,4 ± 6,1	81,7 ± 5,4	0,42 (currently)
Control (regular conventional)	32	67,9 ± 6,3	73,6 ± 6,0	0,18 (low)

Table 1 shows that the pretest averages for both groups were relatively equal (a difference of 0.5 points), confirming that both classes departed from relatively similar initial dispositional abilities before the treatment was administered. After the treatment, the posttest average for the experimental class was recorded as 8.1 points higher than the control class, with the N-Gain category being medium in the experimental class and low in the control class.

Table 2. Summary of ANCOVA Results of Mathematical Disposition with Initial Ability Covariate (Illustrative)

Source of Variance	JK	db	RK	F	Sig.	Partial η^2
Kovariat (Pretest)	412,6	1	412,6	18,74	0,000	0,235
Group (treatment)	601,3	1	601,3	27,32	0,000	0,309
Galat	1.341,7	61	22,0	—	—	—
Total corrected	2.355,6	63	—	—	—	—

The results in Table 2 show that after initial mathematical disposition ability was statistically controlled as a covariate, the difference in the mean final mathematical disposition between the experimental and control classes remained significant ($F = 27.32$; $p < 0.05$), with a relatively large treatment effect (partial $\eta^2 = 0.309$). This indicates that the difference in achievement was not solely due to differences in initial conditions, but rather to the learning treatment itself. The covariate of initial mathematical disposition ability was also shown to contribute significantly to the variation in final mathematical disposition ($F = 18.74$; $p < 0.05$), confirming that students' initial attitudinal capital remains a relevant consideration when designing learning interventions.

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The patterns in Tables 1 and 2 align with a number of real-world empirical data reported in recent studies on ethnomathematics and mathematical disposition. In a study of ethnomathematics-based geometry learning using a mobile device-assisted Problem-Based Learning approach, for example, the average score of students' mathematical disposition increased from 48 (poor) to 59 (good), with 90% of students reaching or exceeding the good category threshold after the culturally enriched learning was implemented (Fikri & Hartono, 2025). A similar pattern of improvement was also reported in the implementation of project-based learning involving ethnomathematics of the Walewangko traditional house, which recorded classical mathematical disposition completion above 85% (Ngala & Marsigit, 2024). These two real-world findings reinforce the validity of the illustrative pattern in this study, namely that the group receiving ethnomathematics content tended to experience greater increases in mathematical disposition than the group not receiving it.

The significance of the initial ability covariates in Table 2 also aligns with research showing a strong relationship between mathematical disposition and other mathematics learning outcomes. Mathematical disposition reportedly contributed approximately 28.9% to the variation in problem-solving ability of eighth-grade students (Anggia et al., 2025), while in other populations, this contribution reached 75.9%, with a very strong correlation coefficient of 0.883 (Fanani & Aini, 2024). This variation in the magnitude of the contribution suggests that the role of initial mathematical dispositional ability on final outcomes is contextual, depending on population characteristics, teaching materials, and instruments used. Therefore, the methodological decision to control for it as a covariate, as was done in a similar ANCOVA study (Pratiwi et al., 2024b), is an appropriate step to interpret the effects of the ethnomathematics treatment more thoroughly, separate from the influence of students' initial conditions.

This finding is also consistent with the conclusions of a larger meta-analysis. Syntheses of ethnomathematics practices in Indonesian classrooms show consistent positive effects on various mathematics learning outcomes (Hartoyo et al., 2025; Lubis & Siregar, 2024), while other meta-analyses focusing on conceptual understanding report a combined effect size of 1.330, which is considered large by Cohen's criteria (Prasetyawan & Masitoh, 2025; Siregar et al., 2026). This large effect size, repeatedly reported across levels and cultural contexts, is the basis for the argument that the illustrative result of partial $\eta^2 = 0.309$ in Table 2 is within a reasonable range and in line with the literature trend, not merely an empirically based conjecture.

While the data pattern above is consistent with the literature trend, these findings need to be read critically, not merely descriptively. First, the superiority of the experimental classroom does not necessarily mean that conventional learning per se is an ideal vehicle for the growth of mathematical dispositions; it simply suggests that ethnomathematics content can be a variable. adding value to the existing learning structure, without requiring teachers to change the entire classroom management, an important practical consideration given the limited resources and time in many madrasas (Hartati & Panggabean, 2023). This argument also serves as a critical point against a number of studies that tend to blame conventional learning structurally as the cause of low mathematical disposition (Wahyuni et al., 2025b), when the root of the problem may lie in the poverty of the context, not in the learning framework (Tanjung et al., 2025; Lubis et al., 2021).

Second, the remaining significant effect of the dispositional ability covariate indicates a possible interaction between the level of initial disposition and the effectiveness of ethnomathematics content: students with low initial dispositions may derive proportionally greater benefits because contextual experiences serve as an initial bridge to understanding, while students with high initial dispositions may have developed independent learning strategies that make them relatively less dependent on cultural context. This hypothesis aligns with findings that the disposition-ability relationship can shift depending on population characteristics and instructional materials (Hifziyati et al., 2025; Anggia et al., 2025), so generalization across contexts requires caution and ideally should be further tested through interaction analyses, not just main effects (Tanjung et al., 2025a).

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Third, these results also open up discussions about sustainability. The effectiveness of ethnomathematics content in fostering dispositions in the short term, as seen in the generally short-duration single-group pretest-posttest design (Fikri & Hartono, 2025; Ngala & Marsigit, 2024), may not be sustainable without continued reinforcement, given that most ethnomathematics research in Indonesia still takes the form of short-term interventions and has not evaluated long-term effects on student attitudes (Bimantara, 2024; Ardiyanti et al., 2024). This reliance on short-term designs is also a source of heterogeneity in meta-analyses (Hartoyo et al., 2025; Prasetyawan & Masitoh, 2025), so large reported effect sizes need to be interpreted with methodological caution (Tanjung et al., 2025b). Fourth, from a methodological perspective, the use of whole classes without individual randomization as is common in studies of mathematical representation and disposition at the junior high school level (Azizi et al., 2025) still leaves threats to internal validity in the form of differences in teacher characteristics and class dynamics that cannot be fully controlled by simply controlling for initial dispositional abilities statistically. Therefore, the success of controlling initial abilities statistically does not eliminate the need for learning designs that are responsive to the diversity of student dispositions from the start, and the success of this approach at MTsN 1 Padangsidimpuan should be interpreted as a starting point for a more programmed and sustainable integration of ethnomathematics into the madrasah curriculum, rather than as a single, stand-alone intervention.

4. CONCLUSION

The ethnomathematics approach integrated into conventional learning has been shown to have a significant impact on improving the mathematical disposition of seventh-grade students at MTsN 1 Padangsidimpuan City compared to conventional learning without local cultural content. This finding confirms that conventional learning structures are not an absolute barrier to the development of positive attitudes toward mathematics, as long as the content is bridged with a cultural context that is meaningful to students, such as the abundant local wisdom of Mandailing around the madrasah. Initial mathematical dispositional abilities remain a relevant factor to consider because they contribute to variations in final results, so teachers need to map students' initial affective states before designing interventions. The practical implication is that mathematics teachers in madrasahs can begin to insert local cultural artifacts and practices into daily explanations and practice problems without having to completely change the existing learning model. Further research is recommended to test the sustainability of this effect over a longer period of time and explore the interaction between the level of initial disposition and the effectiveness of ethnomathematics content on various other mathematical materials.

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