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# FROM CULTURAL PRACTICES TO MATHEMATICS LEARNING IDEAS: EXPLORING MATHEMATICS EDUCATION STUDENTS' PERCEIVED MATHEMATICAL ACTIVITIES

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**Abstract**

The data consisted of written responses to Assignment, entitled "From Cultural Assumptions to Learning Ideas," and were analyzed using thematic analysis. The findings revealed three main themes: (1) students identified mathematical activities through the characteristics and practices of culture; (2) perceived mathematical activities were translated into learning ideas by connecting them with school mathematics concepts and designing student activities; and (3) some students recognized that the relationship between mathematics and culture remained an initial assumption that required further confirmation. The findings indicate that cultural exploration can serve as an initial stage for prospective teachers to identify mathematical potential and develop it into learning ideas, while taking into account the basis and limitations of their interpretations of cultural practices.

## 1. INTRODUCTION

Mathematics learning is not only about understanding mathematical concepts and procedures but also about students' ability to recognize how mathematics is related to problems or situations they encounter in everyday life. Therefore, learning should provide students with opportunities to develop understanding through examples or situations that are relevant to and consistent with their everyday experiences. The use of cultural contexts is one way to present mathematics in situations that are more meaningful and closely connected to students' lives. Recent studies have shown that integrating culture into mathematics learning can strengthen the connections between mathematical concepts,

everyday experiences, and students' social environments (Batiibwe, 2024; Riski et al., 2024). Other studies have also indicated that cultural practices within communities can provide authentic examples that help connect everyday activities with various mathematical concepts taught in schools (Hartoyo et al., 2025; Solihin et al., 2025).

The integration of culture into mathematics learning is grounded in the ethnomathematics approach. D'Ambrosio (1985) viewed mathematics as part of human activities within cultural contexts, while Bishop (1988) considered mathematical activities as part of the process of enculturation. This perspective has been further supported by recent studies showing that various cultural practices involve mathematical activities that can be connected to mathematical concepts taught in schools (Batiibwe, 2024; Riski et al., 2024). Thus, culture can serve as a source for identifying mathematical activities while also enriching mathematics learning through more relevant contexts.

Several studies have identified relationships between cultural products and mathematical concepts. Research on batik, for example, has found geometric transformation concepts in cultural patterns, including translation, reflection, rotation, and dilation (Fachrunnisa & Sari, 2023; Setyaningrum & Kusno, 2024). Asfyra et al. (2026) showed that Palembang jumputan motifs are related to the concepts of translation, reflection, rotation, and dilation and can be used as examples in teaching geometric transformations. These findings indicate that cultural products can serve as resources for learning mathematical concepts through contexts that are more closely connected to people's everyday lives.

However, identifying mathematical concepts in a cultural product does not automatically explain how mathematical activities within cultural practices can be understood and utilized for learning. This process requires the ability to recognize connections between culture and mathematics and then transform these connections into meaningful learning materials. Recent studies have shown that teacher education should provide experiences that help prospective teachers develop the knowledge and skills needed to integrate cultural contexts into mathematics learning (Mabotja, 2025; Rodríguez-Nieto et al., 2025). Therefore, prospective teachers' ability to identify mathematical potential within particular cultural practices and transform it into learning ideas is important to investigate.

Mathematics education students, as prospective teachers, may have different ways of understanding the relationship between culture and mathematics. Research involving prospective teachers has shown that experiences in exploring cultural contexts can help them understand mathematics embedded in everyday life and consider how such mathematics can be utilized in teaching and learning processes (Mabotja, 2025; Rodríguez-Nieto et al., 2025). However, connecting cultural contexts with learning requires not only the ability to identify mathematical concepts but also the ability to develop these contexts into activities or tasks with clear mathematical learning objectives (Kurniawan & Kurniasih, 2026). Therefore, how students understand the mathematical potential of a cultural practice and transform it into learning ideas is important to investigate.

In this study, students' understanding of mathematical activities is considered an initial assumption rather than an established finding of an ethnomathematical investigation. This distinction is important because relationships between culture and mathematics should be grounded in an understanding of the cultural practices underlying them. For example, Asfyra et al. (2026) showed that the identification of mathematical concepts in Palembang jumputan motifs became clearer after observations of the motifs and information about their production processes were conducted. Therefore, students' responses in this study reflect how prospective teachers initially perceive the possibility of mathematical activities within a particular cultural practice.

