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From perception to practice: Pre-service teachers' development of ethnomathematics-based learning tools in Indonesia

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Abstract: This research examines the correlation between pre-service mathematics teachers' perceptions of ethnomathematics-based instructional design and the quality of educational tools they produce during a university course. Employing a mixed-methods explanatory sequential design, quantitative data were gathered from 22 participants through a perception questionnaire utilizing a Likert scale. Descriptive statistics indicated generally positive perceptions, with a mean score of 42.36 and a standard deviation of 4.07, reflecting low variability among responses. Additionally, the final project assessments demonstrated moderately high performance, with a mean score of 37.77 and a standard deviation of 3.96. Qualitative analysis of lesson modules and student worksheets—evaluated via a rubric emphasizing cultural integration, mathematical coherence, and pedagogical quality—revealed diverse levels of success in incorporating local cultural elements into mathematics instruction. While many projects showcased innovative applications of ethnomathematical concepts, notable gaps persisted in aligning cultural contexts with explicit mathematical learning objectives and maintaining systematic lesson progression. The findings suggest that although pre-service teachers generally hold positive perceptions of ethnomathematics-based teaching design, these attitudes do not consistently translate into the development of high-quality, culturally embedded instructional materials. This discrepancy underscores the necessity for structured design training and reflective practice within teacher education programs. Such initiatives are essential to convert favorable perceptions into pedagogically sound and culturally responsive teaching tools. The study contributes to the ongoing discourse on integrating ethnomathematics into teacher education curricula. It highlights the importance of targeted curriculum development in culturally diverse educational settings and offers specific implications for enhancing instructional design through comprehensive training and reflective practices. Implementing these strategies can facilitate the effective translation of positive perceptions into practical, culturally relevant pedagogical approaches, ultimately enriching mathematics education in diverse cultural contexts.

Keywords: *Culturally responsive pedagogy, Ethnomathematics, Pre-service teachers, Student perceptions, Teacher education.*

1. Introduction

Integrating cultural elements into mathematics education has gained increasing attention in recent decades, particularly through the paradigm of ethnomathematics. The ethnomathematics model explains this event most notably. Ethnomathematics studies mathematical ideas, practices, and problem-solving techniques within distinct cultural contexts [1, 2]. It positions mathematics not as a culturally neutral discipline, but as a human activity shaped by local knowledge, values, and practices [3, 4]. It advocates for teaching mathematics that resonates with the cultural realities of students and their lived experiences. This perspective challenges the dominance of both decontextualized and universalized curricula.

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Indonesia's tremendous cultural diversity, coupled with the national education policy's emphasis on character building, as outlined in the *Profil Pelajar Pancasila [5]* heightens the urgency toward ethnomathematics-based approaches. Mathematics learning incorporates local culture; thus it contextualizes abstract concepts, and it supports students' identity formation, critical thinking, and cultural appreciation [6-8]. However, effective implementation depends on the teachers' ability to bridge cultural contexts with curricular mathematics content because they must fully understand concepts and create pedagogies [9].

Pre-service teacher education prepares future teachers for this task [10]. Courses in ethnomathematics build their skills, knowledge, and awareness as they transform and identify mathematical cultural practices into tools for learning. While existing studies have examined teachers' perceptions of ethnomathematics [10-12] fewer have explored the link between perceptions formed during teacher education and the actual quality of learning tools designed by pre-service teachers. Understanding this transition from perception to practice is essential for improving teacher preparation programs and ensuring that cultural integration in mathematics is not merely theoretical but operationalized in classrooms.

This study addresses that gap by employing an explanatory sequential mixed-methods design to examine how Indonesian pre-service mathematics teachers' perceptions of an ethnomathematics course relate to the quality of their final projects—learning modules and student worksheets designed for culture-based mathematics teaching. The study seeks to answer two main questions: (1) What are pre-service mathematics teachers' perceptions regarding ethnomathematics-based teaching design? and (2) How are these perceptions reflected in the quality of their developed learning tools? By connecting survey findings with a qualitative analysis of teaching products, this research provides insights into how ethnomathematics education in teacher preparation can effectively translate into culturally responsive pedagogical materials.

