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Development of STEAM Learning Based on Local Wisdom Weaving to Improve the Ability to Create Elementary Students

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Abstract: This study aims to describe and analyze the application of Science, Technology, Engineering, Arts, and Mathematics (STEAM) learning assisted by ikat weaving in improving the creative abilities of fifth-grade students of SDN Sonraen, South Amarasi District, Kupang Regency, East Nusa Tenggara. The research method uses a descriptive qualitative approach with 32 students divided into eight heterogeneous groups. Data were collected through observation, assessment rubrics, interviews, questionnaires, and tests, then analyzed with the stages of data reduction, data presentation, and drawing conclusions according to the Miles & Huberman model. The results show that the application of STEAM learning assisted by ikat weaving can facilitate the active involvement of students in creative, collaborative, and problem-solving thinking processes through local culture-based activities. Students are able to produce simple woven works that combine aesthetic elements with the principles of science and technology. In addition, this activity improves students' creative abilities as seen from original ideas, problem-solving skills, and appreciation of local wisdom. Thus, culture-based STEAM learning is proven to be effective in fostering creativity while strengthening students' cultural identity. The conclusion of the research using the STEAM approach assisted by ikat weaving has proven effective in building students' creative abilities while making the learning process more contextual, enjoyable, and meaningful.

Keywords: Creative Ability; Ikat Weaving; Local Culture; STEAM Learning

Introduction

Mathematics learning plays an important role in building the a critical, logical and analytical thinking skills of students in problem solving. The mathematics curriculum in schools has been structured to facilitate the development of these skills (Arjaya et al., 2024; Hidayah et al., 2024; Ulfaturrohmatiririn et al., 2022). These provisions are broadly defined through the terms standard competencies and basic competencies (Minister of National Education Regulation No. 22 of 2006), core competencies and basic competencies (Minister of Education and Culture Regulation No. 24 of 2016), or learning outcomes (Head of BSKAP Decree no. 033/H/KR/2022). Through the formulation of competencies and learning outcomes, kThese abilities are built through learning mathematics (Wahdiniawati et al., 2023). On going spirally and gradually, according to the abstraction abilities of students guided by the curriculum. According to Decision of the Head of BSKAP no.033/H/KR/2022 Mathematics is organized into five content elements and five process elements (Margareth et al., 2024; Roussou et al., 2025). These five content elements include number, algebra, measurement, geometry, and data and probability analysis. These five content elements build students' mathematical understanding, which is closely related to the formation of a flow of understanding of mathematical learning materials in the form of facts, concepts, principles, operations, and relations that are formal-universal. Meanwhile, the process elements consist of mathematical reasoning and proof, problem solving, and mathematical communication, representation, and connections (Needles, 2025). The process elements in mathematics lessons are related to the view that mathematics is a conceptual tool for constructing and reconstructing mathematical learning materials in the form of activities that form a flow of thinking and a flow of understanding that can develop skills to support adaptability in social life. In line with

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this, (Suliyanthini & Lubis, 2022) emphasizes the importance of developing five main standards in mathematics learning: number and operations, algebra, geometry, measurement, and data and probability analysis, complemented by communication skills, reasoning, and mathematical representation. Therefore, as a basic science, mathematics needs to be mastered well by students starting from elementary school.

According to Piaget (Papadopoulou, 2024; Rofi'ah et al., 2024) a person's understanding and comprehension develop gradually from the age of 7 to 13 years. One of the characteristics that emerge is the concrete operational stage (concrete operational stage) and meaningful learning. Meaningful learning at this age involves using contexts already familiar to students as an introduction and link between concepts in mathematics. Thus, the set learning outcomes can be achieved. However, in reality, many students still experience difficulties in learning mathematics. According to (Aguayo et al., 2023) the difficulties experienced by students in learning mathematics include difficulty understanding explanations and the meaning of questions, difficulty understanding concepts, difficulty understanding symbols, and difficulty in calculations. These difficulties result in low learning outcomes. There are two factors that influence learning difficulties: internal and external factors. (Putri et al., 2025) also conveyed a similar sentiment, stating that students still experience difficulties in learning mathematics, namely difficulty understanding the meaning of questions, understanding concepts, and developing process skills. This difficulty triggers other difficulties, including difficulties in multiplication operations of units, tens, hundreds, and thousands (Chen & Wu, 2024; Dewi et al., 2025).

Difficulty in interpreting discourse and questions is also experienced by students at public elementary schools.sub-district AmSouth area of Kupang district, NTT (Fathurrahman et al., 2025). Interviews with fifth-grade teachers revealed that students struggled to understand number patterns and still struggled with basic arithmetic operations on whole numbers. Students also struggled to understand multiples and factors, despite frequent discussion in class (Homsombat, 2025; Sunzuma et al., 2025). This problem is thought to stem from difficulties understanding multiplication. These interview results align with the still-poor results of the National Computer-Based Exam (ANBK) at Sonraen Elementary School.

Table 1. compares ANBK results nationally, provincially, and at Sonraen Elementary School.

Area	Numerical Achievement in 2023*)	Description	Source
National	Currently	40% 70% of students achieve the minimum competence in numeracy.	Datakemdikbud.go.id
East Nusa Tenggara Province	Not enough	Low Category: Less than 40.00% of students achieve the minimum competence in numeracy.	file:///C:/Users/USER/Downloads/rapor-pendidikan-indonesia-provinsi-nusa-tenggara-timur-2024.pdf
SDN Buraen 1, South Amarasi District	Below minimum competency (1.42)	Most students are in the basic category and need special intervention, especially in terms of competency in the number domain (25.76)*, competency in the algebra domain (22.47)*, competency in the geometry domain (23.85)*, competency in the data and uncertainty domain (28.82)*, competency in knowing (L1) (30.09)*, competency in applying (L2) (24.79)*, and competency in reasoning (L3) (21.94)* *The number in brackets "()" is the value of the domain.	https://raporpendidikan.dikdasmen.go.id/download-report
South Amarasi Sonraen State Elementary School	Below your minimum competencym (1,45)	Most students are in the basic category and need special intervention, especially in terms of competency in the number domain (28.76), competency in the algebra domain (26.49), competency in the geometry domain (27.69), competency in the data and uncertainty domain (31.14), competency in knowing (L1) (35.06), competency in applying (L2) (23.61), and competency in reasoning (L3) (28.9)* *The number in brackets "()" is the value of the domain.	https://raporpendidikan.dikdasmen.go.id/download-report

Based on 2023 numeracy achievement data, both at the national level, East Nusa Tenggara province, and elementary schools in the South Amarasi region, overall results still show low levels. Specifically, at Sonraen Public Elementary School, the majority of students fall below minimum competency, with the lowest achievement in the domains of number, algebra, and geometry, indicating the need for more contextual and meaningful learning interventions.

Due to these low numeracy learning outcomes, efforts are being made to improve the learning process. We are seeking ways to present engaging and enjoyable learning experiences for students, fostering their learning awareness and motivation to improve. We are striving to draw lessons from students' daily experiences, ensuring a familiar context for learning, encouraging them to actively participate.

