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# Borsang Umbrella Handicraft: A Science Learning Resource in Thailand

**Yuttana Chaijalearn[1*], Jessada Kaensongsai[1], Pimsupa Singtale[1] and Anodar Ratchawet[2]**
[1]Department of Chemistry, Bachelor of Education Program Faculty of Science and Technology, Thepsatri Rajabhat University
[2]Department of Chemistry, Faculty of Science and Technology, Chiang Mai Rajabhat University
Email: yuttana.c@lawasri.tru.ac.th

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**Abstract.** "Borsang's umbrella making" is indigenous knowledge of Science in San Kamphaeng District, Chiang Mai, Thailand. This local knowledge has been relevant to culture and traditions that are important products exported from the past to the present. This qualitative study aimed to survey its manufacturing process and immersed scientific concepts linked to the Thai National Science Curriculum Standards. Data were collected through participant observations and in-depth interviews. The participants were seven folk philosophers who made a career with the Borsang umbrella making, and the data were analyzed with content analysis as the inductive analysis. Also, the data reliability was verified by member check, peer reviewers, and triangulation method. As result, the findings indicated that the process of "Borsang umbrella-making" included 4 steps 1) material preparation for the canopy 2) building an umbrella structure 3) sealing the canopy with the structure, and 4) Painting and dyeing. Along the process, the scientific concepts found for the Borsang umbrella-making were properties of materials, physical and chemical properties of matter, and polymer. As a recommendation use of the indigenous knowledge as a science learning resource for Thai students, needs to concern organizing this kind of knowledge to fit into the National Science Curriculum and preparing science teachers to be ready and aware of its implementation in school contexts.

**Keywords:** Borsang, Science Learning, Indigenous knowledge, Local wisdom, Thailand

## 1. Introduction

Local wisdom (Indigenous Knowledge) is the knowledge that people in the community discovered by faith and behavior modification depending on the experience of adjusting to life and their local environment taking into account the social context, arts, culture, and way of life are main [1]. The interaction with the environment in the community has been developed over a long period. Local wisdom affects the complexity of community culture, resources, and social interactions through the perception of people in the community. From the potential development of local knowledge development to uplift the grassroots economy of the community through the cooperation of members

within the community. Following the policy to reduce inequality generates income and prosperity economic strength by adopting the sufficiency economy as a framework for community practice [2] in which the use of local wisdom skills and geosocial readiness in that community seeking knowledge of local wisdom which take Its part of the scientific process. This is because indigenous wisdom is a process that explains science through culture. By starting from the process of people in the community, the process of rational observation classifies natural events and solves problems arising from the process of

local wisdom. [1] Local wisdom is also developed and applied knowledge through the scientific process. Either as a hypothesis test experimental use and solving problems related to solving local problems and it can be said that local wisdom is a body of knowledge that is consistent with the nature of science that consists of the scientific world view, scientific Inquiry, and the scientific enterprise. [3]

At present, local wisdom is also classified as an important source of scientific knowledge. According to the core curriculum of science learning subjects, revised edition (2017) [4], which has defined indicators and core learning subjects that students need to learn and appreciate science through local wisdom to be used as a basis for living or continuing education which requires learners after graduating from Mathayom 6 must "recognize the importance and value of science and technology knowledge used in daily life, apply the knowledge and processes of science and technology to life and occupation. Moreover, learners could show appreciation, pride, praise, reference work, works that are the result of local wisdom, and modern technology development. Learners can learn more, do projects, or create pieces according to their interests. "It can be seen that the core curriculum (revised edition 2017) focuses on enabling learners to develop works derived from local wisdom. and able to develop the potential to develop as a career path in the future.

Management of science learning that integrates local wisdom, is an alternative learning management approach that helps learners learn effectively in each context. Making science learning that integrates local wisdom in science classrooms is a learning management approach that allows learners to access the knowledge of local wisdom. Understand the worldviews and approaches of different bodies of knowledge in each locality[5] Make a learning management approach for science teachers who want to teach science by integrating local wisdom with lessons. A variety of concepts and classroom experiences need to be organized. as well as a variety of scientific concepts in teaching and learning design to connect learners with their contexts. Therefore, development guidelines for science teachers Management of science learning that integrates local wisdom, Therefore, it is important to develop students' potential by the goals of the curriculum and society in the future.

Developing science teachers is the key to developing learners. But at present, it is found that the development of science teachers to manage learning that integrates local wisdom is not supported as it should be. Because the traditional teacher development believed that local wisdom knowledge is a body of knowledge that is not in line with scientific knowledge.[6] Therefore, in the development of science teachers to develop science learning management that integrates local wisdom. The researcher, therefore, studied the development of science learning centers in Thailand as a study of umbrella-making handicrafts of BorSang District, Chiang Mai Province which is the local wisdom of Chiang Mai that reflects the culture and the image of tourism and is a product that is classified as one of the outstanding export products of Chiang Mai.