2. Literature Review

2.1. From Perception to Practice in Teacher Education

Teacher education programs aim to equip pre-service teachers with theoretical knowledge and the ability to translate this knowledge into effective classroom practice [13, 14]. The perception-to-practice framework posits that teachers' beliefs, attitudes, and perceptions formed during training influence their pedagogical decisions and instructional design [13, 14]. In ethnomathematics, perceptions encompass understanding the role of culture in mathematics, valuing cultural diversity in learning, and recognizing the pedagogical potential of local knowledge.

However, the conversion from apprehension to activity is not smooth. Tenets are manifested within classroom practice according to mediating factors such as pedagogical skills, curriculum constraints, and availability of culturally relevant resources [15, 16]. Accordingly, considering both pre-service teachers' perceptions alongside the concrete learning instruments they generate, we procure a more thorough depiction of their preparedness to instruct in a culturally responsive manner.

2.2. Ethnomathematics as a Pedagogical Lens

Ethnomathematics characterizes mathematics as culturally constructed. Definite communities' customs mold it [1, 2, 17]. Ethnomathematics incorporates cultural contexts within mathematics education, stressing cultural variety and practical applications as students acquire mathematics. Several principal aspects define the pedagogical approach in ethnomathematics:

2.2.1. Cultural Relevance and Contextual Learning

Ethnomathematics associates mathematics with pupils' cultural heritages, making education more applicable and stimulating [18, 19]. This approach respects students' cultural knowledge while incorporating it within the classroom. It heightens their valuation and comprehension of mathematics [18, 19].

2.2.2. Ethnomodelling

Conversion alongside expansion of concrete dilemmas toward mathematical schematics constitutes ethnomodelling. This aspect accentuates mathematics' thorough essence. Furthermore, it accentuates discourse and deference toward disparate cultural iterations of mathematics [20, 21]. Ethnomodelling supports pupils as they comprehend differing aspects of mathematics. Cultural viewpoints furnish understanding into this comprehension [20, 21].

2.2.3. Cognitive and Constructivist Learning Theories

Ethnomathematics aligns with various learning theories, situated cognition, and constructivism. These theories support the idea that students construct knowledge through their cultural experiences and interactions [22-24]. This dimension promotes active learning and critical thinking [22-24].

2.2.4. Literacy, Matheracy, and Technoracy

D'Ambrosio's Trivium, which consists of literacy, matheracy, and technoracy, creates a necessary structure for ethnomathematics. Literacy processes information that comes from daily life, matheracy interprets and analyzes signs and codes, and technoracy uses and combines different tools to solve problems [25]. This framework supports thorough practical mathematics education [25].

2.2.5. Teachers' Beliefs and Practices

Ethnomathematics implementation relies upon teachers' beliefs. Those beliefs are important. The numeracy skills of students, in addition to their comprehension of mathematics, can be improved by having positive beliefs [26]. Teachers need to recognize and honor students' cultural experiences because they create an effective and inclusive classroom environment [26].

2.2.6. Integration of Cultural Artifacts

Using cultural artifacts, such as *Gamelan* [27], Temple [28, 29], *Kentongan* [30] and Ndebele artifacts [31] can transform geometry lessons plus improve students' attitudes towards mathematics. Integrating cultural elements into teaching practices is important because it makes learning more meaningful and engaging [31].

2.2.7. Curriculum Development

An ethnomathematics-based curriculum must have teaching materials with lesson plans and assessments [23, 24, 32]. The curriculum is developed whenever cultural values and contexts are reflected. This method makes mathematics teaching responsive to culture and inclusive [23, 24].

2.2.8. Interdisciplinary and Multidisciplinary Approaches

Ethnomathematics obtains benefits from interdisciplinary approaches, and these approaches combine perceptions from anthropology, history, and educational sciences to improve mathematics education [33, 34]. Mathematics is seen by researchers more broadly as a social and cultural practice [33, 34]. These understanding features dimension-supporting qualities.

2.3. Competency Development in Culturally Responsive Mathematics Teaching

The Culturally Responsive Teaching model [35] identifies four competencies relevant to ethnomathematics-based pedagogy.