One approach to addressing this difficulty is utilizing local cultural context in mathematics learning. According to (Khusniati et al., 2023) the connection between culture and mathematics lessons in ethnomathematics enriches learning through the synergy between mathematical concepts and cultural practices. This makes it easier for students to understand mathematical concepts and their implementation in everyday life. Meanwhile, research by (Almuharomah et al., 2023; Dahal, 2025; Setianingrum & Jumadi, 2024) shows a positive effect of implementing a contextual approach based on local culture on students' mathematical problem-solving abilities.

Local wisdom can be packaged in learning with the STEAM approach (science, technology, engineering, art, and mathematics) (Fathurrahman et al., 2025; Rokhmaniyah et al., 2020). Contextual learning with the STEAM approach provides a fun experience for students to understand mathematical and scientific concepts in a pro-active form.andA project that requires engineering, science, and mathematics to complete a project (Fuad et al., 2024; Jannana et al., 2024; Suryaningsih et al., 2025). STEAM allow sintegrating learning through Creative exploration allows students to better understand concepts through hands-on experiences relevant to everyday life. (Fitriyah et al., 2025) developed learning that adopted the STEAM approach with project-based activities based on a series of activities. electromagneticso that learning in class becomes more meaningful. In cases that emphasize the combination of mathematics, art andn digital technology, Augmented reality has been used to enhance learning outcomes on topic sgeometry (Nurfadilla et al., 2022). Mountain then (Nurfadilla et al., 2022) successfully led students to the creative level in learning about combined area and combined volume. Therefore, creative skills have great potential to be developed in STEAM-based learning.

This research is novel because it integrates STEAM learning with local wisdom in the form of Amarasi ikat weaving practices as the core of the learning process, not merely as illustrations or additional examples (Yanti et al., 2025). By making ikat weaving the primary medium, students not only learn mathematical concepts abstractly but also connect them to real, contextual, and meaningful cultural activities. This research is important because the low numeracy achievement of students at Sonraen Public Elementary School indicates the need for innovative learning interventions that can foster motivation, creativity, and improve learning outcomes (Subali et al., 2023). Furthermore, the integration of local culture in learning is believed to not only improve students' mathematical understanding but also strengthen cultural identity and form an appreciative attitude towards local heritage. Thus, this research contributes to the development of transformative learning models that are relevant to the regional context and support the achievement of national competency standards.

Based on the above background, the author designed a study on creative abilities in STEAM learning assisted by ikat weaving for fifth-grade students at SDN Sonraen, South Amarasi District, Kupang Regency, East Nusa Tenggara. It is hoped that contextual learning assisted by ikat weaving can synergizecomponent sscience, technology, engineering, arts, and mathematics (STEAM) all at oncecan improve the creative abilities of students at Sonraen State Elementary School.

Method

The approach used in this research is qualitativedescriptiveA qualitative approach was chosen in accordance with the main objective of exploring in depth the process and meaning of creative learning through the STEAM approach assisted by ikat weaving. This study focuses on students' learning experiences, their active involvement in the weaving process, and the integration of elements of science, technology, engineering, art, and mathematics in developing creative abilities.PThis research was conducted at Sonraen State Elementary School, located in Sonraen Village, South Amarasi District, Kupang Regency, East Nusa Tenggara Province. The school is situated in a beautiful environment and is dominated by community activities that still uphold local wisdom values. SDN Sonraen has a relatively stable number of students each year, with adequate facilities and infrastructure to support learning activities. The school has clean classrooms, a teacher's lounge, a library, and an open area that is often used for outdoor learning activities.

Culturally, the Sonraen people are known for their strong local traditions and culture, such as weaving, gardening, and animal husbandry. This environment strongly supports a STEAM-based learning approach that connects science to everyday life and local wisdom. The focus of this research was a fifth-grade class with 32 students. This class was chosen becausehave materials that suit research needs.Presearch implementationThistakes place in Decemberber 2024 until March 2025.

Subjects were selected purposively based on their readiness to learn about number patterns and their familiarity with local woven products. The subjects in this study consisted of 32 fifth-grade students of SDN Sonraen, divided into 8 heterogeneous groups, each consisting of 4 students. The selection and grouping were carried out taking into account their mathematical academic abilities. The codes used for naming students are S1 to S32. The codes for groups are K1 to K8.

Table 2. Division of student groups

Q1	K2	K3	K4	K5	K6	K7	K8
S8	S11	S20	S23	S25	S30	S31	S32
S1	S10	S3	S4	S16	S12	S28	S9
S14	S2	S18	S15	S5	S19	S7	S17
S21	S22	S24	S26	S27	S6	S29	S13

To support data accuracy, supporting instruments are used in the form of observation sheets aimed at recording students' activities and abilities during the learning process, assessment rubrics containing criteria and indicators for assessing the learning process and outcomes with a 4-category scale (4 = Very Good, 3 = Good, 2 = Sufficient, and 1 = Less), interview guidelines to dig deeper into students' understanding of learning, questionnaires to measure students' understanding of project-based learning integrated with the STEAM approach, and test sheets in the form of initial and final tests used to determine the increase in students' understanding of the concept of number patterns.This study used qualitative data analysis to process and interpret data obtained from various instruments. The analysis technique was carried out through the stages of data reduction, data presentation, and drawing conclusions (Miles & Huberman, 1994). Data were obtained during project-based learning to produce patterned ikat woven sashes.pan buay ana And perfect Qualitative research data analysis techniques involve creatively condensing and organizing students' words or actions to retain their meaning, requiring considerable ingenuity from the researcher. The STEAM-integrated learning process is explored throughout the weaving stages.

Result and Discussion

This study presents the results of the implementation of STEAM-based learning assisted by ikat weaving as a contextual learning medium to foster the creative abilities of fifth-grade students at SDN Sonraen. Each stage in the weaving process is analyzed to see the integrative involvement of STEAM elements, including science, technology, engineering, art, and mathematics. Through in-depth observation of student activities in each stage, from winding thread to weaving, this study illustrates how local project-based learning can build 21st-century skills in a real and meaningful way. The learning process takes place with the final product being a patterned ikat woven sash.pan buay ana And perfectThe final product produced by the group is the result of collaborative work by each group member. Table 3 displays the assessment of the weaving process that has taken place and has resulted in a STEAM-integrated sash as a whole.

Table 3. Results Assessment Using Rubrics

STEAM element	General Assessment Indicators (across weaving stages)	Very good understanding (%)	Good Understanding (5)
S (Science)	Explains the relationship between the properties of thread materials and the weaving process.	50	50
T (Technology)	Using various toolswinding threadprecisely and safely	87,5	12,5
E (Engineering)	Demonstrate technical skillsin the correct use of the thread winding tool	37,5	62,5
A (Art)	Showcasing Amarasi creativity, aesthetics and cultural values in designs and woven products	100	0
M (Mathematics)	Applying the concepts of counting, pattern, repetition and symmetry throughout the weaving process	25	75

Most students demonstrated achievement in the very good understanding category, particularly in the aspects of the use of aids (87.5%) and the expression of Amarasi cultural arts (100%). Meanwhile, in the technical and mathematical logic aspects, the majority of students were in the good understanding category, namely 62.5% in technical skills and 75% in the application of mathematical concepts. In science-related indicators, student achievement was evenly divided between the good and excellent understanding categories. In general, these data indicate that students have a good understanding of the weaving process using the STEAM approach, although reinforcement is still needed in the technical and mathematical aspects. Contextual learning stages to produce patterned sashespan buay ana And perfect, with the STEAM approach which fosters creative abilities is explained as follows.

