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Ethnomathematics in Improving Students' Concept Understanding: A Meta-Analysis

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ABSTRAK

Abstrak: Pembelajaran matematika dengan konsep budaya lokal atau yang disebut dengan etnomatematika merupakan suatu strategi untuk mengajarkan siswa dalam pembelajaran matematika yang selama ini dianggap menakutkan. Etnomatematik artinya studi matematika yang mempertimbangkan budaya dimana matematika timbul dan merupakan pendekatan yang digunakan untuk mengungkapkan korelasi antara budaya lingkungan dan matematika. Penelitian ini bertujuan untuk mengetahui peningkatan pemahaman konsep matematika siswa dengan pembelajaran berbasis etnomatematika. Metode dalam penelitian ini menggunakan meta-analisis. Data dianalisis menggunakan perangkat lunak JASP dengan inputan nilai Effect Size (ES) dan Standard Error (SE). Hasil penelitian menunjukkan bahwa 38 data yang memenuhi keriteria diperoleh peningkatan sebesar 53%. Pada jenjang SD dengan data sebanyak (N) 13 ditemukan pemahaman konsep siswa mengalami peningkatan sebesar 29%, pada jenjang SMP dengan data sebanyak (N) 18 ditemukan pemahaman konsep siswa mengalami peningkatan sebesar 0.41 atau 41%, dan pada jenjang SMP dengan data sebanyak (N) 9 ditemukan peningkatan sebesar 0.25 atau 25%. Berdasarkan data yang diperoleh bahwa pembelajaran berbasis etnomatematika dalam meningkatkan pemahaman konsep belajar siswa lebih berpengaruh pada jenjang SMP yaitu sebesar 41%.

Keywords:
Ethnomathematics, Concept understanding, Meta analysis.

Abstract: *Learning mathematics with the concept of local culture or what is called ethnomathematics is a strategy to teach students in learning mathematics which has been considered scary. Ethnomathematics means the study of mathematics that considers the culture in which mathematics arises and is an approach used to reveal the correlation between environmental culture and mathematics. This study aims to determine the improvement of students' understanding of mathematical concepts with ethnomathematics-based learning. The method in this study uses meta-analysis. Data were analyzed using JASP software with the input of Effect Size (ES) and Standard Error (SE) values. The results showed that 38 data that met the criteria obtained an increase of 53%. At the elementary level with data as much as (N) 13, it was found that students' concept understanding had increased by 29%, at the junior high school level with data as much as (N) 18, it was found that students' concept understanding had increased by 0.41 or 41%, and at the junior high school level with data as much as (N) 9, an increase of 0.25 or 25% was found. Based on the data obtained, ethnomathematics-based learning in improving students' understanding of learning concepts is more influential at the junior high school level, namely 41%.*

A. INTRODUCTION

Mathematics is one of the components of a series of subjects that have an important role in education which is studied from elementary school to university level, this is because mathematics has a very crucial role in everyday life and technological development, and can train logical, critical and creative thinking (Witha et al., 2021). Mathematics is a compulsory subject for students. Therefore, every student is required to learn it, both in formal and non-formal education (Herdian et al., 2019). Providing math learning to children will certainly train children to develop their ability to think logically, systematically, and creatively (Fauzi & Setiawan, 2020). Given that ethnomathematics links math and culture.

Mathematics in Ethnomathematics is one solution to a form of meaningful mathematics learning, through this Ethnomathematics approach it can be a solution for students in understanding mathematics learning that has ideas that can enrich existing knowledge in mathematics (Badrullah, 2020). in mathematics learning, cultural knowledge is an important thing that can be used as meaningful mathematics learning. by presenting the contexts of community habits or local wisdom that apply in the student environment, it will place mathematics as a science that plays a very important role in life and is interesting to learn (Nur Azmi, 2022). In this regard, mathematics cannot be separated from local culture because in a culture it is not uncommon to contain mathematical concepts, which are applied in life for generations, this is the background for the birth of ethnomathematics (Fatmawati, 2020).

