

Biology Learning Innovation: Utilization of Ethnobotanical Knowledge in Pandan (*Pandanus tectorius*) Craft Production by the Kerinci Community

Relan Okti^{a*}, Indah Kencanawati^a, Novinovrita.M^a

^a Biology Education, Faculty of Teacher Training and Education, Institut Agama Islam Negeri Kerinci, Indonesia

* Corresponding author: Jl. Kapten Muradi, Kecamatan Sungai Liuk, Kota Sungai Penuh, Provinsi Jambi, 37112. E-mail address: relanokti202@gmail.com

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abstract

Etnobotany is focused on using pandan plants in making handicrafts as part of the community's culture. This research was conducted in Rawang Village, Hampan District, Rawang District, Sungai Penuh Regency, Full City, which combines ethnobotany knowledge in the process of making handicrafts by utilizing pandan plants. This study aims to explore the traditional knowledge of local people about the use of pandan plants in making handicrafts. The research method used is a qualitative approach with a descriptive method, including observation, in-depth interviews, and documentation. The study results showed eight stages in the process of making pandan. lapik crafts, namely sorting leaves, sewing or separating leaves into several parts, removing thorns, softening, coloring, drying, and weaving. With their flexibility and diversity, Pandan plants have quite a kiss of economic and cultural potential. Crafts from pandan plants, such as pandan lapiak, reflect technical skills, enrich local cultural heritage, and increase environmental awareness. The use of pandan plants as a learning medium can teach cultural values, traditional skills, and awareness of environmental sustainability to the younger generation.

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1. Introduction

Ethnobotany, derived from the terms "ethnology" (culture) and "botany" (plants), is an interdisciplinary field that investigates the relationship between humans and plants, emphasizing how local communities use, manage, and conserve plants for everyday life. (Batlajery et al., 2022). This discipline combines botany and anthropology, exploring the cultural meaning of plants in local traditions, practices, and beliefs (Rukmana et al., 2021). Through this study, ethnobotany contributes to preserving traditional ecological knowledge and improving the community's quality of life (Purwanto, 2020).

One of the main areas of ethnobotanical study is the use of pandan plants (*Pandanus tectorius*), especially in Koto Dian Village, Hampan District, Rawang Regency, where pandan leaves are the center of handicrafts (Hayati et al., 2021). With its strong and flexible fibers, this plant is processed into functional and aesthetic items such as mats and bags, demonstrating the community's ingenuity and cultural expression (Widyaningsih, 2014). Making crafts reflects

technical skills and a deep relationship between humans and their environment, emphasizing traditional practices' ecological and cultural dimensions (Helmi, 2022).

Pandanus plants, which grow abundantly in humid environments and are characterized by strong fibers and thorny leaves, have significant ecological and cultural value (Arul et al., 2023). Their use in handicrafts aligns with sustainability goals, as they are renewable resources with biodegradable properties, making them environmentally friendly (Yunia, 2017). However, its processing requires time, energy, and special skills, with challenges including vulnerability to pests and limited availability of raw materials (Yunia, 2017). Despite various challenges, pandan-based crafts remain the foundation of cultural identity and ecological sustainability in local communities (Izzah & Ansori, 2021).

Ethnobotanical studies document traditional practices and provide insights into integrating plant-based crafts into education (Dewi et al., 2023). Using pandan as a creative learning medium teaches cultural values, traditional skills, and environmental management to the tumba generation, fostering a sense of responsibility to preserve nature and cultural heritage (Sudirwo et al., 2021). This educational approach deepens students' understanding of ethnobotany and its relevance in contemporary life (Patria & Mutmaniah, 2015).

Pandanus plant crafts are practical and symbolize the richness of cultural heritage and creativity rooted in traditional knowledge (Rahmadi et al., 2016). These handicrafts reflect the diversity and ingenuity of local culture, which serve as a source of income and a means of preserving ancestral skills (Galih et al., 2017). Local craftsmen continue to innovate by combining traditional techniques with modern designs, thereby increasing the attractiveness and selling power of products made from these materials (Nurfadila et al., 2019).