Winding the Thread

The first step in STEAM learning with the aid of ikat weaving is the process of winding the thread. This activity provides students with a concrete introduction to and experience the interconnectedness of science, technology, engineering, art, and mathematics in a meaningful way.

The process of winding the yarn begins with selecting the base yarn color to be used. The yarn is then tied to a rolling pin, then the end of the yarn is found and rolled around a small stone to form a ball. One hand holds the finished roll, while the other hand continues to roll the yarn to make the roll larger. This process is carried out slowly and regularly to ensure a neat result. If the yarn looks loose or uneven, students pause to straighten it. Once all the yarn is wound, the ball-shaped yarn roll is ready to be used for the next weaving process. Learning outcomes at the winding yarn stage are that students can recognize the types of yarn, carry out the activity of winding yarn correctly, and apply STEAM to the process. This activity provides an applicable and meaningful counting experience, because it is directly related to real weaving production results.

Table 4. Results of the questionnaire on students' understanding at the thread rolling stage

Statement	Student understanding: Very well – Number of Students	Very well – Percentage	Good – Number of Students	Good – Percentage
I know the materials used to weave.	28	87.5	4	12.5
I can explain the benefits of weaving for the Amarasi people.	24	75	8	25
I know who the prominent figures or weavers are in my neighborhood.	28	87.5	4	12.5
I understand the role of women in the weaving tradition.	8	25	24	75
I understand the properties of thread (strong, flexible, elastic).	16	50	16	50
I understand that weaving involves science, technology, engineering, art and mathematics.	24	75	8	25

The questionnaire results show students' understanding of the thread winding stage. A total of 28 students understand weaving materials and local artisan figures, 16 students understand the properties of thread, 24 students understand the benefits of weaving and its relationship to elements of science, technology, engineering, art, and mathematics, this shows that the dominant achievement is classified as high in these aspects because it is above 50%. Meanwhile, aspects with achievements below 50% indicate an understanding that still needs to be improved, namely the role of women in the weaving tradition (25%). These results indicate that the integration of STEAM and local values is starting to take shape, but strengthening in the socio-cultural aspect is still needed.

The following is the group's response to the question: How do you wind the thread so that it stays neat and easy to use when weaving? The group's answers are differentiated based on the emphasis of the key words revealed namely oriented towards motor activities and cognitive activities.

Table 5. Interview results at the thread winding stage

Group answers oriented towards mindfulness (psychomotor) activities	Group answers that are oriented towards understanding regularities and the consequences of these regularities (cognitive)
K1: Roll the thread slowly	K2 : Rolled up neatly to make it easier in the next stage
K5: Slowly so it doesn't break	K3: The thread is wound parallel
K8 : Slowly but surely	K7 : Wind the thread properly
K4: Don't roll it up in a mess.	K6: Must be slow so that it is straight and neat.

From the results of the interview analysis of eight groups (K1–K8), it appears that the answers given reflect two main orientations, namely careful activity (psychomotor) and understanding of order and the consequences of that order (cognitive). Groups K1, K4, K5, and K8 emphasized the psychomotor aspect by describing the action of winding the thread slowly and carefully, so that it does not get messy and remains neat. Meanwhile, groups K2, K3, K6, and K7 demonstrated cognitive understanding by conveying the importance of winding the thread so that it is parallel, correct, neat, and easy to use in the next stage. Thus, all groups demonstrated active involvement in both motor skills and conceptual understanding, which reflects the integration between action and meaning in the learning process.

Based on the learning outcomes collected from questionnaires, rubrics, observations, and interviews, the relationship between the thread-rolling activity and STEAM learning can be described in the thread-rolling process. The learning activity has facilitated students to recognize the types of thread, carry out the thread-rolling activity correctly, and apply STEAM to the process. STEAM integration is as follows: 1) Science. Types of thread and their characteristics. Students differentiate between threads: rough versus smooth/slippery, heavy versus light, thin/breakable versus strong/durable. Students can understand that silk thread is too slippery and thin, mercerized thread and combed cotton are not slippery but mercerized thread is heavier. Combed cotton thread is suitable for beginners. Through critical thinking, students choose to use combed cotton thread.

2) Technology. Using a thread-winding tool. Students identify the tool and understand how it works, and can compare two methods: using the foot and using a thread-winding tool. Students recognize the difference in work speed; winding the thread can be done with the foot but takes longer than using a thread-winding tool. Through critical thinking, students choose to use the thread-winding tool. 3) Engineering. Winding thread in the correct direction. Students understand the rules for winding thread. Psychomotorically, students understand that they must be careful by winding the thread slowly to ensure it is neat and does not break. Cognitively, students understand that parallel and straight lines are important for facilitating the next stage of work. 4) Art. Selection of regional colors and design plans. Students chose white as the base color, in keeping with the distinctive characteristics of Amarasi weaving. Students learned about white as the characteristic color of Amarasi motifs, which is maintained when the yarn goes through the dyeing process. 5) Mathematics. Integers and basic operations. Students can calculate thread requirements. The process of calculating thread requirements involves addition, multiplication, and multiples of numbers. For example, consider thread requirements. One head of thread consists of 22 bundles. Each bundle consists of five smaller bundles. These five smaller bundles produce one sash. This means that if we have four heads of thread, we will produce 88 sashes.

Menghani

The process of winding the thread is complete, students continue to the second stage, namely handing. The process of arranging the thread on the hani tool so that it is ready for use in creating a woven pattern. The thread is arranged parallel between two hani poles according to the desired length of fabric. The number of twists is adjusted according to the size of the fabric and the complexity of the pattern to be created. Once the thread is neatly arranged, markings are made to indicate the location of the pattern to be tied in the next step. The ends of the thread are then tied to prevent unraveling and maintain stability during the motif tying process. This handicraft activity requires precision, perseverance, and good coordination between hands and visual observation in groups, which integrates many elements in the STEAM approach.

Table 6. Results of the questionnaire on students' understanding at the learning stage

Statement	Student understanding			
	Very well		Good	
	Number of Students	Percentage	Number of Students	Percentage
I am able to plan the order of the base thread before weaving.	8	25	24	75
I understand that weaving involves science, technology, art engineering and mathematics.	24	75	8	25
I can arrange the threads so that the weaving results match the design.	24	75	8	25
I am able to count the number of turns of thread accurately.	4	12,5	28	87.5
I can adjust the thread spacing while sewing regularly.	16	50	16	50
I can measure the length of thread needed before weaving.	16	50	16	50

The questionnaire results show students' understanding of the thread winding stage. A total of 16 students were able to arrange the distance and measure the length of the thread, 24 students were able to arrange the thread and the relationship between weaving and elements of science, technology, engineering, art, and mathematics, this shows that the dominant achievement is classified as high in these aspects because it is above 50%. Meanwhile, aspects with achievements below 50% indicate understanding that still needs to be improved, namely understanding how to design the thread sequence (25%), and understanding how to calculate the thread winding (12.5%). These results indicate that the integration of STEAM and local values is starting to take shape, but strengthening in the science and mathematics aspects is still needed. The following is the group's response to the question: What should you pay attention to when you handle thread so that the tension is appropriate and the thread does not tangle? The group's answers are differentiated based on the emphasis of the keywords revealed. Namely oriented towards motor activities and cognitive activities.