To investigate this process, this study employs a cultural exploration task that enables students to identify cultural practices, propose possible mathematical activities, and connect them with mathematical concepts and learning ideas. Students' written responses were analyzed to understand how they perceive the mathematical potential of a cultural practice and how they translate this potential into ideas for mathematics learning. The study focuses on the initial process of understanding and translating these connections rather than testing ethnomathematics-based learning or verifying the mathematical activities embedded in a particular cultural practice.

Based on the above discussion, this study aims to investigate how students in a Mathematics Education program connect the mathematical activities they perceive in local cultural practices with mathematical learning concepts. The research question is: "How do Mathematics Education students connect mathematical activities they perceive in cultural practices with ideas for mathematics learning?"

## 2. METHOD

This study employed a descriptive qualitative approach to investigate how students in a Mathematics Education program connect mathematical activities they perceive in everyday cultural practices with mathematical learning concepts. The participants were 29 students from the Mathematics Education Study Program at Universitas Negeri Makassar who participated in learning activities on ethnomathematics.

The research data consisted of students' written responses to an assignment entitled "From Cultural Assumptions to Learning Ideas." In this assignment, students were asked to identify cultural practices, propose possible mathematical activities involved in those practices, relate them to mathematical concepts taught in schools, explain how students might engage in such activities, and develop a mathematics task based on the selected cultural context. All student responses were used as research data.

The data were analyzed using thematic analysis following the guidelines proposed by Braun and Clarke (2006, 2021).

The analysis involved repeatedly reading all responses, generating codes, grouping codes with similar meanings, developing categories and themes, and reviewing the themes across the entire dataset. The analysis aimed to identify how students recognized mathematical activities in everyday cultural practices, connected them with mathematical content taught in schools, and transformed them into learning ideas.

To support the credibility of the interpretations, the researchers repeatedly referred to the original data and used excerpts from students' responses as evidence supporting each theme. The mathematical activities proposed by the students were treated as initial perceptions rather than verified findings of an ethnomathematical investigation.

## 3. RESULTS AND DISCUSSION

Analysis of the 29 students' responses showed that students connected culture and mathematics in various ways. Some students focused on the characteristics of cultural objects, such as their shapes, patterns, sizes, quantities, and arrangements, whereas others began to pay attention to the actions performed within cultural practices. These initial perceptions were then connected to mathematical concepts taught in schools and developed into possible learning ideas or tasks, although the strength of these connections varied across responses. Based on these patterns, the thematic analysis identified three main themes: (1) mathematics in culture is understood through the characteristics and practices of culture; (2) identified mathematical activities are viewed as ideas for mathematics learning; and (3) the relationship between mathematics and culture remains tentative and requires additional evidence for confirmation.

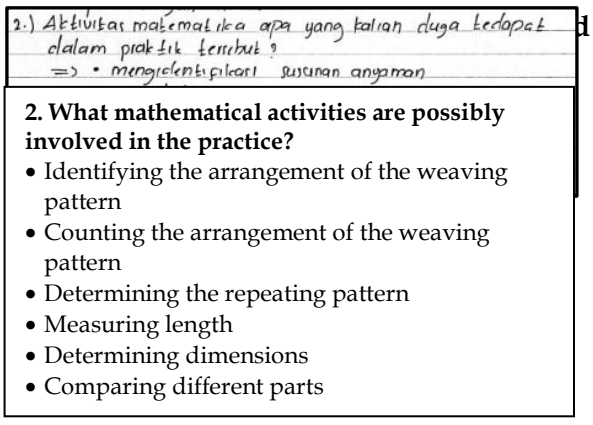



Figure 1. Excerpt from M10's response identifying possible mathematical activities in a cultural practice.

**Through Cultural Characteristics and Practices**

The students' responses showed that a primary way of forming initial perceptions of mathematical activities was by examining the characteristics of cultural objects and paying attention to activities performed within cultural practices. In cultural objects, students frequently identified shapes, sizes, arrangements, patterns, symmetry, and the balance of their components. Meanwhile, in cultural practices, students identified activities such as counting, measuring, comparing, arranging objects in particular sequences, and creating repeated patterns. Thus, culture was not viewed merely as something that contains mathematical forms but also as a set of practices involving actions that can be interpreted mathematically.

