



## THE APPLICATION OF ETHNOMATHEMATICS IN NUMERACY LITERACY PERSPECTIVE: A LITERATURE REVIEW

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### ABSTRACT

Numerical literacy skills in Indonesia remain inadequate, despite these skills being critical for problem-solving. This study aims to review recent ethnomathematics research in the context of numeracy literacy. The design of this study was a literature review using a qualitative descriptive analysis method, with fifteen accredited Sinta, Scopus, and international proceedings related to the use of ethnomathematics in the context of numeracy literacy. The data collection technique employed was a literature study. The results of this study show that the ethnomathematics context in Indonesia can be determined through indicators of mathematical activity and sub-elements in a social-cultural system. These concepts include numbers, geometry, measurement, algebra, data, and uncertainty. The results of numeracy literacy were found to vary in various studies. Thus, applying ethnomathematics can be an alternative to classroom learning to measure students' numeracy literacy abilities. This measurement can be used as a suggestion for further research.

## PENERAPAN ETNOMATEMATIKA DALAM PERSPEKTIF LITERASI NUMERASI: TINJAUAN LITERATUR

### ABSTRAK

#### Kata Kunci:

Etnomatematika

Tinjauan literatur

Literasi numerasi

Kemampuan literasi numerasi di Indonesia masih rendah, sementara kemampuan tersebut penting untuk menyelesaikan masalah. Tujuan dari penelitian ini adalah untuk meninjau penelitian tentang etnomatematika dalam perspektif literasi numerasi dalam 5 tahun terakhir. Desain penelitian ini adalah literature review dengan metode analisis deskriptif kualitatif yaitu mengumpulkan 15 jurnal terakreditasi Sinta, Scopus dan prosiding internasional terkait penerapan etnomatematika dalam perspektif literasi numerasi. Teknik pengumpulan data adalah melalui studi literatur. Hasil penelitian ini diperoleh bahwa konteks etnomatematika di Indonesia dapat ditentukan melalui indikator aktivitas matematika dan subunsur dalam suatu sistem budaya sosial. Konsep tersebut meliputi: domain bilangan, geometri dan pengukuran, aljabar, serta data dan ketidakpastian. Hasil literasi numerasi ditemukan beragam pada berbagai penelitian. Dengan demikian, penerapan etnomatematika dapat menjadi alternatif pada pembelajaran di kelas untuk mengukur kemampuan literasi numerasi siswa. Pengukuran ini dapat dijadikan sebagai saran untuk penelitian selanjutnya.

## 1. INTRODUCTION

The Indonesian government is constantly working to improve the curriculum's quality, including competency and literacy measurement, such as PISA (Program for International Student Assessment). In 2018, Indonesia was ranked 72 out of 77 countries based on the PISA score [1]. The average mathematics score for Indonesian students was 379. In Indonesia, numeracy literacy is measured through the Minimum Competence Assessment (AKM), which includes two materials: reading literacy and numeracy literacy. These are essential qualities that all students must learn to contribute to society throughout their lives [2]. However, students continue to have low numeracy literacy skills in its implementation [3]-[5]. This problem demonstrates that students in Indonesia have poor numeracy literacy skills. Numeracy literacy is described as students' capacity to formulate, apply, and interpret mathematics in a variety of circumstances [6]. It teaches about the function of mathematics in the world [7]-[9]. It is also required to assist and make decisions to improve one's quality of life [8], [10], [11]. Therefore, numeracy literacy becomes a crucial skill students must master while solving a problem.

Students must analyze whether the outcomes gained are reasonable in addition to knowing and employing efficient problem-solving approaches. They must consider whether the mathematical knowledge utilized in analyzing the situation and developing conclusions is appropriate. As a result, numeracy literacy is beneficial not only to individuals but also to society as a whole. It enables people to gain expertise and confidence in interpreting and critically analyzing any circumstance [6], [8], [11]. Thus, understanding the significance of learning, particularly mathematical learning, is critical in problem-solving.

Learning can be made more meaningful by including ethnomathematics. D'Ambrosio, a Brazilian mathematician, coined the term ethnomathematics. Ethnomathematics is defined as mathematics practiced inside socio-cultural communities, such as national (tribe) communities, labor groups, specific age groups of children, and professional classes [12]-[14]. Ethnomathematics is one approach to explaining the function of mathematics in culture [15]. It can be an option to apply mathematical learning in real-world settings. Mathematics and culture are two intertwined concepts. Culture is significant in presenting learning themes since it aligns with the character development of Pancasila students following the current curriculum's objectives, particularly the Independent Curriculum. Furthermore, connecting learning to culture encourages students to be proud of their heritage [15]. Ethnomathematics aims to better understand the relationship between mathematics and culture so that students' perceptions of mathematics become more accurate, resulting in the meaningfulness of mathematics learning since it is tailored to the context of socio-cultural life.