Table 7. Interview results at the implementation stage

Techniques and Tool Settings (cognitive)	Pull and Rhythm of Movement (Psychomotor)
K1: You have to be careful not to use the wrong technique.	K2: Don't pull too tight
K3: Make sure the tool is straight	K5: Hani, don't thread it too fast
K4: If there is a difference, break the thread and reconnect it.	K6: The thread tension is even
K7: Must focus so as not to make mistakes	K8: Slow down to avoid overlapping

From the results of the interview analysis of eight groups (K1–K8), it appears that the answers given reflect two main tendencies, namely orientation towards the technical aspects and tool arrangement (cognitive) and the pulling and rhythm of the movement (psychomotor). Groups K2, K5, K6, and K8 emphasize the psychomotor aspect by emphasizing the importance of pulling the thread not too tight, not too fast, done evenly, and slowly so that the results do not overlap. Meanwhile, groups K1, K3, K4, and K7 focus more on cognitive aspects, such as careful technique, ensuring the hani tool is straight, breaking and reconnecting the thread if there is a gap, and maintaining focus to avoid mistakes. This shows that students are not only involved motorically in the hani process, but also understand the principles of order and precision in work, so that the learning process takes place comprehensively.

Based on the learning outcomes collected from questionnaires, rubrics, observations and interviews, then in the process of processingit can be described the relationship between the activity of rolling thread and STEAM learning. Learning activities have facilitated students to be able to recognize the concept of force, apply simple engineering and concrete mathematics.

STEAM integration intahapmenghani as follows: 1) Science.The concept of thread tension and tension. Students understand that thread that is too tight can cause it to break or distort the pattern, while loose thread will produce an untidy pattern. Through the process of weaving, students learn to adjust thread tension and tension to achieve stability and precision in the final product. 2) Technology. Utilization of the hani tool as a traditional technology. Students use the hani tool to arrange thread in a parallel and orderly manner. Students understand the tool's function in helping them maintain the thread's direction and adjust its length. Using this tool provides students with the experience that technology isn't always modern; it can take the form of local tools that are effective and efficient in completing tasks. 3) Engineering. Layout and systematic thread arrangement. Students learn how to systematically arrange thread between two ropes. They determine the number of twists and thread position with precision and consistency. Through this process, students develop basic technical skills in designing, positioning, and constructing structures that will determine the success of the pattern to be tied. 4) Art. Thread arrangement as the basis for motif and aesthetic expression. Students arrange threads, paying attention to harmony, crisscross patterns, and neatness. Students realize that inappropriate thread arrangement can disrupt the pattern of the motif to be tied and dyed. Therefore, students learn that technical skills are inseparable from sensitivity to visual beauty and pattern regularity as the basis of woven design. 5) Mathematics. Patterns, repetition, and thread counts. This activity trains students to understand the concepts of repetition and number patterns. They arrange threads in a specific number of times, such as a pattern of 3 above, 3 below, separated, and determine the number of loops based on the size and design of the motif. Students learn about the concepts of numerals, grouping, and symmetry in a contextual and applicable way, as essential elements in the production of Amarasi woven motifs.

Creating Motifs

The third stage in STEAM learning with the aid of ikat weaving is motif creation. In this stage, students are guided to express their visual ideas in the form of motifs on pattern paper, which will later be applied to woven yarn. This activity is a central point in the creative process because it encourages students to simultaneously combine knowledge of science, art, and mathematics in a single design product with cultural significance.

The activity began with a short discussion about typical Amarasi motifs. Namely the pan buay ana motif and the kaimanfafa motif. Students are invited to memeaning. The meaning of the motif and its cultural values. This process fosters awareness that woven works are not only aesthetic but also embody the philosophy of local life. After gaining inspiration from local motifs, students begin sketching the motifs in a sketchbook or pattern paper. Students are provided with tools such as rulers, pencils, and square patterns to help maintain proportion, symmetry, and regularity in the design.

Table 8. Results of the questionnaire on students' understanding at the stage of creating motifs

Statement	Student understanding			
	Very well		Good	
	Number of Students	Percentage	Number of Students	Percentage
I know the origin and meaning of Amarasi woven cloth.	32	100%	0	0%
I understand the meaning of the symbols of the Amarasi motifs used in weaving.	20	62.5%	12	37.5%
I can compose motif design patterns independently.	12	37.5%	20	62.5%
I understand that weaving involves science, technology, art engineering and mathematics.	24	75%	8	25%
I am confident in applying artistic ideas into my weaving.	24	75%	8	25%
I use numbers to create symmetrical patterns.	16	50%	16	50%
I can compose repeating patterns in motifs.	12	37.5%	20	62.5%

The questionnaire results show students' understanding at the thread winding stage. A total of 32 students understand the meaning of Amarasi weaving, 20 students understand the symbols of Amarasi motifs, 16 students are able to create patterns using numbers, 24 students are able to apply art in weaving and the relationship of weaving with elements of science, technology, engineering, art, and mathematics, this shows that the dominant achievement is classified as high in these aspects because it is above 50%. Meanwhile, aspects with achievements below 50% indicate understanding that still needs to be improved, namely the understanding of arranging repeating patterns in motifs independently (37.5%). These results indicate that the integration of STEAM and local values is starting to form, but strengthening in the mathematical aspect is still needed.

The following is the group's response to the question: How do you sketch a motif so that your woven product is attractive and orderly? The group's answers are differentiated based on the emphasis of the keywords revealed namely oriented towards motor activities and cognitive activities.

Table 9. Interview results at the motif creation stage

Sketching Planning and Strategy (cognitive)	Sketch Drawing Techniques and Quality (Psychomotor)
K2: Draw the motif first on paper	K1: The picture is simple and nice
K3: Make a picture first	K5: Use a pencil so you can erase it.
K4: The motif must match the idea	K6: Neat and clear image
K7: Choose a sample motif according to your ability	K8: The image is according to the example

From the results of the interview analysis of eight groups (K1–K8) at the stage of creating motifs, it appears that student responses are divided into two main tendencies, namely cognitive and psychomotor orientation. Groups K2, K3, K4, and K7 show a cognitive orientation by emphasizing the importance of planning and strategy in making sketches, such as drawing the motif first on paper, ensuring it matches the idea, and choosing a motif that suits their abilities. Meanwhile, groups K1, K5, K6, and K8 emphasize the psychomotor aspect by focusing on the technique and quality of the sketch drawing, such as using simple and good images, drawing with a pencil for easy erasing, and ensuring the drawing is neat and according to the example. These results indicate that the process of drawing motifs involves not only technical skills, but also strategic thinking that reflects a balance between thinking abilities and manual drawing skills.

Based on the learning outcomes collected from questionnaires, rubrics, observations, and interviews, the relationship between the motif-making activity and STEAM learning can be described in the motif-making process. The learning activity has facilitated students in understanding number patterns and the regularity of arrangement in motifs, cultural expressions through meaningful motifs.