1. Cultural knowledge – understanding students' cultural backgrounds.
2. Curricular integration – embedding cultural references into teaching content.
3. Instructional strategies – using methods that affirm cultural identity and enhance learning.
4. Assessment – designing evaluation tools that reflect both content mastery and cultural relevance.

When mapped onto mathematics teacher education, these competencies align with the Indonesian *Profil Pelajar Pancasila* framework, which emphasizes character development, cultural appreciation, and contextual learning [5].

3. Methodology

3.1. Study Participants

The participants were undergraduate students enrolled in the Mathematics Education Study Program at Universitas PGRI Yogyakarta, who took the Ethnomathematics course in the even semester of the 2024/2025 academic term. A total of N = 22 students participated in the student perception questionnaire, and all final project documents produced by these students were included.

3.2. Research Instrument

A perception questionnaire was developed using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The questionnaire consisted of 13 closed-ended items grouped into four aspects, as shown in Table 1.

Table 1.
Questionnaire blueprint.

No.	Aspect	Items
1	Conceptual understanding	Understand the nature and benefits of ethnomathematics in education
		Can distinguish between academic mathematics and ethnomathematics
		Recognize the existence of basic mathematical concepts that live in the local culture
2	Understanding of ethnomathematics sources	Understand the theories and approaches in ethnomathematical research
		Able to make an initial identification of relevant cultural sources for mathematics learning
		Feel that the outing class activities (Kraton, Sonobudoyo Museum) helped to understand ethnomathematics in real terms
3	Confident in designing mathematics learning based on local culture	Confident in designing mathematics learning based on local culture
		Can develop ethnomathematics-based learning models or tools
		Feel able to develop a teaching module that integrates cultural elements and mathematical concepts
		Feel the experience in this course encourages exploring culture as a source of learning
4	Perceptions of course activities	Practical activities (preparation of modules/articles) help to connect theory and practice
		The discussion and study of theories and research results opened insight into the potential of culture in mathematics learning
		The lecture provides a relevant and contextual learning experience with the world of education in Indonesia

Table 2.
Assessment rubric criteria for final projects.

No	Aspects	Assessment Indicators
1	Integration of local culture	Relevance of content to a specific local culture
2	Connection to mathematical concepts	Alignment between cultural elements and mathematics content
3	Clarity of learning objectives	Learning outcomes formulated in measurable terms
4	Structure and sequence of learning	Logical and systematic arrangement of activities
5	Ethnomathematics-based activities	Inclusion of cultural exploration or reflection
6	Context in student worksheets	Worksheets encourage mathematical understanding through cultural contexts
7	Assessment	Assessment reflects the process and outcomes of culture-based learning
8	Creativity and innovation	Evidence of uniqueness and innovative approach
9	Readability and language	Language is clear, communicative, and appropriate for students
10	Alignment with the national curriculum	Refers to CP, TP, and Pancasila Student Profile

In addition, two open-ended questions were included to explore students' perceived challenges and experiences during the course. The questionnaire underwent expert validation by two scholars in mathematics education and one in cultural education before administration.

Students' final projects included a learning module, a student worksheet, and an assessment rubric. These products were assessed using an analytical scoring rubric based on ten aspects, as shown in Table 2.

3.3. Data Collection

The collection of data was conducted through the administration of a questionnaire designed to elicit student perceptions and the review of final project documentation.

3.3.1. Student Perception Questionnaire

Using a student perception questionnaire serves the primary purpose of collecting and subsequently analyzing survey data. The objective of this data collection is to provide a comprehensive examination of students' perceptions regarding the ethnomathematics course.
The perception questionnaire was distributed to all students at the end of the course via an online form.

3.3.2. Final Project Document

The final project document is an in-depth analysis of students' final projects, encompassing learning modules and student worksheets. The objective of this analysis was to elaborate and explain the quantitative results. The analytical rubric in Table 2 was utilized to assess each product systematically.

The rationale for using this design was to obtain an initial broad understanding of students' perceptions through quantitative data, followed by qualitative content analysis to provide a richer and more contextual explanation.

3.4. Validity and Reliability of the Instrument

3.4.1. Validity Testing

The item's validity was tested using the Pearson correlation between the score of each item and the total correlation score, with the Pearson Correlation Categorization Formula (Likert 1-5), with the strength categories shown in Table 3.