Making pandan mats has been a long-standing tradition in Koto Dian Village, manifesting the community's technical expertise and cultural values (Hayati et al., 2021). Ethnobotanical studies in this area reveal the importance of pandan plants in supporting traditional livelihoods while encouraging biodiversity conservation (Prisilia & Yuningsih, 2021). These practices demonstrate how cultural and ecological knowledge are intertwined, creating sustainable systems that benefit communities and the environment (Rahmatika & Mardiyanningsih, 2023).

By exploring the use of *Pandanus tectorius* in handicrafts, this study underlines the potential of ethnobotany to enhance our understanding of traditional ecological knowledge and its role in contemporary challenges (Dewi et al., 2023). Integrating ethnobotanical knowledge into educational frameworks and craft-making processes promotes cultural sustainability, biodiversity conservation, and innovation. As a result, local traditions and practices can be preserved and adapted for future generations, ensuring sustainable harmony between humans and nature (Patria & Mutmaniah, 2015).

2. Method

This study employs a qualitative approach with a descriptive method, focusing on ethnobotanical studies of handicraft-making using pandan plants in Koto Dian Village, Seberang Rawang District, Sungai Penuh City. The descriptive method is chosen to uncover and understand how pandan plants are utilized as a learning medium, offering insights into handicrafts' cultural and educational aspects. The qualitative approach has particular advantages, as it analyzes events or phenomena and validates findings through confirmation from relevant and knowledgeable sources (Zebua et al., 2024).

Data collection techniques play a critical role in achieving the research objectives. This study adopts a three-step data collection process. First, researchers conduct observations to understand the pandan utilization and craft-making process comprehensively. Second, in-depth interviews with artisans and community members are carried out to capture the detailed steps and

traditional crafting knowledge. Third, documentation records each process phase, creating a visual and written archive of the techniques and practices.

The collected data is analyzed using an interactive model of qualitative analysis, which includes data reduction, data display, and conclusion drawing or verification. Data Reduction: Researchers filter and organize data from observations, interviews, and documentation, focusing on relevant aspects of pandan plant usage and craft-making processes (Palazzolo, 2023). Data Display: Summarized data is presented in narrative form, supported by charts, photographs, or tables to enhance understanding. This step emphasizes the linkage between pandan plants and their cultural, ecological, and educational roles (Adnan & Othman, 2012). Conclusion Drawing: Patterns, themes, and relationships in the data are interpreted to formulate insights into pandan-based handicrafts' cultural significance and pedagogical potential. Verification is conducted through triangulation to ensure the validity and reliability of findings (Dean, 2024).

3. Result and Discussion

The potential in exploring the ethnobotany of pandan plants in making handicrafts significantly impacts students' creative learning. Pandan plants, which are widely found in various tropical regions, not only have economic value in the culinary world but also store cultural richness that can be used as interesting teaching materials for students. According to Adinugraha (2022) and Utami et al. (2019), exploring the use of pandan plants in handicrafts can improve students' fine motor skills, as well as hone their creativity in creating various products such as bags, wickerwork, and home decorations. This not only helps in the development of practical skills but also deepens their understanding of local cultural values.

With an integrated learning approach between natural science, local culture, and practical creativity, pandan plants can be an effective tool in learning. Sari et al. (2020) stated that integrating knowledge about pandan plants in the local context introduces students to the biological and ecological and social and cultural aspects of its utilization. This approach allows students to learn while directly experiencing the values contained in craft products, making learning more meaningful and contextual. Through pandan-based handicraft activities, students can develop their practical creativity while gaining experiences that enrich their insights into cultural diversity and the importance of preserving natural resources. Thus, this learning approach positively impacts students' practical abilities and enhances their knowledge of the relationship between nature, culture, and creativity in everyday life. Table 1 below shows the stages of making handicrafts using pandan plants.