STEAM integration is as follows: 1) Science. Understanding the properties of materials and their reactions to color. Students demonstrate an understanding that the black color in the motif will be bound to prevent color absorption during dyeing, while the white part is left open to absorb color from synthetic dyes. Students have demonstrated critical thinking skills in determining color composition based on the properties of the material and the dyeing process to be undertaken. 2) Technology. Use of tools in drawing motifs. Students utilize tools such as rulers, pencils, and squares in sketching motifs. These tools help maintain line accuracy, shape symmetry, and design neatness. Students demonstrate precision and efficiency in tool use. Students even use tools consistently to maintain proportion and order in the motifs they create. 3) Engineering. Planning and designing motif shapes. Students are able to compose motifs by paying attention to proportion, repetition of shapes, and pattern suitability. Students design motifs by adjusting pencil pressure, positioning their hands for stability, and considering the placement and size of motif elements for balance. Students also demonstrate the ability to project designs into a measured and structured arrangement of boxes, so that the resulting motif can be applied in the thread tying process appropriately. 4) Art. Cultural expression and aesthetic value in motif design. Students demonstrate creativity and originality through motif designs that are not only visually beautiful but also culturally meaningful. Students depict the typical Amarasi motif.*pan bua ana*and motif s*perfect*as a form of representation of local values. Students not only copy but also interpret symbolic meanings in distinctive and identifiable visual forms. 5) Mathematics. Number patterns and regularity in motif arrangements. Students arrange motifs based on certain number patterns, such as odd-numbered patterns in motifs.*pan buay ana* (1–3–5–3–1), repeating unit in the motif*perfect* (2 or 4 squares), as well as the principle of symmetry. Students demonstrate the ability to recognize and apply number regularities in visual arrangements. Students gradually understand that building visual patterns also requires a foundation of mathematical thinking, including unit counting, left-right symmetry, and number sequences in designs.

Tying the Thread (Tying the Motif)

The fourth stage in STEAM learning with the aid of ikat weaving is the process of tying the threads, also known as the motif tying process. This process begins by stretching the warp threads on a wooden frame, then tying specific sections of the threads according to the motif created in the previous stage using raffia.

Each section of the motif is tied tightly. Three loops are usually used for each square in the motif sketch to prevent the color from bleeding during dyeing. The tying is done symmetrically and repeated until the entire motif is complete. Once completed, the thread is checked again to ensure all sections of the pattern are perfectly tied before proceeding to the dyeing stage.

Table 10. Results of the questionnaire on students' understanding at the thread tying stage

Statement	Student understanding			
	Very well		Good	
	Number of Students	Percentage	Number of Students	Percentage
I can determine the thickness and position of the tie on the pattern thread.	20	62.5	12	37.5
I understand that weaving involves science, technology, art engineering and mathematics.	24	75	8	25
I realized the importance of experimentation in the weaving process.	24	75	8	25
I can determine the number of repetitions of motifs in woven fabric.	16	50	16	50
I understand the concept of odd-even in repeating shapes.	20	62.5	12	37.5

The results of the questionnaire show students' understanding of the thread winding stage. A total of 16 students were able to determine the number of repetitions of the motif, 20 students understood the thickness and position of the tie and the concept of odd-even, 24 students realized they were able to apply art in weaving and the relationship between weaving and elements of science, technology, engineering, art, and mathematics, this shows that the dominant achievement is classified as high in all aspects of the assessment because it is above 50%.

The following is the group's response to the question: Why do we have to tie the thread at certain points when creating a woven pattern? The group's answers are differentiated based on the emphasis on the key words revealed.namely oriented towards motor activities and cognitive activities.

Table 11. Interview results at the thread tying stage

The Function of Bonds in Emerging Motives (cognitive)	Binding and Coloring Process (psychomotor)
K1: So that the image will appear on the thread later.	K2: So that the motif is visible when colored
K5: So that the thread can have a picture later	K3: So that the thread can form a pattern when dyed
K6: Because the thread ties make the picture when colored	K4: If tied, that part doesn't get colored, so the pattern appears
K7: If tied, the color will have a nice pattern	K8: So that the pass is colored, the shape can be seen

From the results of the interview analysis of eight groups (K1–K8) at the thread tying stage, it is clear that students' answers are divided into two orientations, namely cognitive and psychomotor. Groups K1, K5, K6, and K7 emphasize the cognitive aspect by demonstrating an understanding of the function of ties in forming motifs, such as so that images appear on the thread when dyed, the thread can form motifs, and the relationship between ties and the emergence of clear colors or motifs. Meanwhile, groups K2, K3, K4, and K8 emphasize the psychomotor aspect by explaining the technical processes of tying and coloring, such as ensuring the shape of the pattern is visible when dyed, the tied part is not exposed to color, and the shape of the motif can be seen when colored. This shows that students understand the technical process as well as the conceptual meaning of each stage, whichshowintegration between practical skills and theoretical understanding in thread tying activities.

Based on the learning outcomes collected fromquestionnaires, rubrics, observations and interviews, then in the process of processingit can be described the relationship between the activity of rolling thread and STEAM learning. Learning activities have facilitated students to be able to use the correct thread tying techniques andnumber patterns and repetition in bonds.

STEAM integration in Menghani Level as follows: 1) Science. Observing the color absorption of yarn**.** Students demonstrated the ability to observe how yarn's absorption of natural and synthetic dyes is affected by the tightness of the binding. They understood that binding that was too loose or too thin caused the color to bleed into areas that should remain white, resulting in unclear patterns. Students analyzed the relationship between the physical properties of the yarn and the desired visual outcome. 2) Technology. Use of tools in the pattern-tying process. Students use tools such as rope and scissors to simplify and tidy up the thread-tying process. Although simple, these tools help maintain tightness and neatness of the ties so that the pattern is clearly printed during dyeing. Students learn that technology doesn't have to be sophisticated, but can actually come from surrounding objects used appropriately. 3) Engineering. Proper thread tying techniques. Students demonstrate technical skills in adjusting pressure, tying direction, and the number of twists according to the thickness and position of the motif. Students learn that one section of a pattern box generally requires three twists to be sufficiently covered. Students also pay attention to the distribution of pressure between the left and right sides, and adjust hand strength to avoid damaging the yarn fibers. 4) Art. Application and development of typical Amarasi motifs. Students apply previously designed motifs by tying sections of thread according to the drawn pattern. Students not only imitate local motifs but also modify and develop them according to their own ideas. This process demonstrates that students are not merely memorizing but also appreciating and adapting the richness of Amarasi culture into weaving media. 5) Mathematics. Number patterns and repetition in bonds. Students calculate the number of turns for one box in the sketch with a value of 6, namely 3.girthto the right and 3 loops to the left. Students also repeat the pattern while paying attention to horizontal and vertical symmetry as the main reference in maintaining the regularity of the design. In this way, students demonstrate the ability to apply mathematical concepts during the thread tying process.

Coloring

The fifth step in STEAM learning with the aid of ikat weaving is the yarn dyeing process. This activity serves as a crucial link between motif planning and the final result of the woven design created by the students. In this stage, all STEAM elements appear to be integrated into a hands-on practice involving observing chemical reactions, using tools, engineering procedures, exploring color, and calculating material ratios.The yarn dyeing process begins by washing the yarn with soap and hot water to remove dirt and open the pores of the yarn so that it can more easily absorb the color. The next step is to mix synthetic dyes, namely naphthol ASBO, Kusti Soda, and Red B dye into the water until evenly distributed. The yarn is then placed in the dye solution and not only soaked but also rubbed gently so that the color absorbs evenly throughout the untied parts of the yarn. Once the color is felt to be sufficiently absorbed, the yarn is removed, rinsed until the rinse water is clear, then hung in the shade to dry.