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \cdot \sum(Y_i - \bar{Y})^2}}$$

Table 3.
Strength Categories of the Pearson Correlation.

Value Range r	Strength Categories	Relationship Direction Description
$0.00 \leq r < 0.20$	Very weak	(+) Positive or (−) Negative
$0.20 \leq r < 0.40$	Weak	(+) Positive or (−) Negative
$0.40 \leq r < 0,60$	Moderate	(+) Positive or (−) Negative
$0.60 \leq r < 0.80$	Strong	(+) Positive or (−) Negative
$0.80 \leq r \leq 1.00$	Very Strong	(+) Positive or (−) Negative

3.4.2. Preliminary Validity Test (Pre-elimination)

The results of the initial validity test (pre-elimination) are presented in Table 4. Table 4 provides a comprehensive overview of the p-values associated with each item's validity test and the initial decision regarding its validity (i.e., whether it is deemed valid or eliminated). Of the 13 indicators in variable X, three have been determined to be invalid (X.3, X.5, X.10). Of the ten indicators in variable Y, one is invalid (Y.4). This determination is made based on a p-value ≥ 0.05.

Table 4.
Results of the Preliminary Validity Test.

Code	Value	Remarks	Post-Elimination Values	Remarks
X.1	0.001	Valid	0.002	Valid
X.2	0.001	Valid	0.004	Valid
X.3	0.128	Eliminated	-	-
X.4	0.009	Valid	0.036	Valid
X.5	0.055	Eliminated	-	-
X.6	0.002	Valid	0.003	Valid
X.7	0.000	Valid	0.000	Valid
X.8	0.000	Valid	0.000	Valid
X.9	0.000	Valid	0.000	Valid
X.10	0.070	Eliminated	-	-
X.11	0.002	Valid	0.004	Valid
X.12	0.001	Valid	0.003	Valid
X.13	0.001	Valid	0.003	Valid
Y.1	0.001	Valid	0.000	Valid
Y.2	0.000	Valid	0.000	Valid
Y.3	0.003	Valid	0.000	Valid
Y.4	0.383	Eliminated	-	
Y.5	0.000	Valid	0.000	Valid
Y.6	0.000	Valid	0.000	Valid
Y.7	0.000	Valid	0.000	Valid
Y.8	0.000	Valid	0.000	Valid
Y.9	0.017	Valid	0.016	Valid
Y.10	0.003	Valid	0.000	Valid

The results of the item correlation to the total (interpretation of strength and significance) are shown in Table 5. To illustrate the interrelationship among the variables in constructing Y, Table 5 presents the Pearson correlation coefficient (r), the strength category, the direction, and the significance.

Table 5.
Item-total Pearson correlations (r), category, and significance.

Item (X)	R (Correlation coefficient with Y)	Category	Direction of Association	Significance
X.1	0.676	Strong	Positive	p < 0.01
X.2	0.664	Strong	Positive	p < 0.01
X.3	0.335	Weak	Positive	Not significant
X.4	0.497	Moderate	Positive	p < 0.05
X.5	0.415	Moderate	Positive	p ≈ 0.055 (marginal)
X.6	0.616	Strong	Positive	p < 0.01
X.7	0.790	Strong	Positive	p < 0.01
X.8	0.820	Very Strong	Positive	p < 0.01
X.9	0.820	Very Strong	Positive	p < 0.01
X.10	0.571	Moderate	Positive	p < 0.05
X.11	0.579	Moderate	Positive	p < 0.05
X.12	0.679	Strong	Positive	p < 0.01
X.13	0.680	Strong	Positive	p < 0.01

A rigorous validity testing procedure was conducted to ensure the research instrument accurately measured the intended constructs. The criterion for determining validity was a significance value (p-value) of less than 0.05, whereby items meeting this threshold were considered statistically valid. In contrast, those with p-values greater than or equal to 0.05 were deemed invalid and subsequently removed. The preliminary testing results indicated three items- X of the 13 indicators measuring variable X.3 ($p = 0.128$), X.5 ($p = 0.055$), and X.10 ($p = 0.070$)—did not meet the validity criterion. Similarly, one indicator of variable Y, namely Y.4 ($p = 0.383$), was also identified as invalid. All remaining items demonstrated p-values below 0.05, fulfilling the required validity standards and confirming their suitability for inclusion in the final instrument. The majority of the items exhibited positive and significant correlations with the target construct. In contrast, some items demonstrated moderate to robust correlations (e.g., X.8, X.9), while the eliminated items exhibited weak and/or insignificant correlations (e.g., X.3, X.5, X.10, and Y.4).