Success in learning mathematics can be seen from students' mastery of concept understanding. According to Azmi & Rosdiana (2022), the main goal of learning mathematics, because mathematics is the relationship between one concept and another, understanding mathematical concepts provides an understanding that in learning mathematics, a person or student does not just memorize the formula of the mathematics material studied, but is able to understand the concept of the subject matter itself (Ma'rufi, 2018).

Research on ethnomathematics in improving concept understanding has been carried out by many researchers, namely at the elementary stage (Farokhah et al., 2017; Mulyasari et al., 2021; Putri & Agustika, 2022; Sutarto et al., 2022) at the junior high school stage (Darma et al., 2021; Derawi et al., 2021; Mutaqin et al., 2021; Sari et al., 2021) and at the high school stage (Andriani & Septiani, 2020). According to Miftakhudin et al. (2019) stated that ethnomathematics-based learning in improving concept understanding was obtained as much as 82.7%, Ajmain et al. (2020) in their research stated that the level of understanding of student learning increased by 82.35%. Furthermore, Mutaqin et al. (2021) & Vevi M. P et al. (2018) revealed that at the junior high school level using ethnomathematics-based learning, the level of understanding of student concepts increased, namely, 17.00% and 3.62% respectively.

Finally, at the high school level, something similar also happened, at the high school level as stated by Andriani & Septiani (2020), 3.03% was obtained in the application of ethnomathematics-based learning to improve students' concept understanding ability.

In addition, several studies on ethnomathematics-based learning in improving students' understanding of concepts in mathematics have been carried out, such as according to researchers Agusdianita & Karjiyati (2021), Nugraha et al. (2020) respectively increased by 3.19% and 34.58% Tyaningsih et al (2020) that it was obtained by 88.89%. In addition, research on ethnomathematics-based learning in improving students' concept understanding in the field of mathematics has been carried out a lot, such as in the field of Geometry conducted by Narita et al. (2022) obtained by 2.553% Rizal et al. (2021) obtained by 3.28%. the geometry field on straight line material Hikmah & Nengsih (2021) obtained 2.424%, in the algebraic field on SPLDV material the percentage obtained was 35% (Prabawati et al., 2019). so that ethnomathematics-based learning can improve students' concept understanding.

The results of the above studies show that there is an effect of ethnomathematics-based learning in improving students' concept understanding. So the purpose of this study is the impact of ethnomathematics in improving concept understanding. Hopefully in the future there will be further researchers who discuss the effect of ethnomathematics-based learning in improving students' overall understanding of concepts.

B. METHODS

In this study, researchers used meta-analysis. Meta-analysis is a statistical technique for combining the results of 2 or more similar studies so that a quantitative blend of data is obtained. Metaanalysis is a quantitative analysis and uses a considerable amount of data and applies statistical methods by practicing them in organizing a number of information (Wati, 2022). The research was conducted by researchers by summarizing research data, reviewing and analyzing data from several previous studies (Mandailina et al., 2021).

The next stage is determining the inclusion and exclusion criteria used in the literature search, including similar research related to the development of ethnomathematics in learning media, and the results of research have been published in international journals relevant to ethnomathematics and concept understanding, reference articles published in 2018-2022, the use of language in articles used in Indonesian or English.

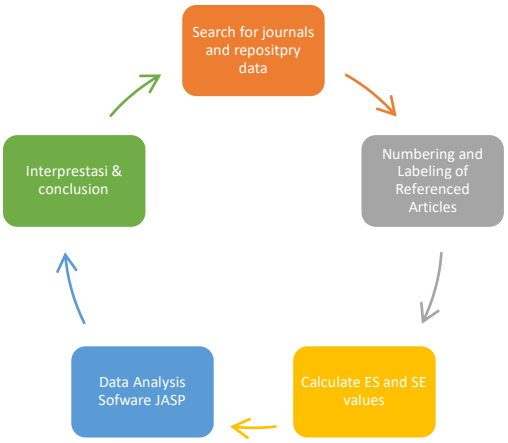


Figure 1. Research Flow Diagram

1. Searching Google Shcolar indexing database articles (https://scholar.google.com/) DOAJ (https://doaj.org/) Portal Garuda (https://garuda.kemdikbud.go.id/) , dan Scopus (https://ww.scopus.com/home.url) .
2. Coding and tabulating in Microsoft Excell including year of publication, author's name, research type, learning method, media/software, material, focus area, level, grade, N-value, F-count, t-count and r-count.
3. Convert F and t values to r values with the formula:

$$F = t^2 \quad (1)$$

$$t = \sqrt{F} \quad (2)$$

$$r = \frac{t}{\sqrt{t^2+N-2}} \quad (3)$$

Based on classical value

ES = Converted to decimal (4)

$$SE = \sqrt{\frac{ES\ (1-ES)}{N}} \quad (5)$$

Based on the correlation coefficient value

$$ES = 0{,}5 \times \ln \frac{1+r}{1-r} \quad (6)$$

$$SE = \sqrt{\frac{1}{N-3}} \quad (7)$$

4. Perform simulation and data analysis using JASP software.
5. Analyze the results found from the articles referenced in the data.
6. Draw conclusions from the research results.

The Effect Size (ES) intervals and categories can be presented as in Table 1.

Tabel 1. Classification of Glass's effect sizes

No	Interval	Category
1	< 0.15	Negligible
2	0.15 – 0.40	Minor effect
3	0.40 – 0.75	Moderate effect
4	0.75 – 1.10	High effect
5	1.10 – 1.45	Very high effect
6	> 1.45	Extraordinary

Table 1 presents an interval that shows the value category of the effect size to determine the size of the practical significance of the research results as a measure of the magnitude of a correlation or difference between one variable and another. For bias publication, the criterion is if the rank-test p-value is greater than 0.001 (p-value> 0.001), then the data used in this study is indicated to be biased.

C. RESULTS AND DISCUSSION

In this study, the data selection process was carried out systematically to ensure the eligibility of the articles being analyzed. This stage aims to obtain data that is relevant and meets the predetermined criteria in order to produce valid and accurate findings.

1. Data Selection Results

Identified from the results of searching articles through the database, a total of 53 data were obtained. Of the 53 articles that were then filtered again based on the criteria, so that 9 articles were obtained that were incomplete from the statistical data such as 9 articles did not include the number of students, but each percentage of indicators was listed. Thus, only 38 articles are complete and according to the eligibility criteria of the 53 articles that have been collected. The results of the calculation of the Effect Size (ES) and Standard Error (SE) values calculated manually with Microsoft Excel can be seen in Table 2.

Tabel 2. ES and SE calculation results

No	Year	Level	N	ES	SE
Study 1	2021	Mahasiswa	90	0,30952	0,107211
Study 2	2020	SD	59	0,016271	0,133631
Study 3	2020	SD	60	0,24572	0,132453
Study 4	2022	SD	32	0,029688	0,185695
Study 5	2017	SD	76	0,307045	0,117041
Study 6	2019	SD	35	0,009143	0,176777
Study 7	2021	SD	13	0,064615	0,316228
Study 8	2021	SD	13	1,562771	0,316228
Study 9	2023	SD	31	0,457909	0,188982
Study 10	2022	SD	183	0,165591	0,074536
Study 11	2022	SD	37	0,017027	0,171499
Study 12	2023	SD	65	0,010308	0,127

No	Year	Level	N	ES	SE
Study 13	2019	SD	75	0,707226	0,117851
Study 14	2022	Sd	30	0,644278	0,19245
Study 15	2020	SMP	20	0,032	0,242536
Study 16	2019	SMP	46	0,196228	0,152499
Study 17	2020	SMP	17	0,055294	0,267261
Study 18	2022	SMP	5	0,166	0,707107
Study 19	2021	SMP	29	0,025172	0,196116
Study 20	2022	SMP	25	0,0292	0,213201
Study 21	2021	SMP	60	0,313144	0,132453
Study 22	2019	SMP	25	0,0332	0,213201
Study 23	2020	SMP	30	0,027667	0,19245
Study 24	2019	SMP	29	0,028276	0,196116
Study 25	2021	SMP	56	1,575611	0,137361
Study 26	2022	SMP	20	0,392866	0,242536
Study 27	2017	SMP	50	0,15396	0,145865
Study 28	2019	SMP	26	0,610482	0,208514
Study 29	2019	SMP	60	0,005833	0,132453
Study 30	2020	SMP	34	2,132288	0,179605
Study 31	2022	SMP	18	0,045556	0,258199
Study 32	2018	SMP	30	0,012067	0,19245
Study 33	2019	SMP	80	1,568514	0,113961
Study 34	2020	SMA	41	0,467925	0,162221
Study 35	2020	SMA	20	0,016	0,242536
Study 36	2020	SMA	24	0,398698	0,218218
Study 37	2021	SMA	9	0,092222	0,408248
Study 38	2021	SMA	24	0,032083	0,218218