According to the explanation above, numeracy literacy skills in Indonesia are low, although numeracy and reading skills are necessary for students to solve difficulties. The meaningfulness of learning must solve a problem in learning. Ethnomathematics can be used to connect mathematics learning with culture to make learning more relevant. Consequently, teachers must be creative to solve these difficulties. This article will discuss studies done on the application of ethnomathematics in the context of numeracy literacy. The findings of ethnomathematics research in the context of numeracy literacy in exploration, development of instructional materials, and mathematics assessments are being considered for future research.

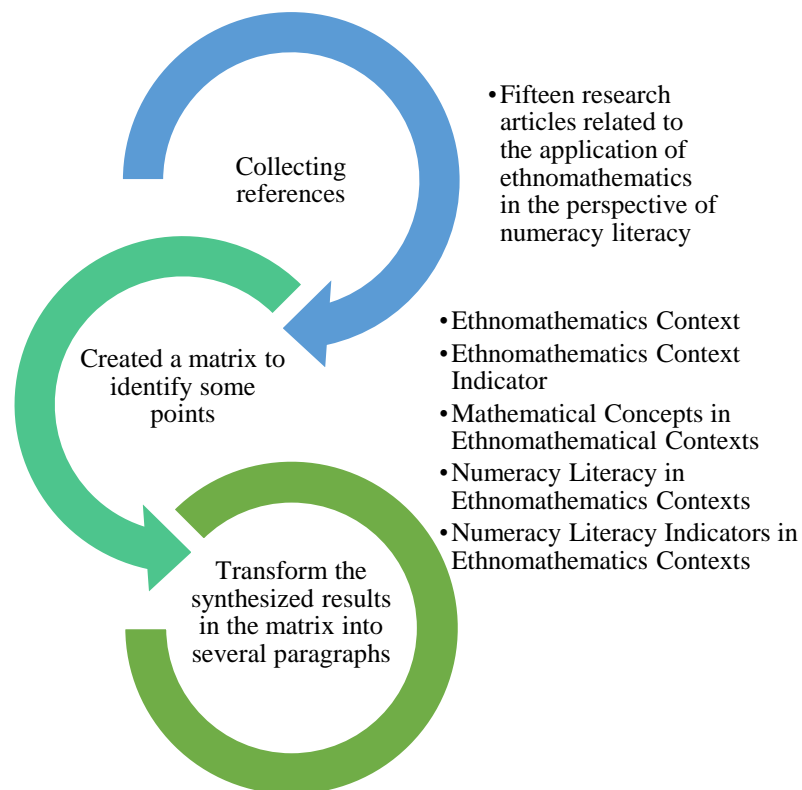
Many ethnomathematics-related studies have been conducted, including ethnomathematics implementation in learning [15], ethnomathematics-based teaching materials to improve mathematical literacy [16], ethnomathematics in the context of

mathematical literacy [17], [18], implementation of ethnomathematics-based PBL [19], and development of ethnomathematics-based mathematical literacy evaluation instruments [20]. However, no research has been conducted on a literature review on ethnomathematics from the standpoint of numeracy literacy.

This study aims to review ethnomathematics research in the context of numeracy literacy over the last five years. Researchers aim to review ethnomathematics based on empirical study. The review is offered in the form of concepts, indicators, and findings from previous research.

**2. METHODS**

The research design of this study was a literature review with a qualitative-descriptive method. A literature review is a set of studies or research that uses a library method for collecting data, where the objects are studied using diverse library information (books, encyclopedias, scientific journals, newspapers, magazines, and documents) [21]. The research steps include collecting references, building a matrix to identify multiple points, and transforming the synthesis results into several paragraphs [22]. The following diagram illustrates the study procedure.



**Figure 1.** The Research Procedure

This study begins with data collection, accomplished by documenting all studies on the application of ethnomathematics in the context of numeracy literacy. Based on these processes, researchers looked for publications using the keywords "ethnomathematics" and "numeracy literacy" and then selected and evaluated the articles based on established criteria. Finally, the data acquired were analyzed, and conclusions were drawn. This assessment relied on fifteen research articles published between 2019 and 2023. Table 1 is a list of some of the sources examined.

**Table 1.** List of Literature Sources

Journal	Proceeding
Three Sinta 2 Journal	Three international proceeding
Two Sinta 3 Journal	
Six Sinta 4 Journal	
One Scopus Q4 Jurnal	

**3. RESULTS AND DISCUSSION**

Some articles on the application of ethnomathematics in the context of numeracy literacy were examined in this study. A literature review was used to acquire data for this study. Some of the studies that have been reviewed are listed below. In this article, the writer tried to organize the findings of a study from diverse kinds of literature, as shown in Table 2.

