EduStream: Jurnal Pendidikan Dasar

Volume 9, Number 1, 2025 pp. 1-13
E-ISSN: 2614-4417
Open Access: https://journal.unesa.ac.id/index.php/jpd/index

Literature study on the effectiveness of ethnoSTEAM on mathematics learning in elementary school based on baduy tribe's craft art

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ARTICLE INFO

Article history:
Received 09 March 2025
Acccepted 29 May 2025
Published 30 May 2025

Keywords:
EthnoSTEAM,
Mathematics education,
Elementary school,
Baduy tribe ,
Craft art

DOI:
https://doi.org/10.26740/eds.v9n1.p1-13

ABSTRACT

Mathematics learning in elementary schools is often considered abstract and less meaningful due to the lack of connection with real-life contexts. This study aims to examine the effectiveness of the application of the EthnoSTEAM approach based on Baduy tribal crafts in mathematics learning to improve concept understanding and foster love for local culture. This research uses the literature study method by analyzing accredited scientific sources, including journals from SINTA, Google Scholar, DOAJ, as well as books and related research reports. Data analysis was conducted through content analysis to examine the impact and challenges of implementing the EthnoSTEAM approach in primary education. The results show that the integration of Baduy craft arts such as Koja bags, weaving, batik, and pottery can help students understand mathematical concepts such as patterns, symmetry, flat shapes, perimeter, and volume more concretely. In addition, this approach encourages the development of critical thinking skills, creativity, and an appreciative attitude toward local culture. However, challenges include limited teacher training, lack of culture-based teaching materials, and lack of integrative support in the curriculum. In conclusion, the EthnoSTEAM approach based on Baduy craft art has the potential to enrich basic mathematics learning in a contextual and meaningful way.

INTRODUCTION

Mathematics learning in elementary schools is often considered abstract and difficult to understand by students due to the lack of connection to everyday life (Song & Ju, 2024; Yohannes & Chen, 2023). Concepts in mathematics are often taught theoretically with a conventional approach that focuses on memorizing formulas and procedures without giving students real experience in applying these concepts (Lindquist et al., 2024; Borji et al., 2021). As a result, many students feel that math is a difficult subject and irrelevant to their daily lives. Based on data from a preliminary survey conducted by researchers on 120 students in grades IV to VI in three elementary schools in the Lebak Regency area, Banten, it was found that 76% of students had difficulty in understanding mathematics material, especially on geometry and pattern topics which were considered too abstract and not related to real life. In addition, 68% of math teachers interviewed admitted to still using conventional learning approaches without involving elements

of local culture or contextual methods. Data from daily test results also showed that only 34% of students were able to achieve scores above the Minimum Completion Criteria on the material of flat buildings and symmetry. This finding indicates that there is a gap between the learning methods used and the learning needs of students in the field (Raes et al, 2020; Ashraf et al., 2021).

A way that can overcome this gap is through EtnoSTEAM by integrating ethnomathematics elements and the *STEAM* (*Science, Technology, Engineering, Arts, and Mathematics*) approach in the learning process (Verawati et al., 2023; Kirikcilar & Ozdemir, 2024) . This approach allows students to understand mathematical concepts through the exploration of local culture, so that learning becomes more contextual, meaningful, and interesting (Rahayu et al., 2025; Prabawati et al., 2025). In the context of local culture, the traditional craft art of the Baduy tribe is one form of cultural heritage that is rich in mathematical values, such as patterns, symmetry, and geometry (Kabuye, 2024; Ahyuni, 2023). Therefore, Baduy craft art has great potential to be used as a learning medium in the application of EtnoSTEAM in elementary schools to facilitate students in understanding various ideas in mathematics.

The EthnoSTEAM approach in culture-based mathematics learning has a strong basis in various educational theories. One theory that supports this approach is ethnomathematics theory, which emphasizes that mathematics is a social construction that develops in various cultures (Fyhn & Nutti, 2023; Prahmana, 2020). Mathematical concepts can be found in cultural activities, including the traditional craft art of the Baduy tribe which is rich in geometry and symmetry patterns (Farokhah et al., 2023). The integration of mathematics in local culture allows students to understand mathematical concepts in a more relevant and meaningful context (Harefa, 2024; Mania & Alam, 2021). Ethnomathematics not only introduces mathematics as an exact science, but also as part of cultural practices that are passed down through generations (Rosa & Orey, 2021; Meaney et al., 2021). Therefore, the application of Baduy craft art in EtnoSTEAM learning provides a more interactive and cultural context-based learning experience.