Table 12. Results of the questionnaire on students' understanding of the thread coloring stage

Statement	Student understanding			
	Very well		Good	
	Number of Students	Percentage	Number of Students	Percentage
I know natural and synthetic dyeing techniques in weaving.	24	75	8	25
I know how colors can change when mixed or dyed.	20	62.5	12	37.5
I understand that weaving involves science, technology, art engineering and mathematics.	24	75	8	25
I was able to manage the coloring process without creating a color buildup.	8	25	24	75
I interpret the yarn drying time based on the weather.	16	50	16	50
I can determine the colors to be used in the motif.	12	37.5	20	62.5

The questionnaire results show students' understanding of the thread winding stage. A total of 16 students were able to interpret drying times, 20 students understood the color change process, 24 students understood natural and synthetic dyeing techniques and the relationship between weaving and elements of science, technology, engineering, art, and mathematics, this shows that the dominant achievement is classified as high in these aspects because it is above 50%. Meanwhile, aspects with achievements below 50% indicate understanding that still needs to be improved, namely understandingmanagecoloring process (25%) anddeterminemotif color (37.5%). These results indicate that STEAM integration, however, requires strengthening of the science aspect.

The following is the group's response to the question: What should be considered when dyeing yarn so that the color is absorbed and as desired? The group's answers are differentiated based on the emphasis of the keywords revealed.namely oriented towards motor activities and cognitive activities.

Table 13. Interview results at the yarn dyeing stage

Yarn Dyeing and Soaking Techniques (psychomotor)	Preparation and Composition of Dyes (cognitive)
K1: When dipping, rub so that the medicine reaches all parts.	K2: The medicine must be of sufficient color and mixed evenly.
K3: The thread must be dyed for a long time so that the color goes in.	K4: Stir the color first so it can penetrate the thread.
K6: The dipping must be done patiently and evenly so that the color sticks.	K5: The color mix must be right
K7: Must be colored slowly and completely submerged	
K8: The medicine must be stirred and the thread must be dipped for a long time.	

From the results of the interview analysis of eight groups (K1–K8) in the yarn dyeing stage, there is a division of the response tendencies into two main categories, namely psychomotor and cognitive. Groups K1, K3, K6, K7, and K8 emphasized the psychomotor aspect by explaining the importance of proper yarn dyeing and soaking techniques, such as rubbing the yarn so that all parts are colored, dyeing for a long time so that the color is absorbed, dyeing patiently and evenly, and ensuring the yarn is completely submerged. Meanwhile, groups K2, K4, and K5 showed cognitive understanding by emphasizing the importance of preparing sufficient dye, stirring it evenly, and having the right composition so that it can be absorbed well by the yarn. These results indicate that in the yarn dyeing process, students demonstrated a combination of technical skills and conceptual understanding of dyes, which strengthens the integration of overall learning through the STEAM approach.

Based on the learning outcomes collected fromquestionnaires, rubrics, observations and interviews, then in the process of processingit can be described the relationship between the activity of rolling thread and STEAM learning. Learning activities have facilitated students to learn about designing procedures and coloring sequences as well.the effect of the balance of the dye solution on the dyeing results.

STEAM integration in Menghani Level as follows: 1) Science. The reaction of yarn to dye solutions. Students understand that hot water can open the pores of the yarn, making it easier for the color to penetrate. The type of yarn and soaking time affect the absorption capacity and final color results. Students understand the balance of synthetic dyes.tis in the form of the ASBO napthol brand,kover koda, and the Red B dye is veryanddetermine the color that will be created. 2) Technology. Use of tools in the dyeing process. Students use tools such as pans, buckets, wooden spoons, and gloves to facilitate the process and demonstrate an awareness of occupational safety principles. Students recognize that technology doesn't always involve sophisticated machinery, but also includes simple household items used to support their work. 3) Engineering. Designing the procedure and sequence of dyeing. Students design the dyeing workflow starting from boiling the yarn in hot water mixed with soap to clean the yarn and open its pores so that the desired brick red color is perfectly absorbed. Students consider the dyeing technique with the technique used, simply soaking or assisted with Of This activity demonstrates simple engineering skills in organizing work steps and solving technical problems that arise during the process. 4) Art. Color selection and matching based on Amarasi motifs. In selecting colors, students considered the dominant color of traditional Amarasi motifs, namely brick red. They developed a visual aesthetic that aligned with local cultural values. 5) Mathematics. Calculation of solution dosage and time estimation. Students calculate the dosage of the red dye solution.andk napthol ASBO 2 spoons, kusti soda 1 spoon, red B 2 spoons, table salt 3 spoons. This experience strengthens the concept of applied mathematics, namely comparison in the context of real production activities.

Weaving

The weaving stage is the culmination of the entire series of STEAM learning activities assisted by ikat weaving. After going through the processes of winding yarn, weaving, creating motifs, tying motifs, and dyeing, students finally enter the weaving process as an integrative process that combines all the skills and knowledge that have been previously acquired. The process begins by arranging the warp threads (long threads) on the loom frame, ensuring uniform thread position and tension. Next, the weaver begins to insert the weft threads (cross threads) alternately. Each strand of weft thread is woven through the gap in the warp threads that are opened and closed alternately using a lever (pallet). The weaver must work carefully so that the designed motif appears precisely and balanced. This process is done manually and requires precision and Diligence is crucial, as even small errors can affect the final woven pattern. Once finished, the woven fabric is removed from the tool and tidied up for use.

Table 14. Results of the questionnaire on students' understanding at the weaving stage

Statement	Student understanding			
	Very well		Good	
	Number of Students	Percentage	Number of Students	Percentage
I can mention the stages in the weaving process.	28	87.5	4	12.5
I understand the importance of preserving the weaving tradition as a cultural heritage.	28	0	4	100
I can differentiate between traditional and factory-made woven fabrics.	28	87.5	4	12.5
I can use weaving tools	24	75	8	25
I understand that weaving involves science, technology, art engineering and mathematics.	24	75	8	25
I understand the relationship between threads as they are woven into cloth.	20	62,5	12	37.5
I feel that weaving activities help me learn many things at once.	24	75	8	25
I can evaluate my weaving results independently.	8	25	24	75
I can explain the weaving process practically.	28	87.5	4	12.5
I can solve math problems related to the weaving process.	16	25	16	75

The questionnaire results show students' understanding of the thread winding stage. A total of 16 students were able to solve math problems, 20 students understood the relationship between threads in weaving, 24 students were able to use weaving aids, realized that they learned a lot from weaving and its relationship with elements of science, technology, engineering, art, and mathematics and, 28 students understood the stages of weaving, distinguishing traditional woven fabrics, the process of making woven fabrics and the importance of preserving cultural heritage, this shows that the dominant achievement is classified as high in these aspects because it is above 50%. Meanwhile, aspects with achievements below 50% indicate that understanding still needs to be improved, namely evaluating the weaving process independently (25%). These results indicate that the integration of STEAM and local values is starting to form, but strengthening the socio-cultural aspect is still needed.

The following is the group's response to the question: How do you use a loom to arrange the threads neatly and form the desired pattern? The group's answers are differentiated based on the emphasis on the key words revealed namely oriented towards motor activities and cognitive activities.