Based on Table 2 above which contains 38 eligible data. Divided into 4 levels, 13 data from elementary school level, 18 data from junior high school level, 5 data from high school level, and 1 data from university level.

2. Ethnomathematics in Improving Concept Understanding

Furthermore, researchers conducted simulations using JASP software to see the effect of Ethnomathematics learning in improving students' concept understanding according to data characteristics, correlation coefficient values, p-Rank tests, and forest plot values, as shown in Table 3.

Table 3. Results of Meta-Ethnomathematics Analysis on Concept Understanding

Category	N	Q_{RE}	Coefficient	Category	I^2 (%)	p-Rank Test	Forest Plot
Ethnomathematics improves concept understanding	38	385.963	0.086	Cukup	90.122	<.001	0.35 [0.18, 0.52]

Based on Table 3, it can be seen that the overall effect of ethnomathematics-based learning with 38 data has an increase of 53.3% so that H0 is accepted and data variation can also be accepted (heterogeneous), the estimate coefficient value is 0.086 with a p-value of <0.001, meaning that the significance value of 5% or 0.05 is greater than the p-value, this means that H0 is rejected, so it is known that the effect size is not equal to zero, or it can be concluded that ethnomathematics-based learning has an effect on increasing students' concept understanding abilities with a moderate category. In the Forrest Plot value of 0.35 [0.18, 0.52] or it can be said that the summary effect is 0.53 or 53% this value explains that the average effect of ethnomathematics-based learning is moderate. From the above results, it explains that ethnomathematics-based learning has an effect on students' concept understanding.

3. Effect of Ethnomathematics Learning Based on Level

At this stage, the author analyzes the data to determine the level of influence of learning outcomes using Ethnomathematics-based learning in improving students' concept understanding abilities when viewed based on education level. The following Table 4 presents JASP output based on education level.

Table 4. Meta-Ethnomathematics Analysis by Education Level

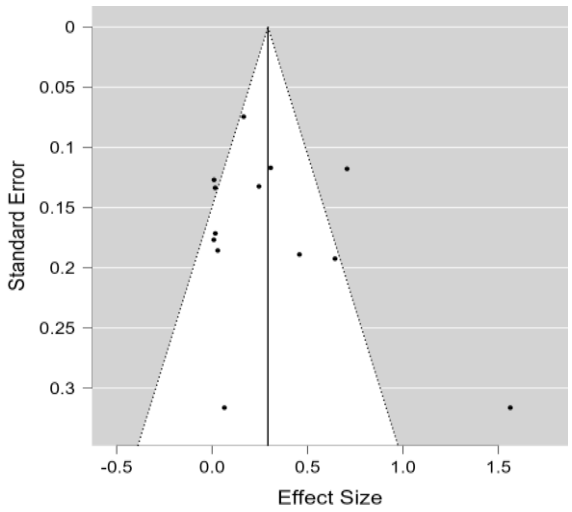
Jenjang	N	Coefficient	Category	p-Rank Test	Forest Plot
SD	13	0.293	Cukup	0.199	0.29 [0.10, 0.48]
SMP	18	0.406	Cukup	0.362	0.41 [0.10, 0.71]
SM	5	0.253	Cukup	0.448	0.25 [0.03, 0.48]

As for Table 4 above, it can be seen that at the elementary, junior high and high school levels, the level of understanding of student concepts by applying ethnomathematics-based learning has increased. At the elementary level with data as much as (N) 10, it was found that students' concept understanding increased by 29%, the estimate value obtained by the coefficient was 0.293 with a p-value of <0.001, meaning that the significance value of 5% or 0.05 is greater than the p-value and the p-Rank Test value obtained a p-value of 0.199 is greater than 0.05 so that H0 is rejected, or it can be said that there is no indication of publication bias. This is in line with research conducted by Jayadinata (2017) obtained an increase of 79.1%.