Culture-based mathematics learning also helps students in building critical and reflective thinking skills, because students not only understand concepts theoretically but also in the context of real life (Hasibuan & Dewi, 2024; Payadnya et al., 2024). In addition, mathematics is not only a universal science, but also influenced by social and cultural factors, so understanding mathematical concepts in the context of local culture can help students connect theory with real applications in their lives (Kolovou, 2023; Nur et al., 2020). Ethnomathematics can also increase students' interest in learning mathematics because students see its relevance in their daily lives (Nurhasanah, 2023; Garba, 2024). This is in line with the importance of the EtnoSTEAM approach which incorporates cultural elements in mathematics learning to improve conceptual understanding and creative thinking skills.

Although the EtnoSTEAM approach has been widely applied in mathematics learning, research that focuses on the integration of Baduy tribal craft art in mathematics education in elementary school is still limited. Most of the EtnoSTEAM research focuses more on science and technology aspects, while the role of art and culture in mathematics learning still receives less attention (Hardiyanti et al., 2024; Zhang et al., 2023). The lack of contextualization in mathematics education is one of the main factors in students' low understanding and interest in this subject

(Rubel & McCloskey, 2021; Reinke & Casto, 2022). Research shows that mathematics learning that focuses too much on theory and memorization of formulas makes it difficult for students to connect the concepts learned with real life, thus reducing their motivation to learn (Ilmiyah et al., 2021; Stupp et al., 2019).

Various studies have confirmed that culture-based learning has a positive impact on improving students' conceptual understanding and interest in learning mathematics. For example, Reyes et al., (2019) showed that the integration of cultural elements in mathematics learning can facilitate the connection between abstract concepts and students' real-life contexts. Meanwhile, Setyawan & Dopo (2020) emphasized that culture-based approaches are also able to foster appreciation for cultural heritage and strengthen students' local identity. Nuryadi et al. (2023) added that ethnomathematics plays an important role in character building, strengthening moral values, and developing an attitude of nationalism in students. A study by Gustina et al. (2025) showed that the use of digital technology, such as augmented reality-based learning applications and interactive multimedia, can strengthen students' understanding of mathematical concepts through visualization of local culture. Although the contribution of the ethnomathematics approach to learning has been widely researched, the focus of studies is generally still limited to cultural integration in general without referring to specific cultural studies.

The novelty in this research lies in its focus on the craft art of the Baduy tribe as a medium for *EthnoSTEAM-based* mathematics learning. In contrast to previous studies that mostly highlight the technological aspects and learning interests in culture-based learning, this study emphasizes how craft can be an effective means of understanding mathematical concepts in elementary schools. The uniqueness of craft lies in its ability to present math concepts visually and applicatively, making it an innovative alternative for students who have difficulty in understanding abstract math concepts. In addition, this research plays a role in the development of a culture-based curriculum that can be customized by teachers to create a more varied and in-depth learning experience. Therefore, the results of this research are expected to provide a new perspective for the world of education, especially in designing learning models that systematically and effectively integrate mathematics with local culture.

METHODS

In this research, the literature study method is used, which focuses on searching and analyzing data from various scientific sources regarding the effectiveness of the EthnoSTEAM approach in learning mathematics in elementary schools by adapting the craft art of the Baduy tribe. literature study is a series of activities that include methods of collecting references, reading, recording, and processing research materials (Galvan & Galvan, 2024; Snyder, 2019). Literature study was chosen because it allows researchers to review previous research results related to cultural integration in mathematics learning and assess its relevance and effectiveness in the scope of basic education. By using literature review, the researcher can identify relevant findings from previous research and understand the development of relevant theories and concepts studied and analyzed (Ghanad, 2023; Paul & Criado, 2020).

The data collected in this study consisted of various empirical and theoretical sources, including journal articles, books, e-books and other relevant indexed sources. Journal articles as an empirical foundation were obtained from various scientific databases, such as Google Scholar, SINTA, DOAJ, and other indexed and accredited educational journal sites. This study analyzed ± 30 journal articles related to the implementation of EthnoSTEAM in mathematics learning and culture-based approaches in education. Meanwhile, the theoretical basis is obtained from *e-books* that discuss the basic concepts of STEAM, ethnomathematics, and culture-based learning. In addition to journals and books, other sources such as seminar proceedings, research reports, and other academic references were also used to enrich the analysis.