Table 1. Reconstruction of community knowledge into scientific knowledge

| The Community of Nations | Scientific Knowledge |
|---|---|
| Pandan plants (<i>Pandanus tectorius</i>) are a type of plant that is used in making handicrafts, which are commonly called (<i>lapaik</i>) by the community. | Pandan is a wild plant (Kaban et al., 2022). Fiber is one type of natural fiber. Pandan plants have various parts such as stems, leaves, flowers, fruits, seeds, and roots. This plant can be a bush, shrub, or tree with a stem that can spread, reaching a height of about 11 meters (Harahap & Purba, 2017). |
| Thorny Pandan (<i>Pandea Beduhii</i>) | Pandan Duri, which is included in the Pandanaceae type, is a wild plant with thorny leaves on the edges, the shape of the tips resembles a sharp triangle, and is generally green or tumba green (Pambudi & Yudiono, 2020). |
| The thorny pandan plant (<i>Pandea Beduhii</i>) can be used to make handicrafts. | Many plants can be processed into handicrafts and benefit the surrounding community economically, but the thorny pandan plant is a good choice because it has flexible leaves (Syukur, 2017). |

| The Community of Nations | Scientific Knowledge |
|---|--|
| <p>The tools and materials needed in the process of making crafts from pandan leaves using pandan plants (<i>Pandanus Tectorius</i>) are: Scissors and pilau, paint or dye, orchids or sewing bamboo (<i>Manyao Jaik</i>), pan, stove, pandan plants (<i>Pandanus tectorius</i>).</p> <p>People use pandan leaves from Koto Dian Village, Hamparan, Rawang Regency, but currently, pandan plants are challenging to obtain.</p> | <p>Pandan is closely related to various aspects of other community life, such as traditional skills, local economy, and culture. From the perspective of traditional skills, this knowledge helps maintain local traditions and cultural heritage, often passed down from generation to generation (Januar, 2017).</p> <p>The craftsmen not only fulfill their own raw material needs, but a small number also buy raw materials from neighboring villages. Some residents look for pandan plants and sell them to craftsmen as an additional livelihood (Davida & Dwiyantri, 1997; Herdiana et al., 2023).</p> <p>Some craftsmen who obtain pandan leaf raw materials from their villages have land or yards and cultivate their pandan plants. However, not all leaves from pandan plants can be used as raw materials for making woven crafts. Some leaves on one tree may not meet the requirements because their size is inadequate, either too long or too short (Khalidi et al., 2024).</p> |
| <p>The amount of pandan needed for one layer of standard-sized pandan (length and width 30 cm) is 35-40 pandan leaves, while for jumbo-sized ones (length and width 50 cm) it is 50-60 pandan leaves.</p> <p>We have already prepared a report</p> <p>We have given you the stage of sewing or dividing several small leaves, removing leaf thorns, softening, coloring, drying, and weaving.</p> | <p>Indigenous peoples who use pandan leaves to make mats have developed empirical knowledge about the number of leaves needed based on the mat's size and the weave's thickness. This knowledge is passed down from generation to generation, indicating a deep understanding of local natural resources and their practical use (Daulay, 2020).</p> <p>The stages carried out in making pandan Layered crafts can be used as creative learning media such as: Leaf selection is related to botany to understand the characteristics of ideal pandan leaves, Removing thorns involves ergonomic and biological techniques, while leaf sewing requires knowledge of techniques and materials to increase the strength and quality of the final result. Leaf softening is explained through physics and chemistry, understanding the molecular interactions of pandan fibers. Coloring using natural or synthetic dyes is associated with chemistry, ensuring the interaction of dyes with fibers and the safety of materials. Drying involves physics, understanding water evaporation from pandan fibers with environmental factors. Weaving connects knowledge of geometry, patterns, and weaving techniques with mathematics and art (Prisilia & Yuningsih, 2021).</p> |
| <p>Processes are being carried out</p> <p>The thorns of the pandan leaves are removed and then sewn or divided into several parts. The pandan is boiled for 30 minutes and then soaked for 1 day and 1 night. The next day, it is rubbed until dry. After drying, the pandan is softened first before being colored. After being colored, it is rubbed, then woven with the motif we want.</p> <p>In Koto Dian Village, Seberang Rawang District, <i>Craft Production from Pandan Tectorius Plants</i> is the primary source of income for local residents.</p> | <p>Processes are being carried out.</p> <p>Procedures for making pandan weaving using the main ingredient of pandan plants (<i>Pandanus tectorius</i>), namely by selecting suitable or strong leaves for the weaving process later (Nurfatiha, Minarsi, 2016). This process, namely the coloring process, contains a chemical compound called <i>a base</i> (Sanivo et al., 2023).</p> <p>Making Handicrafts from <i>Pandanus tectorius</i> Plants can create jobs for the surrounding community. They can be involved in collecting pandan leaves, processing, and making crafts. This helps reduce unemployment in the area and improves the economic livelihood of the community. (Azizah, 2017)</p> <p><u>Handicrafts from Pandan (<i>Tectorius Plants</i>) often have cultural</u></p> |