Table 15. Interview results at the weaving stage

Techniques for Using Tools and the Process of Pressing/Combing Thread (psychomotor)	Selection and Adjustment of (cognitive) Aids
K1: Use a stick to mark, every 20 beats move the stick to make it neat. K2: You have to press the thread firmly and neatly, use a stick to help. K3: Weave slowly, pressing and combing the thread continuously. K5: To make it neat, you have to press and comb the thread using a tool. K7: Weaving is done using tools, the threads are pressed and combed so they don't pile up. K8: Using a string tool, comb the thread so it doesn't pile up.	K4: Use a string and stick tool, press the thread so it is neat and nice. K6: Use a tool to straighten the thread and press it tightly.

From the results of the interview analysis of eight groups (K1–K8) during the weaving stage, it was apparent that students' responses were divided into two main focuses: psychomotor and cognitive. Groups K1, K2, K3, K5, K7, and K8 showed a dominance in the psychomotor aspect, with an emphasis on the technique of using tools and the process of pressing or combing the yarn to ensure neatness. They conveyed the importance of using tools such as sticks or press tools to maintain neat yarn, weaving slowly, and combing regularly to prevent piles. Meanwhile, groups K4 and K6 were more oriented towards the cognitive aspect, emphasizing the importance of selecting and adjusting tools to ensure the yarn remains straight and tight. These results reflect that students understand the weaving process as an activity that requires not only precision in physical actions, but also strategic decision-making in the use of tools, thus making the learning process more comprehensive and meaningful.

Based on the learning outcomes collected from questionnaires, rubrics, observations and interviews, then in the process of processingit can be described the relationship between the activity of rolling thread and STEAM learning. Learning activities have facilitated students to learn about designing procedures and coloring sequences as well.the effect of the balance of the dye solution on the dyeing results. 1) Science. Understanding the physical properties of yarn during weaving. Students recognize that yarn that is too tight or too loose will affect the quality of the woven product. Students are even able to distinguish between types of cotton yarn combedIt has a slightly hairy and lightweight nature, making it easy to style, and it is resistant to pressure, making it suitable for beginners. This process strengthens scientific observation skills and the ability to directly recognize material properties. 2) Technology. Proper use of traditional looms. Students are able to operate the loom, including threading the warp threads, adjusting their seating position, and moving the loom's components with good coordination. Students recognize that the use of this simple technology teaches that cultural heritage, in the form of traditional tools, can be used as appropriate technology that is efficient, functional, and supports local textile production. 3) Engineering. Tool assembly and work system setup. Students demonstrate skills in assembling a loom and adjusting the warp tension so that the threads are neither too loose nor too tight. Students adjust their sitting position. When inserting the weft thread, they must bend slightly to adjust the thread tension. This ability demonstrates a simple engineering thinking process, where students must understand how the tool works and respond to technical problems with practical solutions. 4) Art. Application of distinctive motifs and local cultural values in weaving. Students understand the meaning of traditional Amarasi motifs, namely the motif*pan buay ana*means jewelry box and motif *perfect*means unity/joining hands and trying to maintain the authenticity of the form when translated into cloth. 5) Mathematics. Repetition patterns, symmetry, and thread count. Students apply mathematical concepts to arrange the weft thread repetitions to maintain the left and right symmetry of the motif consistently by moving the stick every 20 beats.

Student Learning Outcomes

The STEAM approach in this study was analyzed qualitatively by emphasizing student involvement in each learning element, namely science, technology, engineering, art, and mathematics. The S, T, E, and A elements were evaluated through observation, interviews, and documentation of learning activities that reflect the creative thinking process, skill in using tools, accuracy in designing motifs, and the meaning of local cultural values in weaving. Meanwhile, the M (mathematics) element was evaluated quantitatively through pre-test and post-test results that measured the increase in mastery of number patterns, multiples, and arithmetic operations, which were applied directly in the preparation of woven motifs. This combined approach provides a comprehensive picture of student learning achievements from both process and outcome aspects.

Based on the results of the learning evaluation using pre-test and post-test instruments, it was found that there was a significant increase in almost all question indicators, which reflects that students' understanding of the material has made significant progress.

Table 16. Improvement in Improvement Per Question Item

Question no	Material	Question Indicator	% Increase
1	Number Patterns	Determines the nth number of the jump pattern	49
2	Number Patterns	Determining missing numbers in irregular patterns	41
3	Multiple	Determining the LCM of two small numbers	54
4	Multiple	Identifying multiples and factors	59
5	Multiple	Implied multiples story questions	57
6	Addition	Vertical addition of large numbers	77
7	Addition	Addition strategy with grouping	45
8	Multiplication	Multiplication of units and tens	50
9	Multiplication	Multiplying multiplication story problems	72
10	Mixed Operation	Combined operations of addition and multiplication	51
Rate-rate			63.3

In line with the improvement in each item on the test content, which indicates improved student understanding of the material, the average pre-test and post-test scores also increased. This indicates that the learning process has had a positive impact on student achievement. This overall improvement can be seen in Figure 1, which illustrates the increase in the highest and lowest scores.

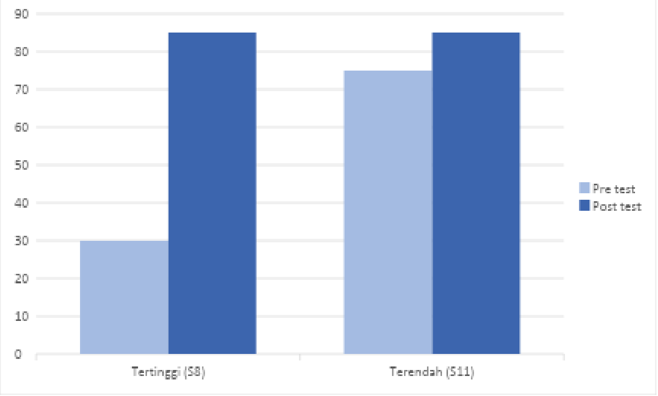

Figure 1. Comparison of the highest and lowest increase in student scores

The results of the pre-test and post-test data analysis showed an increase in scores across all content items, an increase in individual student scores, and an increase in the overall average score. This indicates that the ikat-based STEAM learning approach successfully improved students' mathematical understanding and skills, particularly in number patterns, multiples, addition, multiplication, and mixed operations.

Ability to create

Students' creative abilities are demonstrated through their involvement in designing woven motifs, constructing mathematical patterns, determining color combinations, and completing meaningful and aesthetically pleasing woven products. Each learning stage provides space for students to express ideas, solve problems, and produce original works that reflect their understanding of the material and local cultural values. These activities also foster higher-order thinking skills and strengthen the connection between theory and practice.

This approach has proven effective because it is able to link mathematical concepts with local cultural practices that are contextual and meaningful. By involving elements *Science, Technology, Engineering, Art, and Mathematics*In the weaving process, students not only understand the material abstractly, but also through direct experience that is collaborative, creative and applicable.

STEAM integration in contextual learning produces patterned sashes*pan buay ana* and *perfect* has fostered creative abilities in fifth-grade students at SDN Sonraen. Creative abilities develop at each stage of weaving, as shown in Table 17.