This pattern was evident across the various cultural contexts selected by the students. In the context of Songkok Recca, for example, students connected the production process with repeating patterns, arranging components, measuring, comparing, and identifying geometric forms. In Lipa' Sabbe, students identified activities such as counting threads, determining dimensions, arranging motifs, and recognizing repeated patterns. Meanwhile, in architectural contexts such as Balla Lompoa, Tongkonan, and other cultural buildings, students tended to focus more on dimensions, shapes, proportions, the number of structural components, and symmetry. These findings indicate that students' perceptions of possible mathematical activities emerged from various aspects that they could observe in cultural objects or practices.

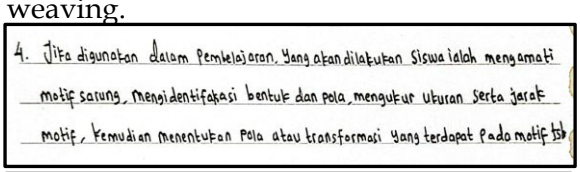
M10's response in the context of Songkok Recca shows that the student developed assumptions about mathematical activities based on observable features of the cultural practice, such as the weaving technique, repetition of forms, dimensions, and relationships among its components. This is consistent with the ethnomathematics perspective, which views mathematical activities as part of people's everyday lives and cultural practices (D'Ambrosio, 1985; Bishop, 1988). Batiibwe (2024) also showed that activities such as weaving and other cultural practices may involve mathematical concepts taught in schools, including measurement, number patterns, and geometry. Thus, M10's response indicates that the student began to understand mathematics not merely as an independent body of knowledge but as something that can be recognized through practices within particular cultural contexts. This finding is also consistent with the study by Rodríguez-Nieto et al. (2025), which showed that exploring cultural practices can help prospective teachers establish connections between everyday activities and mathematical concepts.

**b. Perceived Mathematical Activities Are Translated into Mathematics Learning Ideas**

After identifying possible mathematical activities, students began to connect them with mathematical concepts taught in schools and with potential learning activities. These connections were reflected in their explanations of concepts such as geometry, measurement, patterns, comparison, transformations, sequences, area, perimeter, and trigonometry. Some responses showed that students did not merely identify mathematical concepts but

also described steps that students could carry out within cultural contexts, such as observing pictures or objects, identifying shapes and patterns, taking measurements, counting particular components, comparing dimensions, or determining subsequent patterns. These findings indicate that students began to transform the mathematical potential they perceived in cultural practices into possible mathematics learning activities.

In several responses, this translation was more evident because students not only discussed mathematical concepts but also proposed activities that could be carried out by learners. One example can be seen in M18's response in the context of Sekomandi weaving.


4. Jika digunakan dalam pembelajaran. Yang akan dilakukan siswa ialah mengamati motif sarung, mengidentifikasi bentuk dan pola, mengukur ukuran serta jarak motif, kemudian menentukan pola atau transformasi yang terdapat pada motif tsb

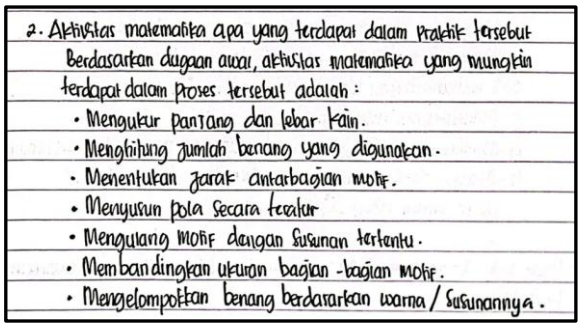
If used in learning, students could observe the Sarung motif, identify its shapes and patterns, measure the dimensions and distances between motifs, and then determine the patterns or transformations present in the motif.

Figure 2. M18's response in developing perceived mathematical activities into learning ideas.

M18's response indicates that the perceived mathematical activities were beginning to be transformed into activities that students could carry out during the learning process. The student not only identified mathematical concepts but also suggested activities such as observing, identifying, measuring, and examining patterns or transformations in cultural motifs. This indicates that the cultural context was beginning to be viewed as a situation that students could investigate to support their understanding of mathematics. Recent studies have also shown that cultural contexts can serve as a basis for designing mathematical activities; however, such contexts need to be integrated with mathematical structures and learning objectives rather than being used merely as a backdrop for a story (Batiibwe, 2024; Rodríguez-Nieto et al., 2025).

c. **The Relationship Between Mathematics and Culture Remains Tentative and Requires Confirmation**

The analysis also showed that the mathematical connections proposed by the students were not yet fully regarded as verified cultural knowledge. Some students explicitly stated that their identifications were still initial assumptions and needed to be further examined through observation, interviews, or document collection. In their response regarding Sekomandi weaving, one student clearly stated that identifying mathematical activities was considered a first step before describing activities such as measuring length and width, counting the number of threads, determining the distances between parts of a motif, and arranging patterns. This statement indicates that some students had already recognized the importance of distinguishing assumptions based on initial observations from mathematical knowledge that is actually embedded in cultural practices.