| The Community of Nations | Scientific Knowledge |
|---|--|
| <p>The constraints include a lack of availability of raw materials because environmental or weather factors disrupt plant growth.</p> | <p>and sales value. Making and using these crafts maintains the community's cultural heritage and local traditions. This helps preserve their cultural identity and strengthens social ties between the younger and older generations (Putri & Rusdi, 2023).</p> <p>Pandan Lapiak production is an integral part of cultural heritage that must be preserved. Students can become a significant source of additional income by learning and honing skills in making pandan lapiak. By mastering this skill, students can positively contribute to the local economy while understanding the importance of supporting small businesses and entrepreneurship.</p> |
| <p>Useful because it can introduce us to the local culture and customs that existed (<i>Pandanus Tectorius</i>) in ancient times.</p> | <p>The purpose of making pandan leaf crafts is to introduce local culture and customs to the tumba generation, including students, so that they can appreciate the richness of the nation's culture. Pandan leaf crafts have benefits for the community, especially students. Here are the benefits:</p> <p><u>Creative Skills Development: Making Pandan Lapiak craft is a creative process of cutting, folding, and arranging pandan leaves into the desired shape. This activity can help students develop innovative skills and train their precision and patience. It also helps preserve and introduce local culture and customs to the tumba generation, including students, so they can appreciate the richness of the nation's culture.</u></p> |

Table 1 above compares public knowledge and scientific knowledge about pandan plants with making handicrafts using pandan plants (*Pandanus tectorius*), especially pandan mats. From the table, the difference between the knowledge held by the public in general and more detailed scientific knowledge can be seen. In the process of making pandan mats, such as the coloring process, chemicals are used in the dye; this dye is often called a base (Gusmailina, 2010).

Pandan (*Pandanus Tectorius*) can be a creative learning medium for students because there are many benefits that we can get from this pandan mat craft. For example, we can deepen our understanding of the benefits of pandan plants, local wisdom, maintaining customs, and other benefits that can be learned through making crafts from the pandan plant. Pandan plants have many values that can be integrated into various subjects. Students can use pandan plants as an interdisciplinary learning medium, primarily through making crafts that can be linked to biological concepts.

Making crafts from pandan leaves can be linked to learning about plant morphology, adaptation, and natural fibers. In this process, students can learn the morphology of pandan leaves, such as their broad and elongated shape, and the adaptive structure that allows pandan plants to survive in humid tropical environments. In addition, pandan leaves contain strong and flexible natural fibers, making them ideal material for handicrafts, such as making pandan mats. In making mats, students can see firsthand how pandan leaves are cut, softened, colored, and dried before being woven into basic functional shapes.

Through this activity, students learn how to utilize natural materials practically and gain a deeper understanding of using natural fibers in everyday life. They can also learn about the importance of preserving local plants and appreciating cultural wisdom that has existed for a long time. In addition, the process of making pandan crafts also provides an opportunity for students to develop practical creativity, improve fine motor skills, and foster a sense of pride in the cultural richness of the local community.