**Table 2.** Literature Study Results

Articles		Finding	
Cahyono & Budiarto, 2020 [16]	E	Tambourine ( <i>Rebana</i> ) art	
	IE	Mathematics activities: explaining, measuring, summarizing, and designing buildings	
	M	Curved three-dimensional figures (tubes, cones, and spheres).	
	LN	Numeracy literacy results are found in learning activities in: <i>Explaining activity</i> Formulating: Students discuss with their respective groups the steps to be taken. Applying: Applying prior knowledge (comparison, definition, elements, area, and volume of tubes). Interpreting: Interpreting and giving a brief explanation (comparison, definition, elements, area, and volume of tubes). <i>Measuring activity</i> Formulating: Students cut the paper according to the size of the elements of each type of tambourine. Applying: Students apply knowledge of the concept of tube nets to cut paper according to the size of the elements of each type of tambourine. <i>Numbering activity</i> Formulating: Students formulate mathematical modeling of the elements of each type of tambourine. Applying: Students apply the knowledge gained about the formulas of surface area and volume of tubes to calculate them. Interpreting: Students interpret the results of mathematical calculations in the tambourine context. <i>Building design activity.</i> Formulating: Students discuss with their respective groups the steps to be taken. Applying: Students apply knowledge about tube nets to make tubes. Interpreting: Students give the name of each tube made according to the type of tambourine.	
	IN	Formulate, Apply, and Interpret (OECD)	
	Wurdani & Budiarto, 2021 [17]	E	Rattan weaving crafts (bags, baskets, chairs, and serving hoods) in the Gresik community.
		IE	Forms of local cultural wisdom owned by a particular region in learning mathematics.
		M	The concept of measurement, correlation, curved three-dimensional figures of tubes without lids, flat-sided three-dimensional figures of cuboids, and geometric transformations: reflection (mirroring) and translation (shifting).
		LN	Mathematical Process Aspects The formulation process is that students can model problems in everyday life into mathematical models. The students can determine the concepts, facts, and procedures to solve the problem. Interpret process is where students recheck the mathematical process and results and interpret them in the real world.

		<i>Context Aspect</i>
		The social context is in the form of two and three-dimensional figures and geometric transformation concepts that exist in everyday life, especially in the rattan handicraft business of the Gresik community.
		The scientific context is the application of mathematics in contextual problems carried out by the Gresik community related to problems related to science and technology.
		<i>Content Aspect</i>
		The application of the concept of geometric transformation in the form of reflection and translation, where the application of this content can be expressed in geometric form and graphic depictions that have their own characteristics.
		The application of the two and three-dimensional figures concept of rattan handicrafts.
		The content is related to the geometry material used to introduce the shape and characteristics of an object with a geometric shape.
	IN	Mathematical process, context, and mathematical content.
Masrukha & Budiarto, 2021 [18]	E	Batik Pamiluto Ceplok art in gresik.
	IE	Academic mathematical knowledge is developed by different sectors of society and considering their different cultural mathematical practices (ways of categorizing, counting, measuring, designing buildings or tools, playing, and others).
	M	Geometry (rectangle, square, rhombus, trapezoid, parallelogram, circle, semicircle, triangle, isosceles triangle, ellipse, and cuboid), Transformation (reflection, translation, and rotation), and Multiplication.
	LN	The researcher made a study on learning activities based on the ethnomathematics of Batik Pamiluto art. Through this content, the researchers teach the second-grade elementary school students multiplication material. With the mathematical concepts in Batik Pamiluto Ceplok, teachers can utilize ethnomathematics-based learning to improve students' mathematical literacy.
	IN	Mathematical knowledge in solving problems in everyday life starts from understanding the problems, formulating problems, using mathematical knowledge, and interpreting.
Prihatiningtyas & Buyung, 2023 [19]	E	Tidayu culture (Barongsai-Naga, Sumpit-Perisai, Saprahan).
	IE	Mathematical concepts through a culture of the community.
	M	Chance and sets
	LN	<i>Percentage of pretest achievement:</i> Communication 48% Representation 72.6% Mathematization 40.5% Determining problem-solving strategies 40.1% Reasoning and arguing 29.2% Using symbols, formal language, and operations, 50%
		<i>Percentage of posttest achievement:</i> Communication 68.5% Representation 88.1% Mathematization 89.3% Determining problem-solving strategies 75% Reasoning and arguing 69.6% Using symbols, formal language, and operations, 88.1%
		<i>Mathematical literacy/numeracy skills improved.</i>
	IN	Communication, representation, mathematization, determining problem-solving strategies, reasoning and arguing, using symbols, formal language, and operations.
Susanti & Budiarto, 2020 [23]	E	Jonegoroan Batik culture (typical batik of Bojonegoro district).
	IE	Categories of subunits in a cultural and social system: (1) Community system and organization; (2) Religious system and religious ceremonies; (3) Livelihood system; (4) Knowledge system; (5) Technology and equipment system; (6) Language; and (7) Arts (Koentjaraningrat, 1974).