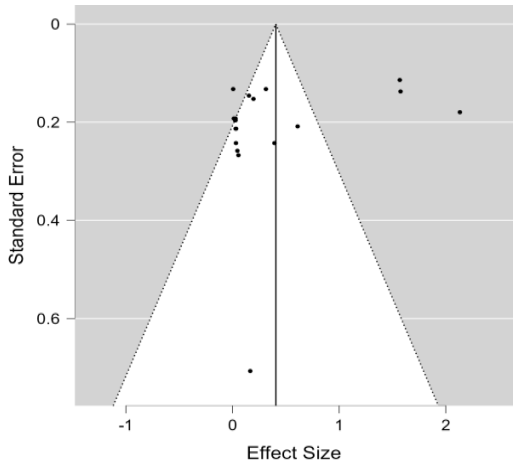
Furthermore, at the junior high school level with data as much as (N) 18, it was found that students' concept understanding increased by 0.41 or 41%, the estimate coefficient value was 0.406 with a p-value of <0.001, meaning that the significance value of 5% or 0.05 is greater than the p-value, this means that H0 is rejected and the p-Rank Test value obtained a p-value of 0.305 is greater than 0.05 so that H0 is rejected, or it can be said that publication bias is not indicated. Similar research results were also presented by Pratami et al. (2018) with the acquisition of an increase in concept understanding ability of 17.943%.

At the high school level with data as much as (N) 5, an increase of 0.25 or 25% was found. The estimate coefficient value of 0.253 with a p-value of <0.001 means that the significance value of 5% or 0.05 is greater than the p-value, this means that H0 is

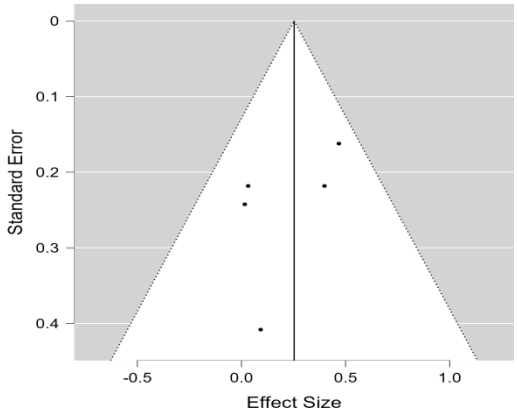
rejected and the p-Rank Test value obtained a p-value of 0.448 is greater than 0.05 so that H0 is rejected, or it can be said that there is no indication of publication bias. Tyaningsih et al. (2020) also explained that ethnomathematics-based learning was able to improve students' concept understanding ability by 88.89%. This indicates that of all levels, ethnomathematics-based learning in improving student learning abilities has a greater effect on student concept understanding at the junior high school level, namely 41%. The figure shows the pattern of data distribution according to education level.



(a) Level SD



(b) Level SMP



(c) Level SMA

Figure 2. Data distribution pattern according to education level

From Figure 2 (a) elementary school level, 1 (b) junior high school level, and 1 (c) high school level, it can be said that there is no research bias, this is indicated by all closed circles or stated that there is no indication of publication bias. Furthermore, it can be seen from the figure above that ethnomathematics learning has more effect on students' concept understanding ability at the junior high school level with a percentage increase of 0.41 or equal to 41%.

D. CONCLUSIONS AND SUGGESTIONS

The results of data analysis show that there is a significant effect in improving student learning outcomes using ethnomathematics-based learning as a whole achieving an increase of 0.53 or equivalent to 53%. When compared by level, it can be seen that at the elementary level with 13 data, students' concept understanding has increased by 29%, at the junior high school level with 18 data, students' concept understanding has increased by 0.41 or equivalent to 41%, and at the high school level with 5 data, it has increased by 0.25 or 25%. From the description above, it can be concluded that the effect of ethnomathematics-based learning in improving students' concept understanding ability has a very large effect when applied at the junior high school level, this can be seen from the percentage results obtained of 41%.

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