

Ethnoscience Study of Rangrang Woven Fabric from Seraya Karangasem as Supporting Material for Junior High School Science Education

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Abstract: The importance of linking science education to the local cultural context so that scientific concepts become more meaningful to students. This study aims to examine the potential of ethnoscience in the traditional rangrang woven fabric of Seraya, Karangasem, as a supplement to junior high school science curriculum. The study employs a descriptive qualitative research design using an ethnoscience approach. The research subjects included business owners, two weavers in Seraya Village, and three science teachers at SMP Negeri 3 Amlapura, selected through purposive sampling. Data were collected through observation, semi-structured interviews, and questionnaires, and analyzed using the Miles and Huberman model across the stages of data reduction, data presentation, and conclusion drawing. The results of the study indicate that the process of making rangrang woven fabric incorporates various scientific concepts, including the classification and transformation of materials in the use of natural dyes (indigo, noni, and others) and the process of spinning cotton into thread, the principles of simple machines in the use of traditional tools, concepts of heat and its transfer during the boiling process, pH concepts in the dyeing and color-fixing processes, as well as concepts of force, motion, and work in weaving activities. The conclusion of this study indicates that the entire process of making rangrang woven fabric is closely connected to the junior high school science curriculum and has the potential to serve as a contextual learning resource grounded in local wisdom. This integration of ethnoscience can help students understand scientific concepts more tangibly while fostering awareness of cultural and environmental preservation.

Keywords: Ethnoscience; Rangrang Weaving; Science Education.

Introduction

Indonesia is renowned for its local cultural wisdom, which refers to traditional knowledge, beliefs, and practices rooted in local customs, values, and experiences. This includes diversity in customs, races, cultures, ethnicities, and languages passed down through generations [1]. Local knowledge about the natural environment, the understanding and practices communities develop regarding their ecological surroundings, can be identified and explained using scientific principles that contain science concepts [2].

Science education in junior high school can provide a basic understanding of the universe and natural phenomena around us [3]. One approach to learning that is in harmony with and relevant to students' environment and culture is the application of knowledge developed from local wisdom and cultural practices of the local community, known as ethnoscience [4]. In this context, 'local wisdom' refers to the traditional knowledge, values, and practices passed down within a community, while 'cultural practices' are the behavioral patterns and customs shared among community members. Ethnoscience means knowledge derived from the beliefs and norms of local communities that influence the understanding and interpretation of nature [5].

Currently, science learning largely follows government regulations and curricula. According to Article 3 of Law No. 20 of 2003 on the National Education System, national education aims to develop students' abilities,

character, and civilization, helping them become knowledgeable, skilled, creative, healthy, and responsible citizens. To support these goals, the government has made various efforts to improve science learning, such as implementing school literacy programs, minimum competency assessments, school operational assistance, educator competency development, school leadership transformation, curriculum refinement, textbook improvement, and the use of digital learning platforms [6].

In reality, the Program for International Student Assessment (PISA) is an international survey that evaluates education systems by testing the skills and knowledge of 15-year-old students. Students' science literacy scores in Indonesia remain relatively low. Science literacy, as assessed by PISA, is defined as the capacity to use scientific knowledge, identify questions, and draw evidence-based conclusions to understand and make decisions about the natural world. It includes four interrelated domains: context (personal, local, and global), knowledge (content, procedural, and epistemic), competency (explaining phenomena, evaluating and designing scientific research, and interpreting data), and scientific attitudes (interest, attention, and response to science and technology as well as real-life issues) [7]. PISA measures students primarily in three main areas: reading literacy, science, and mathematics [6]. In the latest PISA results for 2022, Indonesian students ranked 69th or 12th from the bottom, out of 81 countries, with a score of 1108 [7].

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There are several factors behind students' low science literacy, which can be grouped into those related to students, teachers, and schools [6]. For students, low interest in reading and in independently reviewing learning materials is common; research by Sutrisna confirms that most students read textbooks only when preparing for exams or completing assignments [8]. These issues affect not only students and teachers but also schools themselves. Limited facilities, such as laboratories and practical equipment, can restrict students' hands-on experience, hindering the development of cognitive science competencies. Ideally, science involves active, practical participation, allowing students to understand not just procedures but concepts through direct experience [9]. However, science learning often emphasizes mastering content over developing competencies, and students perceive it as abstract and unrelated to daily life. Despite this perception, many science concepts can actually be integrated contextually, connecting learning materials to real-life situations and local knowledge from the surrounding environment to bridge understanding [8].