	M	The concept of geometric transformations, two-dimensional figures, and graphs of trigonometric functions.
	LN	<p><i>The concept of mathematics transformation</i></p> <p>Formulate: Recognize mathematical structures (regularities, relationships, and patterns) in problems or situations.</p> <p>Employe: Generalize based on mathematical concepts to find appropriate or approximate solutions.</p> <p>Interpret: Evaluate the reasonableness of mathematical solutions in the context of real-world problems.</p> <p><i>The mathematical concept of two-dimensional shapes.</i></p> <p>Formulate: Recognize aspects of the problem that fit with mathematical concepts.</p> <p>Employ: Find the right solution.</p> <p>Interpret: Explain why the mathematical solution makes sense or not, given the context of the problem.</p> <p><i>The mathematical concept of graphing trigonometric functions</i></p> <p>Formulate: Represent the problem in mathematical language.</p> <p>Employ: Find the right solution.</p> <p>Interpret: Explain whether the mathematical solution makes sense or not, given the context of the problem.</p>
	IN	Formulate, employ, and interpret.
Sukmawati et al., 2022 [20]	E	Ethnomathematics in Javanese culture.
	IE	Ethnomathematics has its own way of using reasoning that can be interpreted mathematically both with awareness and without awareness so that it can form certain patterns.
	M	Build three-dimensional faces
	LN	The mathematical literacy evaluation instrument product based on the perspective of multiple intelligences of ethnomathematics in Javanese culture has met the valid criteria based on the results of material expert validation, with an average score of 92.53 in the highly feasible criteria. Twenty items of a mathematical literacy test in the perspective of multiple linguistic bits of intelligence, twenty items of a mathematical literacy test from the standpoint of multiple logical-mathematical bits of intelligence, twenty items of a mathematical literacy test in the perspective of multiple visual-spatial intelligences, and twenty items of a mathematical literacy test in the perspective of multiple bodily-kinesthetic intelligences have met the criteria of valid criteria to be used as mathematical literacy evaluation instruments in the perspective of multiple intelligences.
	IN	Communication: Expressing mathematical problem-solving ideas in written form
Susanto et al., 2022 [24]	E	A tradisional meal from Sambas, West Kalimantan. It is a spicy porridge ( <i>bubbor paddas</i> ), the traditional clothing of east Kalimantan relics of Kutai Takwo Sultanate, cultural heritage Tugu Jepang in Kupang of East Nusa Tenggara, place of worship: Jami' Sultan Syarif Abdurrahman Alkadrie Mosque In Pontianak, West Kalimantan, and Laskar Pelangi movie.
	IE	The reality of the connection between culture and mathematics learning can be seen in various aspects, such as works based on culture.
	M	Triangle, square, rectangle, trapezoid, rhombus, and kite.
	LN	Based on the results of the SPSS output, there is a significant increase in scores on both numeracy literacy samples, with an average of 14.519 (lower than 50.544).
	IN	<p>Quasar General Rubric:</p> <ul style="list-style-type: none"> <li>- Does not answer/does not understand the problems.</li> <li>- Understands some of the mathematical concepts and processes in the problem, uses inappropriate strategies and tools, and makes errors in many calculations.</li> <li>- Almost understands the mathematical concepts and processes of the problem and identifies important factors, but makes many errors in ideas and calculations.</li> <li>- Good understanding of the mathematical concepts and processes in the problem, using almost correct notation and terms, using a complete algorithm followed by correct calculations, but still has errors.</li> </ul>

		- Expresses understanding of the mathematical concepts and processes in the problem, uses the correct notation and terms, and uses a complete algorithm with correct calculations.
Safina & Budiarto, 2022 [25]	E	Ethnomathematics in the Sidoarjo culture of Batik Sari Kenongo, Candi Pari, and Tambak Cemandi.
	IE	Multicultural mathematics includes traditional cultural values, traditions, symbols, and mechanisms that aim to help people learn mathematics. With ethnomathematics, the form of local cultural wisdom can be linked to the context of mathematics learning.
	M	Standard and non-standard units, height concept, comparison, geometry transformation, unity, and two and three-dimensional figures.
	LN	<i>Applying the geometric transformation concept on Sari Kenongo and Candi Pari Batik.</i> Formulate: Recognize mathematical structures (regularities, relationships, and patterns) in problems or situations. Employ: Make generalizations based on mathematical concepts to find the right solution. Interpret: Evaluate the reasonableness of mathematical solutions in the context of real-world problems. <i>Applying the Concept of two-dimensional shapes and congruence in Sari Kenongo Batik and two and three-dimensional figures in Pari Temple.</i> Formulate: Recognize aspects of the problem that align with mathematical concepts. Employ: Find the right solution. Interpret: Explain why the mathematical result or conclusion makes sense or not. <i>Determination of pond height and use of comparison concept in Tambak Cemandi activities</i> Formulate: Represent a problem in the form of mathematical language. Employ: Design mathematical constructions and information. Interpret: Identify the mathematical solution used. <i>Use of standard and non-standard units in Tambak Cemandi activities</i> Formulate: Represent a problem in the form of mathematical language. Employ: Design mathematical constructions and information. Interpret: Identify the mathematical solution used.
	IN	Formulate, employ, and interpret.
	E	Sidoarjo Batik.
	IE	Mathematics is embodied in daily life or the culture of a particular community in a social environment.
	M	Ratio and comparison
	LN	Mathematical literacy/numeracy questions developed “My father has a batik industry. To manufacture a piece of batik, he needs several materials: 1 piece of mori cloth, 5 bags of fabric dye, ½ kg of wax, and 1 liter of petroleum. He keeps 40 pieces of mori cloth, 37 bags of fabric dye, 8 kg of wax, and 11 liters of petroleum in the warehouse. Could you please help father determine the maximum number of pieces of batik produced using the materials in the warehouse?” The average mathematical literacy/numeracy test results show in the adequate category.
	IN	Mathematical Literacy/Numeracy Indicator Formulating the situation mathematically (Formulating Stage (FS)) - Identifying variables and mathematical structures in real-world problems and making assumptions. - Using the understanding of context to guide or accelerate the process of solving math problems, such as working on a level of accuracy appropriate to the context. Employing mathematical concepts, facts, procedures, and reasoning (Employing Stage (ES)) - Execute effective and continuous control mechanisms across all multi-procedures oriented towards mathematical solutions, conclusions, or generalizations. - Explain, defend, or justify the processes and procedures used to determine mathematical results or solutions.