3.4.3. Item Elimination and Re-Testing (Post-Elimination)

Following the elimination of the invalid indicators, researchers retested the remaining 10 indicators of variable X as well as 9 indicators of variable Y, with this test revealing that all retained indicators had p-values below the 0.05 threshold because the indicators met established validity criteria. The outcome confirms that the refined set of indicators is statistically valid. Thus, incorporating the improved indicator collection into later studies works well.

Instrument quality improves when invalid indicators are eliminated since removal ensures items negligibly contribute to variable measurement. To reinforce its reliability, retest results indicated that the research instrument had full validity. Following their finding that the 10 indicators of variable X and 9 indicators of variable Y met criteria for analysis, researchers concluded this.

3.4.4. Reliability Analysis and Internal Consistency

Reliability testing was done to check the instrument's internal consistency, which refers to how indicators in a variable yield stable data repeatedly. Researchers assessed the reliability of the instrument using the Cronbach's Alpha coefficient, a widely accepted measure that evaluates the dependability of research instruments. A Cronbach's Alpha value greater than 0.60 indicates that the instrument is reliable, according to the established criteria, while a value equal to or less than 0.60 suggests that the instrument lacks sufficient reliability. This threshold acts as a benchmark to ensure the robustness of the measurement tool. A strong tool will yield consistent results in the subsequent analyses.

The outputs of the reliability assessment are presented in Table 6. The variable "X" in this study is "Student Perception." The Cronbach's Alpha value was 0.927, notably higher than the minimum threshold of 0.60. This finding suggests that the indicators within the student perception variable exhibit exceptionally high internal consistency, thereby ensuring the reliability of the instrument in consistently measuring student perceptions.

Table 6.
The Reliability.

Variable	Reliability Coefficient	Standard Criteria	Remarks
X Student perception	0.927	>0.6	Reliable
Y Final project	0.937	>0.6	Reliable

The final project grade is a variable that is to be recorded. The Cronbach's Alpha value was 0.937, notably higher than the minimum threshold of 0.60. This value indicates that the final project grade indicators are reliable and generate stable data.

The alpha reliability coefficient of both variables exceeded 0.90, indicating that the research instrument exhibited high internal consistency. Consequently, the instrument is well-suited for subsequent analysis because it can generate consistent and reliable results.

5. Results and Discussion

5.1. Descriptive Statistics Analysis

Descriptive statistics provide an overview of the research data, including the mean, standard deviation, and number of respondents. The analysis of 22 pre-service mathematics teachers indicated consistent patterns across both measured variables (Table 7).

Table 7.
The Descriptive Statistics Analysis

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
Y	37.7727	3.96331	22
X	42.3636	4.06548	22

For Variable Y (Final Project Grade), the mean score was 37.77 with a standard deviation of 3.96, suggesting that students' project performance was clustered closely around the average with limited variability. Similarly, Variable X (Student Perception) yielded a mean score of 42.36 and a standard deviation of 4.07, reflecting generally favorable perceptions with modest variation among participants. The relatively low standard deviations for both variables indicate that the data distribution is homogeneous, suggesting that the participants performed consistently in their final projects and demonstrated shared positive perceptions of the assessed aspects.

5.2. Paired Samples t-test

A paired samples t-test was conducted to compare the Student Perception Questionnaire scores and the Final Project Document scores of the same students. Before the paired samples t-test was conducted, a Test of Classical Assumptions was performed first, including normality, linearity, and homoscedasticity tests.

5.2.1. Normality Test

The normality of the residual data was assessed using the One-Sample Kolmogorov–Smirnov Test. In this test, the decision rule is straightforward: if the significance value (Asymp. Sig.) is greater than 0.05, the data can be considered normally distributed. Conversely, if the significance value is equal to or less than 0.05, the data are interpreted as not following a normal distribution.