Science education focuses more on mastering content than on developing scientific competencies in practice [10]. Science education is also often perceived as abstract by students because the material taught is considered unrelated to daily life [11]. Although it is often assumed that science education is abstract and far removed from students' daily realities, this view is not entirely accurate [9]. In reality, many concepts in science education can be developed contextually, that is, by integrating learning materials into real-life situations relevant to students' lives to bridge students' understanding of scientific concepts through direct experience or local knowledge derived from their surroundings [12].

The rangrang woven fabric of Seraya Timur Village is an example of indigenous scientific knowledge that can be studied using an ethnoscience approach. Seraya Village itself is located in Karangasem District, Karangasem Regency, Bali Province, and has several livelihoods, including fisheries, agriculture, and handicrafts [13]. Seraya Village comprises three administrative villages: Seraya Administrative Village, West Seraya Administrative Village, and East Seraya Administrative Village. The production of rangrang woven fabric is only found in East Seraya Village among the three administrative villages. East Seraya Village has developed a weaving craft that has brought the name of East Seraya, located in Karangasem regency, to national and international attention and has made it a tourist product, although it has not yet been produced in large quantities [13].

The process of making Seraya Timur's distinctive woven fabric begins with the production of yarn from processed cotton, which is then dyed naturally according to market demand. The uniqueness of the rangrang woven fabric lies in the use of natural dyes sourced from the village's surrounding environment. Another distinctive feature of this woven fabric is the small holes, which are a unique characteristic of rangrang fabric. These holes are the result of a unique weaving technique used by artisans, in which the weaving is not done tightly, creating small gaps on the fabric's surface [13]. This technique not only distinguishes rangrang woven fabric from other types of woven fabric but also reinforces the aesthetic value and uniqueness of the local culture it embodies. Weaving in

Seraya Timur Village remains traditional, passed down from generation to generation, in both the tools and materials used and each stage of the manufacturing process. In addition to its uniqueness, the rangrang woven fabric, typical of Seraya Karangasem, unknowingly embodies concepts in natural sciences (IPA) that can be scientifically studied through the perspectives of physics, chemistry, and biology at each stage of its production.

The uniqueness of the traditional Seraya Karangasem rangrang woven fabric, encompassing tools, materials, and the entire production process, warrants in-depth explanation and analysis from a scientific perspective, as these elements have the potential to serve as a context for Natural Sciences (IPA) learning at the junior high school level. The context of this material covers topics such as physical and chemical changes, separation of simple mixtures, motion and force, pressure, simple machines, heat, insulators and conductors, pH, and pollution prevention efforts.

Research on Rangrang woven fabric has so far focused primarily on promotional and marketing aspects. To date, no study has specifically examined Rangrang woven fabric within the context of ethnoscience as a teaching aid for science education at the junior high school level. Given that local wisdom has not yet been integrated into science education at Amlapura State Junior High School 3, particularly in the production of Rangrang woven fabric, the author is very interested in examining the production process of this woven fabric so that it can be developed in junior high schools in Karangasem Regency, as rangrang fabric is a form of local wisdom that needs to be developed and deserves attention. Therefore, this study is highly novel and has the potential to make a positive contribution to scientific development, particularly in integrating local culture into science education. This study is expected to enrich students' understanding of scientific knowledge through an ethnoscience approach, ensuring that science education is not merely theoretical but also contextual and relevant to the surrounding environment. Based on this background, the study conducted is titled "Ethnoscience Study of Rangrang Woven Fabric from Seraya Karangasem as Supporting Material for Junior High School Science Education."

Research Method

This study employs a descriptive qualitative research design using an ethnoscience approach. This approach was chosen because the research focuses not only on outcomes but also on the meaning of local knowledge that has developed within the community and its relationship to scientific concepts [14]. The research subjects consisted of one business owner, two weavers of traditional Seraya rangrang woven fabric from Karangasem, and three science teachers at SMP Negeri 3 Amlapura. Subject selection was conducted using *purposive sampling* based on several considerations: direct involvement in the rangrang weaving process, field experience, and willingness to provide information openly [15]. Data collection was carried out through participant observation, semi-structured interviews, and questionnaires. Participatory observation was used to directly observe the process of making rangrang woven fabric, from material processing to the weaving process [15]. Semi-structured interviews were conducted to provide the

researcher with a set of guiding questions while also allowing informants to explain their experiences and knowledge more freely [16]. Questionnaires were administered to science teachers to determine their responses regarding the relevance of the results analysis study on the ethoscience of the process of traditional Seraya Karangasem rangrang woven fabric in relation to science learning materials at the junior high school level [15].