2. Aktivitas matematika apa yang terdapat dalam praktik tersebut
Berdasarkan dugaan awal, aktivitas matematika yang mungkin terdapat dalam proses tersebut adalah :
- Mengukur panjang dan lebar kain.
- Menghitung jumlah benang yang digunakan.
- Menentukan jarak antarbagian motif.
- Menyusun pola secara teratur
- Mengulang motif dengan susunan tertentu.
- Membandingkan ukuran bagian-bagian motif.
- Mengelompokkan benang berdasarkan warna / susunannya.

**2. What mathematical activities are present in the practice?**
Based on the initial assumptions, the mathematical activities that may be involved in the process include:
• Measuring the length and width of the fabric.
• Counting the number of threads used.
• Determining the distance between motifs.
• Measuring patterns regularly.
• Repeating motifs in a particular arrangement.
• Comparing the sizes of different parts of the motif.
• Grouping threads based on their colors or arrangement.

Figure 3. M43's response showing that the identification of mathematical activities was positioned as an initial assumption

M43's response shows that the student did not immediately regard the relationship between the cultural practice and mathematical activities as something that was certainly valid. The use of the phrase "initial assumption" indicates that the relationship identified from the first observation still needed to be examined further. From an ethnomathematical perspective, mathematical activities should be understood in relation to the underlying cultural practices rather than merely based on the observable characteristics of cultural objects (D'Ambrosio, 1985). Research conducted by Asfyra et al. (2026) also demonstrated a relationship between Palembang jumputan motifs and geometric transformation concepts. They identified this relationship through observation and documentation and strengthened their understanding through interviews with artisans. Thus, the relationship between cultural characteristics and mathematical concepts can be further examined by considering information about how the cultural products are made, which differs from an initial understanding based solely on students' observations. This finding indicates that the use of the phrase "initial assumption" in M43's response reflects an awareness that the identification of mathematical activities still needs to be investigated and confirmed through actual cultural practices.

Overall, the students connected their perceived mathematical activities in cultural practices with learning concepts through three steps: identifying mathematical activities, connecting them with mathematical concepts taught in schools, and designing appropriate learning activities. The ways in which students established these connections varied, ranging from identifying mathematical features in cultural objects to designing more explicit and concrete learning activities. Some students also began to recognize that the mathematical connections they identified remained initial assumptions and required further confirmation.

## Discussion

### Reading Mathematics Through Culture

This study shows that engaging with culture can provide prospective teachers with an initial experience that broadens their ways of thinking about mathematics as a subject. From an ethnomathematical perspective, mathematics is not viewed solely as formal knowledge developed through teaching and learning processes but also as part of human activities that emerge within social and cultural environments (D'Ambrosio, 1985). This perspective suggests that community activities can provide a setting for understanding how mathematical knowledge is used in everyday life. For Mathematics Education students, such experiences are important because they can broaden their understanding that the mathematics taught in schools is connected to experiences and practices that occur beyond the classroom.

However, understanding mathematics through culture does not stop at the ability to match cultural characteristics with mathematical concepts taught in schools. More importantly, it requires understanding how these characteristics are connected to the activities underlying them. Batiibwe (2024), in a literature-based study of ethnomathematics in mathematics education, showed that various cultural practices may contain mathematical knowledge and can be utilized as instructional resources. However, this potential needs to be investigated and

integrated systematically so that it does not remain merely at the level of identifying mathematical concepts within cultural objects (Batiibwe, 2024).

In the context of prospective teacher education, this indicates the need to develop ways of reading culture that focus not only on "what mathematics can be found" but also on "how these activities are carried out in practice." This shift is important so that students do not view culture merely as a collection of objects that can be associated with school mathematics concepts. Cultural exploration can provide an experience that helps students understand that mathematics is closely related to the activities, needs, and ways in which people live their everyday lives. Thus, ethnomathematics for prospective teachers can become a space for developing a more contextually relevant understanding of mathematics while broadening their perspectives on sources of mathematical knowledge.