Table 2. The relationship between the craft-making process of pandan and biological knowledge

| The Process of Making Pandan Layers | Biological Concepts in Pandan Plant Crafts |
|--|---|
| Describe the pandan plants (<i>Pandanus tectrius</i>) that can make handicrafts from pandan. | There are many types of pandan plants (<i>Pandanus tectrius</i>) that can be used in the process of making handicrafts from pandan. However, in the Koto Dian community, Seberang Rawang District, Sungai Banyak City, they use thorny pandan in making handicrafts, because it is easy to find. |
| Explaining the biological concepts involved in the process of making pandan cake. | Making pandan mats involves several relevant biological concepts, such as plant morphology, adaptation, and natural fibers. Pandan leaves (<i>Pandanus tectrius</i>) are long, narrow, and pointed with thorny tips, and are equipped with sclerenchyma tissue containing strong and flexible fibers, making them an ideal material for crafts. Pandan plants (<i>Pandanus tectrius</i>) adapt well to tropical environments through hard and strong leaves and vegetative reproduction that allows them to survive in competitive habitats. In addition, the natural fibers of pandan leaves, consisting of cellulose, lignin, and hemicellulose, provide strength and durability, making them suitable for processing into mats. The process of processing pandan fiber involves a deep understanding of its structure and composition, so the resulting crafts are highly quality and sustainably useful. (Zebua & Indrayani, 2018). |
| Why is it important to understand the concept of biology in the craft industry in selecting and processing natural materials such as pandan leaves (<i>Pandanus tectrius</i>)? | Understanding the concept of biology in the selection and processing of natural materials such as pandan leaves (<i>Pandanus tectrius</i>) is very important in the craft industry because this knowledge allows craftsmen to choose the right materials based on morphology and fiber composition and optimize the processing process so that the final product has high quality and good durability. Innovation of new products and ensuring that craft results are more durable and by consumer needs, all done in an environmentally friendly way. |

Table 2 above shows that the concept of biology has a very close relationship with making handicrafts that utilize pandan plants. The type of pandan used, such as durian pandan, is chosen because it is easily found locally. In the coloring process, a chemical substance known as a base provides color to the craft. In addition, exposure to sunlight during the drying process of pandan leaves also affects the chlorophyll pigment contained in the leaves, which ultimately causes a change in color in the pandan leaves. Understanding the characteristics of pandan plants, the types of chemical compounds involved in the coloring process, and the role of light in photosynthesis is vital for craftsmen. With this knowledge, they can maximize the potential for making handicrafts based on pandan plants, which are an abundant natural resource around them. This biological knowledge allows craftsmen to make handicrafts of better quality, as well as utilize local natural resources optimally and sustainably. Through a deep understanding of the interactions between plants, chemicals, and the environment, making handicrafts becomes more efficient and effective, while still preserving nature and local culture.

Based on the interviews with business actors (A) and the community and workers in Koto Dian Village, Hamparan District, Rawang District, Sungai Penuh City, it can be seen that the process of making pandan floors consists of several stages.

Pandanus Plant

Pandanus plants are obtained directly from trees growing in the surrounding villages. The type of pandan used is thorny pandan, which is locally known as "Pandee." The pandan used is about 3 months old, with characteristics of dense leaves and a length ranging from 20 cm to 30 cm. The leaves are bright green, and small thorns begin to appear along the edges of the leaves, which is a distinctive sign of thorny pandan. Knowledge about the use of this plant reflects a deep understanding of plant phenology and its growth cycle. In addition, this also shows the local wisdom of the community in utilizing plants efficiently and optimally to meet their needs. Pandan plants for making *Wu'u* are shown in Figure 1.



Figure 1. Pandanus plant

The process of sewing pandan leaves or dividing the leaves into several parts

Making pandan crafts begins with sewing pandan leaves or splitting pandan leaves into several parts. This process is carried out so that the results of handicrafts can have better uniformity and beauty. By splitting the leaves straight, weavers can produce more uniform pandan threads, thereby improving the quality and aesthetics of the final product. After being split straight, it is boiled for 30 minutes until wilted, then soaked for 1 day and 1 night, and the next day, it is dried. Sewing leaves is a skill that has been passed down from generation to generation and shows the traditional technology used by the community in processing natural materials into valuable products. Figure 2 shows the process of sewing pandan leaves.



Figure 2. The process of sewing pandan leaves or dividing the leaves into several parts

Processes that are carried out during the day

At this stage, the weavers first clean the leaf thorns. This action reduces the potential for interference during the weaving process, and the thorns do not benefit the weaving craft process. This technique shows the special skills and traditional equipment used to process pandan leaves, reflecting the community's adaptation and innovation in utilizing natural resources. The process of cleaning pandan leaves is shown in Figure 3.