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		<ul style="list-style-type: none"> <li>- Connect pieces of information to arrive at mathematical solutions, make generalizations, or multi-step arguments.</li> </ul> <p>Interpreting, applying, and evaluating mathematical outcomes (Interpreting Stage (IS))</p> <ul style="list-style-type: none"> <li>- Interpret mathematical results in various formats appropriate to the situation and compare or evaluate two or more representations related to a situation.</li> <li>- Construct and communicate explanations and arguments in the context of a problem.</li> </ul> <p>Category Math Literacy/Numeracy          Good: Fluency, accurate computation, and optimal idea development          Adequate: Fluency, accurate computation, and suboptimal idea development          Inadequate: Fluency, accurate computation, and suboptimal idea development</p>
Runtu et al., 2023 [27]	E IE M LN IN	<p>Cultural ethnomathematics in North Sulawesi</p> <p>Ethnomathematics as a link between mathematics, mathematical modeling, and cultural anthropology</p> <p>Ratio and comparison</p> <p>Students' mathematical literacy skills in answering mathematical literacy questions in a mathematical context are relatively low. In percentage terms, only 87.5% of upper-grade students, 67.6% of middle-grade students, and 31% of lower-grade students could answer the questions formulating competencies.</p> <p>Formulating, employing, and interpreting</p>
Kurniati & Mariani, 2020 [28]	E IE M LN IN	<p>Cultural ethnomathematics in Semarang.</p> <p>Ethnomathematics is a special means certain cultural groups or communities use in mathematical activities. Mathematical activities are abstracting from real experiences in everyday life into mathematics.</p> <p>SPLDV (Substitution, elimination, and mix)</p> <p>In this study, the results of the mathematical literacy test between students representing the responsible group and students representing the high-responsibility group were the same. The factor that influenced the findings was the thoroughness of the students representing the responsibility group who were having their work corrected.</p> <p>The achievement of mathematical literacy indicators in each group:          (a) Subjects with high responsibility could solve five out of six problems that meet the four mathematical indicators. One of them could only solve four out of six problems that met the four indicators of mathematical literacy;          (b) Subjects with medium responsibility also had differences in the achievement of indicators even though the problems they solved were five out of six. However, the number of problems they cannot solve is different. The five problems they could solve met the four mathematics indicators;          (c) Students with low ability have differences in achieving indicators. One of the subjects solved three out of six problems that met all four indicators, and there was one problem that could not be solved. One of the subjects can only fulfill two indicators. There is one problem that cannot be solved by one of the subjects.</p> <p>PISA's mathematical/numeracy literacy focuses on students' ability to analyze, reason, and communicate ideas about mathematical problems in various content.</p>
Kehi et al., 2019 [29]	E IE M LN IN	<p>Cultural ethnomathematics in Malacca, East Nusa Tenggara, traditional house building, <i>Siri pinang</i> (<i>Kabi</i> and <i>Koba</i>) used to entertain guests, and school bags made from woven palm leaves.</p> <p>Mathematics learning is needed to provide content/bridge between mathematics in the everyday world based on local culture and school mathematics.</p> <p>Three-dimensional shapes: cuboids and cubes</p> <p>The average proportion of mathematical literacy skills in the experimental class is 78.38, which is better than the control class (71.38). This finding shows that the eliciting activities learning model with ethnomathematics nuances is effectively applied in classroom learning.</p> <p>PISA 2012: (1) Communicating, (2) mathematizing, (3) representing, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal, and technical language and operation, and (7) using mathematics tools.</p>