The results of the normality test using the Kolmogorov–Smirnov method are presented in Table 8. In evaluating the normality of the residual data, the analysis was conducted on 22 samples. The residuals had a mean value of 2.9624 with a standard deviation of 2.08380, indicating relatively small variability around the mean.

Table 8.
Normality Test using the Kolmogorov–Smirnov method.

One-Sample Kolmogorov-Smirnov Test		
		ABS_RES
N		**22**
Normal Parameters[a,b]	Mean	2.9624
	Std. Deviation	2.08380
Most Extreme Differences	Absolute	0.146
	Positive	0.146
	Negative	-0.098
Test Statistic		0.146
Asymp. Sig. (2-tailed)		0.200[c,d]

Note: a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.
d. This is a lower bound of the true significance.

Results from the Kolmogorov–Smirnov test showed a statistical value of 0.146. Furthermore, the obtained Asymp. Sig. (two-tailed) was 0.200, which exceeds the threshold of 0.05. These findings suggest that the residual data are normally distributed, fulfilling one fundamental assumption for subsequent parametric statistical analyses. Consequently, it can be concluded that the residual data is normally distributed. This outcome indicates that the normality assumption is satisfied, rendering the regression model suitable for further analysis.

5.2.2. Linearity Test

A linearity test ensures that the relationship between the independent variable (X) and the dependent variable (Y) is linear. The linearity of the relationship was examined using the Deviation from Linearity parameter. The decision rule applied in this analysis is based on the significance value (p-value). If the obtained p-value is greater than 0.05, the relationship can be considered linear. Conversely, the relationship is interpreted as non-linear if the p-value is less than 0.05. The results of the linearity test are presented in Table 9.

Table 9.
LinearityTest.

Variable	**Defiation From Linearity**	**Standard**	**Remarks**
Y*X	0.858	>0.05	Linearity Assumption Satisfied

Following the findings derived from the test results, the calculation indicates a deviation from linearity with a value of 0.858. This value is greater than the significance threshold of 0.05, suggesting no significant deviation from linearity. Accordingly, it can be inferred that the relationship between the examined variables satisfies the linearity assumption, thereby confirming the appropriateness of applying linear statistical techniques for further analysis.

5.2.3. Homoscedasticity Test

The homoscedasticity test is a statistical procedure utilized to determine whether the variance of residuals in a regression model remains constant across the full range of independent variable values. This evaluation is based on the significance value and follows specific decision-making criteria. The null hypothesis (H0) is accepted if the significance value is greater than 0.05, which indicates the absence of heteroscedasticity and the fulfillment of the homoscedasticity assumption. Conversely, if the significance value is less than or equal to 0.05, it suggests the presence of heteroscedasticity, thereby violating the assumption of homoscedasticity.

Table 10.
Homoscedasticity Test.

Variable	Defiation From Linearity	Standard	Remarks
Y*X	0.630	>0.05	Homoscedasticity Assumption Satisfied

In light of the test results, the calculation indicates a deviation from linearity with a value of 0.630. Since this value exceeds the significance threshold of 0.05, it can be concluded that there are no symptoms of heteroscedasticity in the regression model. This finding confirms that the assumption of homoscedasticity has been satisfied, thereby supporting the suitability of the model for subsequent analysis. Following this, a paired samples t-test was conducted to compare the scores obtained from the Student Perception Questionnaire and the Final Project Document, which were assessed for the same group of students.

5.2.4. Results of the T-Test

The t-test was employed to examine the partial effect of the independent variable (X) on the dependent variable (Y). This statistical test evaluates whether the predictor variable contributes significantly to the variation in the outcome variable. The decision criteria applied are straightforward: if the significance value (Sig.) is less than or equal to 0.05, it can be concluded that the independent variable significantly affects the dependent variable. Conversely, if the significance value exceeds 0.05, the independent variable is considered to have no significant effect on the dependent variable.