**From Cultural Contexts to Mathematics Learning**

The findings also show that using culture in mathematics learning involves a pedagogical process that goes beyond simply understanding the mathematical aspects of culture. This distinction can be understood through the concept of pedagogical content knowledge, in which the ability to transform subject matter knowledge into forms that are accessible to students is considered an important component of teachers' knowledge (Shulman, 1986). In the context of ethnomathematics, this process becomes more complex because prospective teachers need to consider the relationship between mathematical understanding, local cultural characteristics, and the learning experiences provided to students.

This perspective is consistent with the study by Rodríguez-Nieto et al. (2025), which showed that a brick-making context could help prospective teachers develop mathematical and ethnomathematical connections when the context was related to problem-solving processes and appropriate mathematical structures. Rodríguez-Nieto et al. (2025) found that this reinforces the understanding that cultural contexts have educational value when they guide students toward particular mathematical activities. Therefore, developing culture-based learning requires not only selecting contexts that are relevant to students' lives but also an appropriate pedagogical process for determining how those contexts can be used to develop mathematical understanding.

For prospective teacher education, this implies that experiences in exploring cultural practices should be followed by experiences in designing learning activities. Students should be given opportunities to consider the relationships among mathematics learning objectives, contextual characteristics, student activities, and the tasks to be provided. Through this process, students not only learn to identify mathematical potential within culture but also develop the ability to consider whether such potential can be transformed into learning experiences with clear mathematical purposes.

**Initial Assumptions as an Early Stage of Ethnomathematical Exploration**

The findings concerning the use of initial assumptions provide an important epistemological dimension to the exploration of ethnomathematics. When individuals observe cultural practices through the lens of mathematical knowledge they already possess, the relationships that initially emerge are shaped by their own understanding and interpretation. Such interpretations can provide a useful starting point for exploring culture, but they do not automatically explain how a practice is carried out or understood by the people who engage in it. Therefore, in ethnomathematical exploration, it is important to allow initial interpretations to be strengthened, refined, or even revised after more comprehensive information about the cultural practice has been obtained.

This issue is important because there is a distinction between understanding the mathematical structure of an object and understanding the mathematical activities

embedded in a cultural practice. Patterns, shapes, or dimensional relationships can be analyzed using mathematical concepts taught in schools, but such analysis does not necessarily explain why, how, or in what ways communities create and use those objects. Therefore, the status of an initial assumption does not merely indicate a limitation in students' knowledge but can also be understood as a position that allows exploration to take place through greater reflection.

The study by Asfyra et al. (2026) provides an appropriate example to clarify this point. In exploring Palembang jumputan motifs, the relationship between cultural patterns and geometric transformations was analyzed through observation and documentation and further supported by information from artisans regarding how the motifs were produced. This approach demonstrates that understanding the mathematical properties of a cultural product can become more comprehensive when connected to the processes used to create those properties. Therefore, previous research provides a basis for viewing mathematical ideas emerging from initial observations as a starting point for further exploration, while information about cultural practices can be used to deepen understanding of the relationship between mathematics and culture.

For prospective mathematics teachers, this awareness influences how they use culture as a learning resource. Students need to become accustomed to questioning the basis of the mathematical relationships they identify rather than simply checking whether an object can be associated with a particular mathematical concept. Questions concerning how a practice is carried out, its purposes, and how the community involved understands the practice can help prospective teachers approach cultural contexts more carefully. Thus, ethnomathematical exploration not only helps connect culture and mathematics but also encourages a reflective attitude toward the limitations and foundations of the knowledge used in designing learning processes.

Overall, the discussion indicates that cultural exploration experiences for Mathematics Education students have broader significance than merely searching for mathematical concepts in cultural objects or practices. Such experiences are related to changes in how mathematics is viewed, the ability to transform contexts into part of the learning process, and awareness of the distinction between initial understandings and established cultural knowledge. Therefore, ethnomathematics education for prospective teachers should provide space for these three aspects so that students are not only able to identify mathematics in culture but also able to understand and use mathematics more responsibly in their teaching practices.

## 4. CONCLUSION

This study shows that students in the Mathematics Education Study Program connected mathematical activities in cultural practices with mathematics learning concepts. They identified mathematical aspects within culture, related them to mathematical content taught in schools, and transformed them into learning activities or tasks. This process indicates that students were beginning to view cultural practices as resources for developing ideas for mathematics learning. However, some students also recognized that the relationships between mathematics and culture they identified remained initial assumptions that needed to be examined through observations of actual cultural practices. Therefore, in prospective teacher education, cultural exploration should not only help students identify mathematical potential but also enable them to translate this potential into learning processes while maintaining awareness of the basis and limitations of the interpretations they make.

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