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Agusdianita et al., 2021 [30]	E	The miniature <i>Tabut</i> building from Bengkulu
	IE	Ethnomathematics is useful to motivate, stimulate, and overcome student difficulties in learning mathematics because it is part of a student's daily life, an initial conception that the local socio-cultural environment has owned.
	M	Regular and irregular two-dimensional shapes
	LN	Ethnomathematics affects students' mathematical literacy skills because in learning mathematics using the RME ethnomathematics model, students are actively involved, and they discover directly and explore their knowledge. The learning resources are presented directly in the classroom so that students can build literacy habits. The outcome is judged based on the increase in scores from the pretest to the posttest.
Yuliana et al., 2023 [31]	IN	Ethnomathematics affects students' mathematical literacy skills. Through learning close to the student's mind, the ethnomathematics approach can improve problem-solving skills and mathematical communication and overcome mathematical difficulties. Mathematical literacy is the human ability to formulate, use, and interpret mathematics in various circumstances.
	E	Cultural ethnomathematics in Petanahan, Kebumen, Central Java.
	IE	Mathematical practices, mathematical ideas, and mathematical knowledge of a socio-cultural group.
	M	Three-dimensional shapes: cubes and cuboids.
Julianto et al., 2021 [32]	LN	The significance level of the t-test is 0.000 (lower than 0.05). Therefore, $H_0$ is rejected. It means that the control and experimental class data have differences in mathematical literacy scores. In short, the experimental and control classes have different mathematical literacy skills. The average score of the experimental class (65.5385) is higher than the average score of the control class (50.5882). Based on the findings, the ethnomathematics-based learning module effectively improves the mathematical literacy skills of fifth-grade elementary school students.
	IN	The prototype of teaching modules assessed by the experts showed that the development of ethnomathematics-based teaching modules with the RME approach to improve mathematical literacy was declared valid and suitable for use. The aspects assessed in language validation by validators were sentence clarity, communicative, dialogical, and interactive, incompatibility with student development, conformity with language rules, and appropriateness of using icons, symbols, and terms. The language was adapted to the thinking stage of elementary school students. The sentences chosen in the teaching module were simple by adjusting to the elementary school students. The icons, symbols, and concrete terms were adjusted to the thinking stages of elementary school students.
Julianto et al., 2021 [32]	E	Ethnomathematics in the culture of Surakarta, Central Java (Lemper).
	IE	Ethnomathematics uses broad mathematical concepts related to various mathematical activities, including classifying, calculating, measuring, designing buildings or tools, playing, determining locations, etc.
	M	Two and three-dimensional shapes.
	LN	The results of this study show the percentage of mathematical literacy achievement in the categories of spatial literacy (53.45%), numerical literacy (44.68%), and quantitative literacy (36.33%).
	IN	Understanding, planning, determining, solving, and concluding.

Description:

- E : Ethnomatematics context
- IE : Ethnomatematics context indicators
- M : Mathematical concepts in the ethnomathematics context
- LN : Numeracy literacy in ethnomathematics contexts
- IN : Numeracy literacy indicators in ethnomathematics contexts

Based on Table 2, the author concludes by categorizing the above indicators and putting them together. Ethnomathematics context, ethnomathematics context indicators, mathematical concepts in ethnomathematics context, numeracy literacy in

ethnomathematics context, and numeracy literacy indicators in ethnomathematics context are only a few.

### **3.1 Ethnomathematics Contexts**

According to research findings from many sources, mathematical concepts exist in Indonesian culture. The author divides ethnomathematics contexts into Indonesian areas, including East Java, Central Java, Sumatra, Kalimantan, Sulawesi, and East Nusa Tenggara. First, ethnomathematics found in East Java include; Javanese culture [20], tambourine art [16], rattan woven handicrafts (bags, baskets, chairs, and serving hoods) [17], and Pamiluto Batik [18] in the Gresik community, Jonegoroan Batik from Bojonegoro [23], Sidoarjo culture batik of Sari Kenongo [25], [26], Candi Pari [25], and Petambak Cemandi [25]. Second, ethnomathematics in Central Java includes Semarang culture [28], Petanahan culture [31], and Surakarta culture, namely Lemper [32].

Third, Sumatran ethnomathematics, specifically the small Ark building from Bengkulu [30]. Fourth, ethnomathematics in Kalimantan includes Tidayu culture (Barongsai-Naga, Sumpit-Perisai, and Saprahan) [19], typical Sambas food of spicy porridge/bubbor paddas [24], Kutai Sultanate traditional clothes Takwo [24], Jami' Sultan Syarif Abdurrahman Alkadrie Mosque in Pontianak [24]. Fifth, Sulawesi ethnomathematics, namely culture in North Sulawesi [27]. Sixth, East Nusa Tenggara ethnomathematics include Japanese monument culture in Kupang [24], culture in the Malacca area, specifically traditional home constructions, Siri Pinang sites (*Kabi* and *Koba*) used to entertain guests, and school bags fashioned from woven palm leaves [29].

The findings of the ethnomathematics context reveal aspects of ethnomathematics in Indonesia. Therefore, it can be argued that the culture in Indonesia can be used as an ethnomathematics background for teaching and learning.