To ensure the relevance and validity of the sources used in this literature study, this research applies strict selection criteria in the selection of references. According to Ilmiyah et al., (2021), the ethnomathematics approach in mathematics learning must be aligned with the applicable curriculum and based on the concept of *real-world* problems so that students can relate mathematical concepts to their daily experiences. Therefore, this study only considers sources that discuss ethnomathematics in the context of basic education and are relevant to the implementation of EthnoSTEAM in elementary schools. Thus, the literature review method used in this research is expected to provide in-depth insight into the integration of local culture in mathematics learning in elementary schools. Data processing in this research was carried out through the content analysis method, which involved several stages in table 1.

Table1. Data Analysis Stage

Steps		Description
1.	Data Reduction	The process of simplifying, selecting, and classifying data that is relevant to the research focus, while inappropriate data is eliminated;
2.	Data Presentation	The process of compiling data in a structured form so that it can be further analyzed with a systematic approach; and
3.	Conclusion Drawing/Verification	The stage where the data that has been analyzed is used to draw conclusions and answer the proposed problem formulation.

In this method, the research aims to provide an in-depth understanding of the effectiveness of the application of EthnoSTEAM in mathematics learning based on the craft art of the Baduy tribe, as well as revealing various opportunities and challenges in its application in elementary schools. The results of this study are expected to be a reference for educators and educational practitioners in designing learning strategies that are more innovative and relevant to the learning context.

RESULTS

Results of Literature Study on the Effectiveness of EthnoSTEAM in Learning Mathematics in Elementary School Based on Baduy Tribe's Craft Art

1. Effectiveness of EthnoSTEAM in Learning Mathematics in Elementary School

The findings of the literature review reveal that the application of the EthnoSTEAM approach in mathematics learning can improve students' concept understanding, critical thinking skills, and creativity. The incorporation of local culture, such as the Baduy craft, creates a more relevant and meaningful learning experience compared to traditional methods that tend to be abstract. A number of studies have revealed that culture-based approaches in mathematics learning are capable:

a. Making it easier for students to understand various mathematical concepts through visualization and concrete objects (Jala, 2024).
b. Increasing students' activeness in learning by integrating local cultural elements that are close to students' lives (Siregar et al., 2024).
c. Develop critical thinking and problem solving skills through analyzing patterns, symmetry, and form in craft (Ramadhan et al., 2025).
d. Fostering students' cultural identity while instilling pride in regional cultural wealth (Taufiqurrahman et al., 2024).

Thus, it can be concluded that the EthnoSTEAM approach, especially based on traditional craft arts such as those of the Baduy Tribe, has strong potential in improving the effectiveness of mathematics learning at the elementary school level. Cognitively, the integration of local cultural elements through craft practices allows students to understand abstract mathematical concepts more concretely and visually. Mathematical elements such as patterns, geometric shapes, symmetry, and measurement can be found and explored directly in craft works, thus providing a learning experience that is applicable and contextual.

On the affective side, the involvement of local culture in learning helps build students' emotional attachment to the material being taught. This creates a more inclusive, fun and meaningful learning atmosphere, as students feel that their cultural identity is recognized and valued in the classroom. In addition, the presence of cultural values in learning can strengthen positive attitudes such as curiosity, discipline, responsibility and respect for local traditions.

Socially, this approach can also foster a spirit of intercultural collaboration and dialogue, especially when students are involved in discussions, group projects, or hands-on exploration of local cultures. Students not only learn math, but also build an understanding of the values of togetherness, tolerance, and appreciation of cultural diversity. In other words, the craft-based EtnoSTEAM approach does not only target academic learning outcomes, but also supports the formation of a complete Pancasila learner profile, which is intellectually, emotionally and socially intelligent.

Therefore, the results of this literature study emphasize the importance of developing a contextual and integrative mathematics learning model, where local culture is not only a source of illustrations, but also serves as a pedagogical foundation in building concept understanding. This approach is in line with the demands of the Merdeka Curriculum and 21st century education which emphasizes meaningful, adaptive learning, and is rooted in globally relevant local values.

2. Linkage of Baduy Tribe's Craft Art with Mathematics Concepts

The literature study found that Baduy craft has many mathematical elements that can be utilized in learning in elementary school. From the results of this research, some of the Baduy crafts have ethnomathematics elements that can be integrated with mathematical concepts in elementary school. The following are some ideas of learning activities that can be integrated with the craft of the Baduy tribe, which are as follows.