The research instruments consisted of an observation guide, an interview guide, and a questionnaire. These instruments were first reviewed with the supervising lecturer to ensure that their content aligned with the research objectives. Data validity was ensured through source triangulation and other techniques [15]. Source triangulation was conducted by comparing information from weavers, business owners, and teachers. Methodological triangulation was performed by cross-referencing data from observations, interviews, and questionnaires [15]. Member checking was conducted by reconfirming interview results with informants to prevent misinterpretation [16].

Data analysis was conducted using the Miles and Huberman model, which comprises three (3) stages, namely: (1) Data Reduction is the process of selecting and simplifying

data considered relevant to the focus research; (2) Data presentation in the form of narratives and tables to make the relationships between data easier to understand; (3) Drawing Conclusions, which is done gradually while continuously verifying consistency in the field [16]. The survey data were analyzed descriptively by calculating the percentage of respondents' answers, which were then interpreted to identify trends in teachers' responses regarding the use of rangrang woven fabric as a science learning resource. These analysis results were subsequently used to reinforce the findings from observations and interviews.

Results and Discussion

Based on observations and interviews with business owners and weavers of rangrang woven fabric in Seraya Village, Karangasem, it was found that the production process of rangrang woven fabric, typical of Seraya Village, Karangasem, consists of several stages. The tools, materials, and stages of the process of making rangrang woven fabric, typical of Seraya Village, Karangasem, are presented in the following figure.

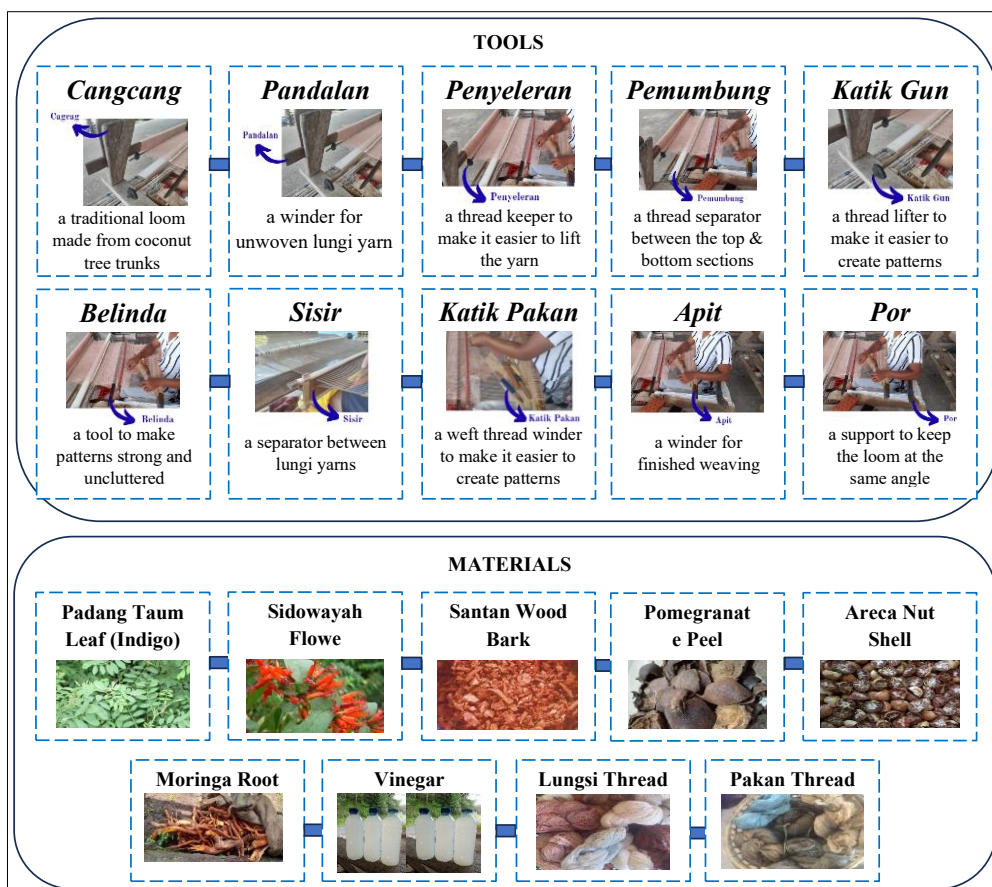


Figure 1. Tools and Materials Used to Make Traditional Rangrang Woven Cloth from Seraya, Karangasem