### **3.2 Ethnomathematics Indicators in Ethnomathematics Contexts**

Several indicators were discovered to be used to determine culture as ethnomathematics content based on research results from diverse sources. Ethnomathematics is a mathematical notion derived from local cultural understanding owned by particular locations and spreads throughout society [17], [19], [26]. The relationship between mathematics, mathematical modeling, and cultural anthropology might be understood as ethnomathematics [27]. Ethnomathematics is also defined as a method of thinking that may be understood mathematically with and without awareness to produce specific patterns [20]. Multicultural mathematics encompasses traditional cultural values, customs, symbols, and methods that aid in studying mathematics [25]. As a result, ethnomathematics serves as a gateway to learning mathematics through local cultural knowledge [25], [29]. The relationship between culture and mathematics learning can be examined from various perspectives [24]. Ethnomathematics is defined as a unique method of mathematical activity employed by specific ethnic groups or cultures. In contrast, mathematical activities occur during abstracting from real-world experiences into mathematics [28].

Mathematical activities in ethnomathematics, such as explaining, classifying, counting, measuring, counting, designing buildings or tools, playing, finding locations, and so on, can be classified as ethnomathematics context indicators [16], [18], [32]. Community organization systems, religion and religious rites, livelihoods, science, technology, equipment, language, and art are all subunits of a cultural and social system [23].

The application of ethnomathematics in education can be divided into three categories: mathematical practice, mathematical ideas, and mathematical understanding of a socio-cultural group [31]. Furthermore, the advantages of ethnomathematics as a learning context have become a tool for motivating, stimulating, and overcoming students' challenges in studying mathematics [30]. It is an initial concept held by the local socio-cultural context since ethnomathematics is a part of student's daily life.

Previous explanations reveal that indicators or categories are required to determine culture as content in learning mathematics for the culture to be suitable for use in learning. Therefore, indicators of ethnomathematics context can be distinguished from mathematical processes and cultural and social system subunits.

### **3.3 Mathematical Concepts in Ethnomathematics Contexts**

Several mathematical ideas were discovered in the ethnomathematics setting based on study findings from various sources. The Education Assessment Center divides mathematical concepts into four domains: number, geometry and measurement, algebra, and data and uncertainty. Those mathematical topics have been grouped in the context of ethnomathematics.

The mathematical concepts gained in the numbers domain include standard and non-standard units [25] and multiplication [17]. The mathematical concepts learned in the Algebra domain are the mathematical notion of a two-variable linear equation system (substitution, elimination, and combination) [28] and ratio and comparison [25]-[27]. There are concepts of chance and sets in the data and uncertainty domain [19].

Furthermore, the mathematical ideas obtained in the geometry and measurement domain include irregular and regular two-dimensional shapes, which comprise square, rectangle, rhombus, trapezoid, triangle (right-angled & isosceles), and kite [18], [23]-[25], [30], [32]. There are also the ideas of circles, semicircles, and ellipses [19]. Then, in the three-dimensional faces, cubes, and cuboids [17], [20], [29], [31], [32] were obtained. Tubes, tubes without caps, cones, and spheres are formed in curved three-dimensional figures [16], [17]. Reflection, translation, rotation [17], [23], [25], and congruence [25] are examples of transformation geometry.

The above results suggest that there are mathematical notions in the ethnomathematics context. Thus, it may be argued that there are mathematical notions from the domains of numbers, geometry and measurement, algebra, and data and uncertainty in the ethnomathematics context.

### **3.4 Numeracy Literacy in Ethnomathematics Contexts**

Numeracy literacy outcomes were discovered in ethnomathematics based on research from numerous sources. The first is from the findings of ethnomathematics research in Indonesian culture. The study of ethnomathematics from the standpoint of numeracy literacy can be utilized to develop instructional materials for mathematics learning [17], [18], [23]. The second results from the development of ethnomathematics-based teaching materials and tools. The development results demonstrate that they are valid, practical, and effective [16], [20], [31]. Therefore, ethnomathematics-based teaching materials and instruments can be employed in the classroom.

The third is based on the findings of ethnomathematics studies from the standpoint of numeracy literacy. The numeracy literacy process category demonstrates that three mathematical processes are used to assess students' numeracy literacy: formulate, apply, and interpret. This aspect corresponds to the PISA 2018 Assessment and Analytical

Framework [6]. Table 3 shows the activities performed in the mathematical process [16], [17], [23], [25], and [26].

**Table 3.** Mathematical Processes and Their Activities

<b>Mathematical processes</b>	<b>Activities</b>
Formulate	Formulate, discuss, model, recognize, represent, and identify.
Employ	Apply, determine, generalize, and design.
Interpret	Interpret, check, evaluate, explain, identify, and interpret.

Then, four mathematical contents are discovered: number [17], [25], geometry and measurement [16]-[18], [23]-[25], [29]-[32], algebra [25]-[28], and data and uncertainty [19]. Furthermore, mathematics exists in a socio-cultural and scientific environment. They are consistent with the Assessment Center's determination of the content and context of the AKM for mathematics-numeracy literacy.