Table 2. Baduy Tribe Craft Art in EtnoSTEAM Learning

No.	Craft Art of Baduy Tribe	Activities
a.	Baduy/Koja bag 	This learning activity through Baduy bags reflects the EtnoSTEAM approach by integrating local culture and cross-disciplinary learning. The teacher introduces the Baduy/Koja bag craft and its motifs through pictures or slides (Ethno & Art). Students select motifs, then count and record the shapes of flat shapes seen (Math). The process of identifying shapes shows the application of the concept of geometry, while the use of digital media reflects the element of Technology. The final discussion links the concept of counting with cultural works, strengthening the understanding of science, art, and traditional values in an integrated manner.
b.	Baduy weaving 	This activity applies the EtnoSTEAM approach by combining local culture and cross-disciplinary concepts. The teacher explains the history and meaning of Baduy weaving (Ethno & Art), then students observe pictures or examples of weaving. Next, students count the number of threads, recognize color patterns and geometric shapes (Math & Science), and measure the dimensions of the weave (Engineering). This activity also involves visual media (Technology), thus encouraging contextual understanding, critical thinking skills, and cultural preservation through integrated learning.
c.	Batik Baduy 	This activity reflects the EtnoSTEAM approach by combining elements of culture, math, and collaborative work. An introduction to the history and craft of Baduy batik (Ethno & Art) opens up an understanding of local culture. Students solve contextual problems, such as calculating the lace length of a batik-patterned tablecloth, by observing and calculating the perimeter of flat shapes (Math & Engineering). Group discussions and the use of visual media (Technology) strengthen the understanding of concepts contextually and collaboratively.
d.	Batik Lebak 	This activity applies the EthnoSTEAM approach by integrating local culture and math concepts. The teacher introduces the history and cultural values of Baduy batik (Ethno & Art), then students observe the pattern to understand symmetry and geometry (Math & Science). With LKPD, students measure area and perimeter and identify symmetry in the motif (Engineering). This activity fosters cultural appreciation through contextual learning that integrates art, math and technology.
e.	Pottery	This activity carries the EthnoSTEAM approach by combining local culture and geometry concepts. The teacher introduces the history and value of Baduy

No.	Craft Art of Baduy Tribe	Activities
		pottery (Ethno & Art), then students observe shapes such as tubes and cones to calculate volume, compare sizes, and create patterns (Math, Science & Engineering). This activity develops analytical skills and cultural appreciation through traditional context-based learning.

3. The Impact of EthnoSTEAM on Mathematics Learning in Elementary School

Based on various literature sources, the application of EtnoSTEAM based on Baduy tribal craft art in mathematics learning has the following positive impacts:

Table 3. Impact of EthnoSTEAM on Mathematics Learning in Elementary School

Aspects	EthnoSTEAM Impact
Concept Understanding	Increased due to a contextual approach through cultural exploration (Rahayu et al., 2022).
Critical Thinking Skills	It is sharpened because students are invited to analyze patterns, shapes, and mathematical relationships in crafts (Haryanto et al., 2024).
Creativity	Develop through the exploration of motifs, colors, and designs in crafts (Fikrina et al., 2023).
Learning Motivation	Increased because students feel closer to the material being taught (Hasibuan et al., 2023).
Cultural Identity	Strengthened because students recognize and appreciate local culture (Muzakki & Putri 2024)

In other words, the EtnoSTEAM approach provides multiple benefits, both in academic and non-academic aspects. Although it has many advantages, the application of EtnoSTEAM based on Baduy tribal craft art in elementary school still faces several challenges, such as:

a. Lack of culture-based learning resources → Solution: Development of more systematic ethnomathematics-based teaching materials.
b. Lack of teacher training in implementing EtnoSTEAM → Solution: Teacher training on cultural integration in mathematics learning.
c. Time constraints in the curriculum → Solution: Flexible incorporation of EthnoSTEAM with other learning themes.

With an appropriate approach, EthnoSTEAM based on Baduy tribal craft art can be an innovative learning model that is effective in improving the quality of mathematics teaching in elementary schools. Based on the results of the literature review, this method is proven to be able to improve students' understanding of mathematics concepts, critical thinking skills, creativity, and appreciation of culture. This approach also creates a more relevant, concrete and interesting learning experience, so that students can understand mathematics more deeply and applicatively. Although there are still some challenges in its implementation, the right strategy can optimize the use of local culture in mathematics learning. The findings of this study are expected to be a reference for educators in designing innovative culture-based learning models and encourage further research on the integration of ethnomathematics in education.

DISCUSSION

Exploration of the Baduy craft through various literature studies shows that the cultural elements in this craft have a close relationship with basic mathematics concepts. This approach is a combination of ethnomathematics and STEAM *(Science, Technology, Engineering, Arts, and Mathematics)* concepts that allow students to learn mathematics in a more contextual and meaningful way (Rahayu, et., 2024; Auliya et al., 2024). Ethnomathematics itself arises from cultural activities that involve counting, measuring, and making patterns (Umbara et al., 2021; Fouze & Amit, 2017). In the Baduy craft, such as weaving, plaiting, and traditional house architecture, there are mathematical concepts such as symmetry, geometric transformation, and number patterns, which can be used as learning media (Izzah, 2024).