Figure 3. The process of cleaning pandan leaves

Softening

Softening is done twice, namely, before boiling and before coloring. After the pandan leaves are sewn, soften the pandan leaves. After they are soft, cook them for 30 minutes until they turn white, then soak them for 1 day and 1 night, then dry them in the sun until dry. After drying, soften it again before the coloring process; this is done to get better coloring results. Moreover, the softening process makes the leaves more flexible and easier to weave. This process reflects knowledge of pandan leaves' physical and chemical properties and skills in manipulating natural ingredients to achieve the desired results. The softening process is shown in Figure 4.



Figure 4. The softening process

Coloring

After the softening process, the next step is the coloring process. Coloring is done with a pandan leaf dye solution that is heated slowly so that the color adheres more to the leaf fibers. Depending on the desired color intensity, this process can take several minutes to several hours. The leaves are stirred periodically during heating so that the coloring is even. This process contains a chemical called "base" in the dye. This dye can produce various colors such as red, green, blue, and others according to our needs. In Koto Dian Village, Rawang area, it is called instant lipstick. This coloring process also has aesthetic and cultural value, because specific colors may have symbolic meaning or be used for particular purposes in local culture. The pandan coloring process is shown in Figure 5.



Figure 5. Pandanus coloring process

Drying in the sun

After being colored, the next step is to dry the pandan leaves without drying them directly so that the color does not fade. The purpose of this process is to reduce the water content in the leaves, resulting in stronger leaves that are ready to be woven. Drying is an important step to ensure that the leaves remain strong and not easily damaged. This shows the community's understanding of the environmental impact of natural materials and traditional ways of

processing raw materials into finished products. The drying process under sunlight is shown in Figure 6.



Figure 6. The drying process under sunlight

Weave

The following process is weaving, which is carried out according to the desired model or design. Weaving is done carefully and precisely to produce quality pandan. Lapiak crafts that are below expectations. Weaving is a form of traditional art that reflects the community's creativity, aesthetics, and cultural values. The weaving process is shown in Figure 7.



Figure 7. Weaving process

Weaving Results

Pandan weaving results have aesthetic and functional value. Pandan crafts have economic value, cultural preservation and environmental sustainability. Once finished weaving, the pandan woven cloth is ready to be sold to neighboring villages or to Paso. The results of Pandan weaving are shown in Figure 8.



Figure 8. The results of pandan weaving

Using pandan as a natural material can increase economic value and sustainability while supporting preserving the environment and local culture (Herdiana et al., 2023). Sunarya et al. (2020) stated that pandan plants can empower communities and preserve culture and the environment. Making crafts from pandan leaves can train students in constructive activities through experimental activities (Johan et al., 2020). Nasrudin et al. (2018) stated that making crafts from *Pandanus tectorius* can train students to strengthen the concepts of physics and chemistry. Therefore, a curriculum that integrates the local wisdom of *Pandanus Tectorius* needs to be designed to support the achievement of the SDGs.

4. Conclusion

This study highlights the important role of pandan (*Pandanus tectorius*) plants in the lives of the people of Koto Dian Village, especially in producing handicrafts such as pandan mats. These crafts not only support the local economy but also serve to preserve cultural heritage. Making crafts involves several main steps, including leaf selection, dividing the leaves into parts, removing thorns, softening, coloring, and weaving. These steps reflect the integration of biological and chemical concepts into traditional practices. This study also underlines the potential of pandan crafts as an educational medium. Using pandan in the context of creative learning enhances students' understanding of local wisdom, encourages the application of scientific principles, and fosters an appreciation for environmental and cultural preservation. In addition, this study reveals that promoting pandan-based crafts can bridge traditional knowledge with modern educational frameworks, enriching cultural identity and sustainable practices. In conclusion, this study aims to uncover the diverse importance of pandan plants in Koto Dian Village. By documenting traditional processes and highlighting their cultural, economic, and educational dimensions, this study emphasizes the need to preserve and develop pandan crafts as an important aspect of local heritage. These efforts strengthen community identity and contribute to broader sustainability goals by connecting culture, science, and environmental stewardship.

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