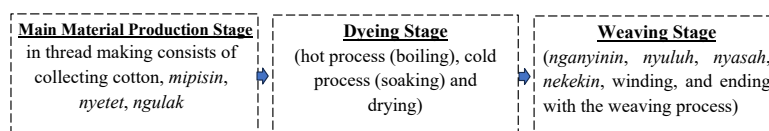


Figure 2. The Process of Making Rangrang Woven Fabric, a Speciality of Seraya Karangasem

Table 1. Field Findings, Related Science Concepts, and Interpretations

Field Findings	Science Concepts	Interpretation
Research Focus 1: Plants used as natural dye sources		
Indigo leaves, noni roots, santen bark, sidowayah flowers, and areca nuts are used as sources of.	Natural pigments (flavonoids, tannins, anthocyanins).	The community recognizes the properties of substances based on empirical evidence.
Research Focus 2: The process of producing natural dyes from plants		
Ingredients are chopped, boiled, or soaked.	Heat and heat transfer.	Heating helps release pigments from plants.
Research Focus 3: The process of applying natural and synthetic dyes to thread.		
The yarn is dyed, washed, and soaked in lime water and vinegar.	Acid-base (pH)	Changes in pH affect the strength of the bond of the color on the fiber.
Research Focus 4: The process of thread formation		
Cotton is separated, refined, and spun.	Physical changes and structural plant cells.	The process only changes the shape without producing w substances.
Research Focus 5: The use of a <i>jatra</i> to spin cotton		
Tools are used for spinning and winding thread.	Simple machines (wheels and axles).	Tools help reduce effort. and increase work efficiency
Research Focus 6: Straight and bent hand movements with strength and tension when weaving		
Repetitive hand movements when pulling and arranging threads.	Force, motion, work, and energy.	Weaving activities demonstrate a relationship between force and placement.
Research Focus 7: Factors that influence the quality of Seraya Karangasem's distinctive rangrang woven fabric		
Duration extraction and drying affect the color.	Environmental and energy effects.	Light intensity and time affect the color stability.

The research results presented in Table 1 show that the process of making rangrang woven fabric in Seraya Village, Karangasem, not only represents a cultural practice but also incorporates scientific concepts that can be scientifically explained. This connection is evident in the consistent use of materials, the treatment processes, and the results produced at each stage of production.

The use of plants as a source of natural dyes demonstrates a tangible process of identifying the properties of substances. Communities use various types of plants, such as indigo leaves, noni roots, santen bark, sidowayah flowers,

and betel leaves, to produce specific colors. This practice demonstrates the ability to identify the characteristics of substances through observation. Scientifically, this phenomenon is associated with the content of natural pigments, such as flavonoids, tannins, and anthocyanins [17]. Interestingly, although the community is unfamiliar with these terms, the results obtained are consistent with those in scientific explanations. These results align with Emda's view that local knowledge can be understood as an early form of scientific construction [18].

Table 2. The relationship between CP in Junior High School Science and the Process of Making Traditional Rangrang Woven Fabric from Seraya, Karangasem

Science Learning Outcomes SMP	Weaving Context Rangrang	Concepts Emphasized
Analyzing classification, properties, and changes in materials.	The use of natural dyes and extraction.	Properties of substances, physical changes, and chemical changes.
Analyzing the various motions, forces, and pressures, as well as the relationship between work and energy.	Weaving activities and tool use.	Force, work, energy, and simple machines.
Analyzing the effect of heat and its transfer on temperature changes.	Boiling of dye materials.	Heat, conductors, and insulators.
Understanding pH as a measure of the acidity of a substance and using it to classify materials (acids and bases based on their pH).	The use of lime water and vinegar.	pH changes and chemical reactions.
Designing efforts to prevent and overcome pollution and climate change, and carry out environmental conservation.	Use in production.	Environment and sustainability.

The color extraction process, which involves boiling and soaking, demonstrates the utilization of thermal energy in the production process. Boiling the materials raises the temperature, accelerating the release of pigments from plant tissues. In scientific terms, this temperature increase accelerates the release of compounds from plant tissues [19]. This finding is supported by Ragab's research, which explains that temperature influences the rate and amount of extracted substances [20].