Based on the results of the numeracy literacy test, students' outcomes are low [27], [32] for those with low learning responsibility [28]. However, when ethnomathematics-based learning was provided, student learning results improved [19], [24], [26], [30]. Students with a high level of learning responsibility also had better learning outcomes [28]. Furthermore, the ethnomathematics nuanced eliciting activities learning approach performed well on numeracy literacy assessments [29]. Ethnomathematics' effect and approach can increase students' numeracy literacy skills, problem-solving skills, mathematical communication, and overcoming mathematical challenges [30].

The previous discussion reveals that there is numeracy literacy in the ethnomathematics context. Therefore, it is possible to conclude that various numeracy literacy results exist in various studies.

### 3.5 *Indicators of Numeracy Literacy in Ethnomathematical Contexts*

Several indicators were discovered to be used to determine the numeracy literacy category in the ethnomathematics context based on research results from various sources. The definition of numeracy literacy can be used to derive ethnomathematics indicators. Numeracy literacy, as defined by the Program for International Student Assessment (PISA), is a person's ability to formulate, use, and interpret mathematics in a variety of situations [30]. Furthermore, PISA's mathematical/numeracy literacy focuses on students' ability to analyze, justify, and communicate ideas about mathematical problems in a variety of contexts [11].

Then, according to the OECD (Organization for Economic Cooperation and Development), indicators of numeracy literacy can be determined from aspects of numeracy literacy, namely mathematical processes, mathematical content, and mathematical context [17]. Furthermore, the OECD divides the mathematical process into three stages: formulation, application, and interpretation [16]-[18], [25]-[27]. Furthermore, numeracy literacy indicators can be derived from the OECD's seven basic mathematical skills: communication; mathematization; representation; reasoning and argument; devising problem-solving strategies; using symbolic, formal, and technical language and operations; and mathematics tools [19], [20], [29]-[31].

Furthermore, numeracy literacy indicators can be determined using Lane's Quasar General Rubric, which includes the following: not answering / not understanding the problem; understanding some mathematical concepts and processes in the problem, using inappropriate strategies and tools, and making mistakes in many calculations; Almost understand the mathematical concepts and processes in the problem, identify important factors, but make numerous errors in ideas and calculations; Good understanding of the

mathematical concepts and processes in the problem, using almost correct notation and terminology, using a complete algorithm followed by correct calculations, but with errors; Using correct notation and terms to express understanding of the mathematical concepts and processes in the problem, as well as a complete algorithm and correct calculations [24]. Furthermore, numeracy literacy indicators can be seen from the aspects involved in mathematical/numeracy literacy, namely: (1) spatial literacy, mathematical literacy that includes an understanding of the (three-dimensional) world in which we live and move; (2) numeracy, mathematical literacy related to the numeracy aspect to process data and evaluate statements about problems and situations that invite mental processing and estimation in the context of the real world; and (3) numeracy, mathematical literacy related to the numeracy aspect to process data and evaluate statements about problems and situations.

Furthermore, student numeracy literacy test results are classified as good (fluency, accurate computation, and optimal idea development), adequate (fluency, accurate computation, and suboptimal idea development), and inadequate (fluency, accurate computation, and suboptimal idea development) [26].

The above explanation demonstrates that there are various types of indicators that can be used to determine or measure numeracy literacy. As a result, it is possible to conclude that numeracy literacy indicators can be measured using the OECD, the Quasar General Rubric, and the factors involved in mathematical/numeracy literacy.

After reviewing several studies on applying ethnomathematics in numeracy literacy, the author discovered benefits and drawbacks. The author gains an advantage by reviewing the research and discovering that ethnomathematics can be used to improve students' numeracy literacy skills. Using ethnomathematics to learn is an alternative to combining culture and mathematics. So that student learning has meaning. The disadvantage of this article is that it takes a long time to answer the research question. Then, when thoroughly searching the literature, it is possible to overlook some important studies, which can have an impact on the conclusions.

#### 4. CONCLUSION

The findings of the ethnomathematics context demonstrate that there are elements of ethnomathematics in Indonesia that can be used as an ethnomathematics context to benefit the teaching and learning process. Through ethnomathematics-based learning, students develop numeracy literacy skills. This skill can be used to solve problems in everyday life. Furthermore, indicators or categories of ethnomathematics contexts, namely mathematical activities and subunits in a cultural and social system, are required to determine culture as content in mathematics learning. There are mathematical concepts from numbers, geometry and measurement, algebra, and data and uncertainty in ethnomathematics. Diverse numeracy literacy outcomes in the ethnomathematics context can also be found in various studies. The OECD, Quasar General Rubric, and aspects involved in numeracy literacy can be used to determine or measure indicators that can be used to determine or measure numeracy literacy. Ethnomathematics can be used as an alternative in the classroom to assess students' numeracy literacy skills.

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