Table 17. Creativity that fosters the ability to create at the weaving stage

Stages of producing a patterned sash*pan buay ana* And *perfect*	Creativity that fosters the ability to create
Winding the Thread	Independent, consistent, anticipate knots, arrange threads ready for dyeing.
Menghani	Innovative in arranging tools, pre-commanding friends, adjusting colors.
Making a Motif	Creative & balanced motives; combine new ideas; explain the philosophy.
Tying the Thread	Very neat ties, precise pattern, efficient, minimal thread waste.
Yarn Dyeing	Smooth color gradation; new blending experiments; stable results.
Weaving	Very precise weaving, sharp patterns, efficient, neat finishing.

During the process of weaving to produce a patterned sash, creative abilities develop, especially at the stage of making the motif. *pan buay ana* And *perfect*, and yarn dyeing. Creativity develops when: 1) Students are given the freedom to explore and develop motif ideas. 2) Students use their imagination and knowledge to produce new solutions, for example motifs and color gradations. 3) Students get the opportunity to understand knowledge, produce ideas or innovations that are relevant and have an impact in real life contexts, for example when they plan the results of motifs on sashes. 4) A complex process involving critical, creative, and innovative thinking to produce something new and useful, within the integration of STEAM.

Discussion

The STEAM learning process using ikat weaving at Sonraen Public Elementary School demonstrated success in fostering students' creative abilities through active involvement in every stage of weaving. Students were not only physically involved in processes such as winding thread, weaving, and weaving, but also cognitively engaged in understanding mathematical concepts such as number patterns, multiples, and symmetry, and affectively in exploring Amarasi cultural values through the pan buay ana and kaimanfafa motifs. This multidimensional involvement demonstrates that learning does not stop at academic aspects, but also touches the emotional and social realms of students. This is in line with the views of (Dhany & Yulianti, 2025; Fikriana et al., 2023; Monika et al., 2023) who emphasized that the creative process in education involves combining knowledge and imagination in a meaningful, real-world context. In other words, creativity cannot be separated from students' life experiences, including the cultural environment that surrounds them.

The relevance of the local context in this learning makes the creative process part of academic skills as well as an effort to reflect on and preserve cultural identity. Students learn that ikat weaving is not only an aesthetic work, but also a symbol of mathematical knowledge, tenacity, and collaboration between individuals (Zaky & Jamhari, 2024). By presenting local motifs in the classroom, students gain an understanding that each pattern has meaning, both mathematically and culturally. This reinforces the idea that contextual learning can be a strategic tool for developing higher-order thinking skills, as stated by (Gusman et al., 2023; Zulirfan & Yennita, 2022) that cultural integration in STEAM education allows for a more authentic and relevant learning process to students' lives.

The findings of this study confirm the results of (Kim et al., 2025; Li et al., 2023) study, which showed that the entire weaving process of the Amarasi community holistically applies STEAM principles, despite being carried out traditionally. They identified scientific aspects in the processing of natural dyes such as noni roots and teak leaves, technological aspects in yarn spinning techniques, tool engineering in the design of moleng and roki ko'u, art in motif arrangement, and mathematical skills in calculating yarn rolls and arranging symmetrical patterns (Chappell et al., 2025; Li et al., 2022; Thuneberg et al., 2018). In the context of formal education, this approach is further developed by integrating learning about number patterns and arithmetic operations as part of the process of designing and executing woven motifs. This is clearly evident in this study, when students directly practice the weaving process while connecting their skills to mathematical concepts learned in class (Haq et al., 2025; Kumbhat et al., 2024).

Furthermore, previous research supports these findings. (Y. Wang et al., 2024) demonstrated that creative activities in combined geometry topics can stimulate students' creative thinking through drawing and modeling plane shapes. Meanwhile, (García-Llamas et al., 2025) developed creative-based learning through magnetic induction materials that encouraged students to produce simple, experimental-based works. Research by (Al-Betar et al., 2025; Santos et al., 2025) found that integrating local wisdom into science learning can improve conceptual understanding while fostering an appreciation for regional culture. Similarly, a study by (Haghghi et al., 2024; Kurkin et al., 2025; Montero-Izquierdo et al., 2024; Plehiers et al., 2019) demonstrated that the STEAM model, combined with traditional arts such as batik and woodcarving, can foster problem-solving skills and enrich the learning experience of elementary school students.

Thus, this research offers a novel contribution through the integration of local culture into all stages of STEAM learning. Unlike previous research, which generally only used culture as an illustration or additional example, this approach makes ikat weaving the core of the learning itself (Nkulikiyinka et al., 2020; Ross-Veitía et al., 2024). This means that culture is not merely present as a backdrop, but rather as a comprehensive and strategic learning vehicle. This approach enriches the contextual learning model in elementary schools, strengthens the relevance of academic content to real life, and fosters a strong cultural identity in students.

The creative activities in this study not only produced woven products as learning artifacts, but also fostered critical, creative, collaborative, and reflective thinking (Rahimi & Salaudeen, 2024). Students learned to observe, plan, execute, and evaluate their woven products, which are higher-order thinking stages in Bloom's taxonomy. They also practiced collaborating with peers, sharing ideas, and appreciating the work of others, so that the value of mutual cooperation inherent in Amarasi culture could be internalized in everyday behavior (N. Wang et al., 2024).

Based on these results, it can be confirmed that ikat-based STEAM can be an innovative and transformative learning model. This model is not only relevant for improving academic understanding, particularly in mathematical concepts such as number patterns and arithmetic operations, but also for building students' cultural awareness and character (Jiang et al., 2025; Nguyen & Diab, 2023; Oliva-Córdova et al., 2025). Furthermore, this approach is worthy of widespread application, especially in regions rich in local wisdom such as East Nusa Tenggara. Thus, learning is no longer abstract and detached from students' lives, but truly becomes part of the process of shaping their identity and civilization.

Conclusion

This study aims to describe the profile of the growth of students' creative abilities through learning based on approaches.STEAM with the help of ikat weaving mediaat Sonraen State Elementary School. The results of the study showed that all stages in the weaving process, starting from winding the thread, weaving, making motifs, tying the thread, dyeing, to weaving, successfully integrated the element sscience, technology, engineering, arts, and mathematics and encourage students to be active, creative and independent. Students' creative abilities are evident through their activities in designing motifs, constructing mathematical patterns, selecting color combinations, and producing woven products that are not only mathematically meaningful but also aesthetically and culturally valuable. This process provides space for students to express ideas, solve problems, and connect theory to real-world practice. More broadly, these findings indicate that STEAM-based learning rooted in local wisdom can be an effective strategy for enhancing higher-order thinking skills and creativity in elementary school students.

From the sidepractical implications this study confirms that teachers can utilize local cultural media such as ikat weaving as a contextual learning tool that is more meaningful, enjoyable, and closer to students' daily experiences. Furthermore, this approach can be an alternative in improving the quality of mathematics and science learning, which are often considered difficult, because the material is learned through real-life activities and culture-based projects. For schools, the results of this study can serve as a basis for developing learning innovations that integrate local culture to strengthen students' character, identity, and competitiveness in the global era.

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Author Contributions

Jouis Nieldy Otemusu: Conceptualized the research, designed the methodology, and coordinated the research implementation and data analysi

Helti Lygia Mampouw: Provided input, direction, and advice in the literature review and preparation of the discussion section.

Ferdy S. Rondonuwu: Provided input, direction, and suggestions in data analysis and final editing of the manuscript.

Conflicts of Interest

The authors declare that there is no conflict of interest in this research."

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