The yarn dyeing stage demonstrates a more complex concept, particularly regarding pH. The use of alkaline lime

water and acidic vinegar water indicates changes in solution conditions that affect the final result. At the junior high school level, pH is used to classify substances based on their acidity or alkalinity [19]. Changes in pH during this process affect the bond strength between the dye and the fiber, making the color more durable [21]. Although not expressed in scientific terms, this practice reflects an empirical understanding of the interaction between dyes and solvent media. Priatmoko's research also indicates that acidic and basic conditions play a crucial role in the color fixation process for natural dyes [22].

The process of spinning cotton into thread involves a physical change, specifically a change in form without the creation of new matter [23]. From the perspective of material structure in science, cotton fibers are composed of cellulose, which provides strength and elasticity to the thread [24]. This process demonstrates the connection between the concepts of material structure and physical change within a single sequence of activities. This finding supports Waite-Stupiansky's view, which emphasizes the importance of direct experience in building an understanding of scientific concepts [25].

Weaving involves interactions between force, motion, work, and energy. The weaver's repetitive hand movements demonstrate the presence of a force causing displacement, which can be explained through the concept of work in physics [23]. The greater the force applied and the greater the displacement of the thread, the greater the work performed [26]. The energy used originates from muscle energy converted into kinetic energy [19]. At the junior high school level, this concept is explained in the context of force and motion. Additionally, the use of tools such as the *jantra* demonstrates the application of the wheel-and-axle principle, a simple machine that facilitates work [19]. This aligns with Tamam's research, which states that traditional tools can serve as tangible representations of mechanical concepts in learning [27].

Environmental factors also play a role in determining the quality of the woven fabric. The duration of the extraction and drying processes affects the intensity of the resulting color. Under certain conditions, excessive exposure to light can actually cause the color to fade. This phenomenon can be explained as the effect of light energy on changes in the properties of substances in junior high school science lessons [19]. On the other hand, the use of natural materials throughout the production process indicates a trend toward more environmentally friendly practices, as the waste produced is more readily biodegradable [28]. This view aligns with Ragab's view on sustainability [20].

The relationship between all research findings and junior high school science learning is summarized in Table 2. The table shows that concepts such as changes in matter, heat, force, and energy, as well as acids and bases, can be directly linked to the process of making *rangrang* woven fabric. This indicates that ethnosience has the potential to serve as a learning context that is both relevant and practical. Previous research has also shown a similar trend. Context-based learning using local contexts can enhance students' conceptual understanding because the material becomes more closely aligned with their daily experiences [29]. The findings of this study reinforce these results and demonstrate that integrating ethnosience can serve as an alternative approach in science education. Overall, this discussion

indicates that the practice of making *rangrang* woven fabric is not only culturally relevant but also scientifically valuable, with potential to be leveraged in education. However, its application in an educational context still requires further development, particularly through structured instructional materials to ensure optimal classroom use.

Conclusion

The research results indicate that the process of making the traditional Seraya Karangasem *rangrang* woven fabric not only embodies cultural value but also incorporates scientific concepts that can be explained scientifically. Local knowledge, which has been passed down from generation to generation, turns out to have a strong connection with junior high school science curriculum, particularly regarding the classification and transformation of materials in the use of natural dyes (indigo, noni, and others), the principles of simple machines in the use of traditional tools, the concept of heat and the movement of substances during the boiling process, the concept of pH in the dyeing and color-fixing processes, and the concepts of force, motion, and work in weaving activities. These findings demonstrate that ethnosience can serve as a bridge between abstract scientific concepts and students' real-world experiences. Theoretically, this study reinforces the idea that local wisdom has the potential to serve as a source of science learning, while practically, the results can be utilized as an alternative for developing teaching materials or learning contexts that are more closely aligned with students' lives, particularly in the implementation of a curriculum that emphasizes contextual learning. The study implies that teachers can begin integrating local resources, such as *rangrang* woven fabric, into science lessons so that students not only understand the concepts but also see their relevance in daily life. Further research is needed on other forms of local wisdom to broaden the development of ethnosience-based learning and ensure it is not limited to a single region.

Author's Contribution

N. P. D. P. Prameswari: conceptualized the study, conducted data collection and analysis, and drafted the manuscript. K. Selamet & P. H. Sudewa: validated the findings, provided critical revision of the manuscript, and reviewed the final manuscript.

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