The integration of craft in learning aims to strengthen cultural character in education, as well as improve students' understanding of mathematical concepts (Root-Bernstein, 2015). Character education has an important role in the education system, especially in instilling a sense of love for the country to students (Anugrah & Rahmat, 2024; Yusuf & Fajari, 2025). In the era of globalization, maintaining cultural wealth is key in shaping a generation that is not only globally connected but also still appreciates local values (Febrianty et al., 2023; Aristova, 2016). One efficient way to foster the spirit of patriotism in the learning process is to incorporate elements of tradition into certain subjects, such as mathematics (Nurdin, 2017). A culture-based approach to learning can increase student motivation and engagement (Getz et al., 2024).

Before implementing EtnoSTEAM-based mathematics learning, teachers need to conduct curriculum analysis to see the relationship between mathematical concepts and local culture (Awang et al., 2020). Research on ethnomathematics in Banten culture shows that teachers can apply this approach using inquiry, exploration, observation, and project methods (Nirmalasari et al., 2021). With this approach, students can understand math in a real context, making it easier to understand and relevant to their lives. The implementation of EthnoSTEAM in teaching mathematics at the elementary school level has been proven to strengthen concept understanding, increase creativity, and hone students' critical thinking skills (Prabawati et al., 2025). By using the Baduy craft as a learning medium, students can learn math more interestingly and interactively, while understanding the cultural values inherent in students' lives (Nurhaliza et al., 2024).

One concrete example of the application of EtnoSTEAM is through the Baduy weaving motifs, which contain repeating patterns and reflect fold symmetry and rotary symmetry. The patterns of weaving motifs can be used to teach arithmetic sequences and geometric series, which help students in understanding the concept of number sequences in repeating patterns (Muldiana et al, 2021; Febriyanti & Rahmawati., 2020). In addition, woven bamboo in Baduy traditional houses illustrates the concept of flat and spatial shapes. Students can recognize the shapes of triangles, squares, and jajargenjang and understand surface area and volume through woven projects (Dewi et al., 2023; Wijaya et al., 2023). The challenges in implementing EthnoSTEAM in mathematics learning are still quite significant. One of the main obstacles is the lack of culture-based teaching materials, which causes teachers to have difficulty in finding learning resources that can connect culture with mathematical concepts (Wandari et al., 2018; Mendrofa, Dewi &

Simamora, 2024). To overcome this, a more systematic development of ethnomathematics-based modules and textbooks is needed.

To overcome these obstacles, further research is needed. One aspect that needs to be studied more deeply is measuring the effectiveness of EtnoSTEAM learning quantitatively, using pre-test and post-test methods to compare the learning outcomes of students taught using the EtnoSTEAM approach with conventional learning methods (Sulaiman & Nasir, 2020). In addition, research on developing a more systematic learning model is also important, given that there are not many culture-based guidebooks or curricula available for widespread use by teachers (D'Ambrósio & Knijnik, 2020; Hidayati & Prahmana, 2022). With the right approach, EthnoSTEAM can make mathematics learning more meaningful and relevant for students, by connecting the knowledge they learn with the cultural contexts they are familiar with on a daily basis. Through cultural integration in mathematics learning, students not only gain a deeper understanding of mathematical concepts, but also of their cultural heritage, further enriching students' learning experience.

CONCLUSIONS

The conclusion of this literature study shows that the EtnoSTEAM approach that integrates the craft art of the Baduy Tribe in mathematics learning in elementary school is able to deepen students' understanding of mathematical concepts such as patterns, symmetry, perimeter, and area of flat buildings contextually and meaningfully. Through this approach, students not only learn cognitively, but are also invited to recognize, appreciate, and preserve local culture. In addition to improving conceptual understanding, EtnoSTEAM also encourages creativity, critical thinking skills, and love for the nation's culture. However, the implementation of this approach is faced with challenges such as teachers' limited understanding of culture-based learning models, the lack of relevant teaching materials, and absence of educational policies that support the systematic integration of culture in the curriculum. Therefore, intensive training for teachers, development of local culture-based teaching materials, and support for educational policies that encourage the widespread application of EtnoSTEAM are needed. The impact of this research is expected to encourage synergy between teachers, government, and society in realizing mathematics learning that is not only effective, but also relevant to the cultural context of students, as well as contributing to the preservation of cultural heritage in the midst of globalization.

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