Based on the test results (Table 11), the constant value was 22.416 with a t-value of 2.603 and a significance of 0.017 (< 0.05), indicating that without the influence of variable X, the value of Y tends to remain at that level. The regression coefficient of variable X was 0.362 with a t-value of 1.791 and a significance of 0.088 (> 0.05). These results indicate that, partially, variable X does not significantly affect variable Y at the 5% significance level. However, the positive regression coefficient suggests a positive direction of the relationship.

Table 11.
Results of the t-test.

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	22.416	8.610		2.603	0.017
	X	0.362	0.202	0.372	1.791	.088

Note: a. Dependent Variable: Y.

The regression equation derived is:
Y=22.416+0.362XY = 22.416 + 0.362XY=22.416+0.362X

- Intercept (a) = 22.416, $t = 2.603$, $p = 0.017$ — This indicates that, in the absence of perception (X), the expected Y score is approximately 22.42 (statistically significant at $\alpha = 0.05$).
- Slope (b) = 0.362, $t = 1.791$, $p = 0.088$ — Suggests a positive but non-significant partial effect of perception on final project scores at the 5% significance level.

  The simple regression analysis produced the equation Y=22.416+0.362X, where a =22.416 represents the constant (intercept) and b=0.362 is the regression coefficient for variable X. The constant value of 22.416 indicates that if the student perception score (X) is 0, the predicted final project score (Y) would be 22.416. Meanwhile, the regression coefficient of 0.362 suggests that for every 1-point increase in student perception (X), the final project score (Y) is predicted to increase by 0.362 points, assuming that other variables remain constant.

5.3. Coefficient of Determination (R^2)

The coefficient of determination (R^2) was used to measure the proportion of variance in the dependent variable that the independent variables can explain.

Table 12.
The Coefficient of Determination (R^2).

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	0.372[a]	0.138	0.095	3.76998

Note: a. Predictors: (Constant), X.

The coefficient of determination is used to measure the extent to which the independent variable (X) can explain the variation in the dependent variable (Y). Based on the test results, the R value was 0.372, indicating that the relationship between X and Y falls into the weak category. The R Square value was 0.138, meaning that variable X could explain 13.8% of the variation in variable Y. In comparison, the remaining 86.2% was influenced by other factors not included in this research model. The Adjusted R^2 value was 0.095, which corrects R^2 for greater accuracy, particularly when the sample size is small. Therefore, it can be concluded that the ability of variable X to predict variable Y is relatively low, although the direction of the relationship is positive.

The model's weak predictive power ($R = 0.372$; $R^2 = 0.138$; adjusted $R^2 = 0.095$) implies that only 13.8% of the variance in project scores is explained by perception alone, leaving the majority to other unmeasured factors. This aligns with theoretical and empirical studies in ethnomathematics education, which highlight persistent gaps between teachers' positive perceptions of culturally responsive pedagogy and their ability to integrate it into practice [11] effectively; Cross-cultural insights emphasize that understanding the ethnomathematics conceptually does not automatically translate into its pedagogical application [36, 37]. Similarly, broader scholarship on equity, diversity, and inclusion in mathematics education underscores the need for pedagogical skill-building and structural support to convert awareness into effective practice [38]. Therefore, our findings suggest that while students hold ethnomathematics in high conceptual regard, additional training, resources, and targeted instructional scaffolding are necessary to translate this positive perception into high-quality culture-based learning tools.

6. Conclusions

The findings indicate that pre-service mathematics teachers exhibit generally high and homogeneous perceptions toward ethnomathematics-based teaching design, underscoring a positive disposition toward integrating local cultural contexts into mathematics instruction. Nevertheless, the qualitative evaluation of their final projects revealed that such favorable perceptions did not always correspond to consistently high-quality learning tools. While several submissions successfully embedded culturally relevant contexts and demonstrated pedagogical creativity, others reflected superficial connections between cultural elements and mathematical concepts, suggesting that conceptual appreciation alone is insufficient for robust implementation. By linking survey results with a content analysis of teaching products, this study underscores the importance of embedding explicit design training, iterative feedback, and reflective practice in teacher education programs. Such measures are essential to ensure that positive perceptions are effectively translated into culturally responsive and pedagogically sound instructional materials, thereby strengthening the practical impact of ethnomathematics education in pre-service teacher preparation.

Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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