## 2. Methodology

local wisdom in Chiang Mai mostIt is a business about agricultural products and also outstanding in bringing local wisdom about local arts and culture because the charming

old town boasts of diverse local cultures and languages, such as food, traditional architecture, festivals, handicrafts, and uniquely beautiful dances. There are also hill tribes that have different and unique cultures, making them stand out and adding diversity to Chiang Mai. The researcher selected to study local wisdom in handicrafts. In "Making an Umbrella" of the BorSang community in San Kamphaeng District, Chiang Mai Province. By collecting data from 7 research participants who are qualified to choose the location of the data collection. Handicraft center umbrella-making center is a popular learning center and allows outside to study the process of making umbrellas that is unique to the community. The criteria for selection must be people who work within the handicraft center who are professionals within the center for not fewer than10 years and are voluntary in providing information and in collecting data, village sages had to perform umbrella activities throughout the data collection.

The researcher visited the center's area to make participant observations by keeping records of events, words, and actions of those involved in the center. The researcher has been visiting the area for some time (1 week) to get acquainted with the person on the premises and a preliminary understanding of the body of knowledge and local wisdom. The researcher then took the results of the records of events, words, and actions of those involved and interpreted them from the field notes. Examples of field recordings “The selling place consists of the sale of the center's products. At the entrance, there is a sale of color--related products used for drawing patterns on umbrellas. In the other zone, various products that are souvenirs of Chiang Mai will be sold, such as wood carvings, silver jewelry, and a shirt pin, which is a distinctive product of Chiang Mai's local wisdom. Later, there will be products related to fans and umbrellas. which are divided into 4 zones, in zone I, It is an umbrella made of cotton. Where Zone II, is an umbrella made of mulberry paper. In Both zones, I and II umbrellas are available that are painted and finished patterns and are a solid color. For customers who want to draw a product's specifics, that zone III, which about products that use mulberry paper such as mulberry paper lanterns, and mulberry paper mobiles. In Zone IV, it will be a product about decorative items such as fans and there also has a zone that tells the story of the local wisdom of the BorSang community in umbrella making and lifestyle as well. Moreover, there is an exit door to study the process of making umbrellas. There will be a walk to see the products around the distribution area and then continue to walk out to the place to see the process of making umbrellas and will come back to buy products according to the patterns or characteristics that customers like. Some people will have to buy in solid colors. Then hire a local sage to draw patterns or design according to their needs, then, brought all the data obtained as the results of the observations to create the next tool is a semi--structured interview. Analysis of the results of participant observations then analyzes the content with the analysis steps. The researcher read all the information obtained and extracted the data as segmenting. After all, the collected data was divided into 6 issues as follows: 1. The identity of the umbrella 2. Handicraft center 3. Guidelines for the transmission of wisdom 4. materials and equipment for making umbrellas 5. Methods of making Umbrella and 6. Knowledge development of local wisdom (category) and then coding the information. After the researcher considered all messages for encoding, the example is detailed in Table 1, then the researcher made a codebook.

**Table 1** shows an example of a content analysis from Participatory observation 5. Umbrella-making method and 6. Knowledge development of local wisdom.

| field record form | Category | code | message |
|---|---|---|---|
| How to make an umbrella? | | | |
| date1 | location | Lo1 | When entering the San Kamphaeng district, it is decorated with umbrellas. And there are shops selling umbrellas between both sides of the road. |
| date1 | | Lo2 | Area in front of the center, there are photo spots, cafes, and gardens where you can sit and relax under the big trees. |
| date3 | | Lo3 | When tourists arrive and park their cars, will walk into the inner area, then walk straight into the area that makes the umbrella behind and go back to buy products inside |
| date1 | product | P1 | Products related to arts and culture, whether postcards, mobile from mulberry paper, carved wood, or carved silverware. |
| date2 | | P2 | The umbrellas that are sold are divided into 2 groups, a group that has already painted patterns and colors and a group that has been painted without drawing patterns. |
| date1 | product position | LP1 | Zone I is an umbrella made of cotton. Zone II is an umbrella made of mulberry paper. Where zone III was about products that are |
| | | | recycled paper. Zone IV will be a product about being a decorative item. |
| date3 | | LP1 | The product display within the handicraft center will include a sample of the products above. And there are products for sale at the bottom of the exhibit. |

The researcher conducted a preliminary study on local wisdom from field visits. make participant observations to use the results of field visits to design interview tools. The tool was a semi structured interview. by asking several village sages 8 people by the nature of the questions divided into issues as follows: 1. Characteristics and strengths of local wisdom 2. Importance of occupation related to local wisdom 3. Transfer of knowledge about local wisdom 4. Materials and equipment used in making local wisdom 5. Processes used in making about local wisdom and 6. Guidelines for product development on local wisdom. The in-depth interview takes approximately 40 minutes per person.use audio recording The researcher asked for permission from a local philosopher to record the sound. Then, take the tapes of the interviews to make the tapes of the individual interviews. After that, make a return to the center for the village sage to check the accuracy of the interview.

The results of the study were analyzed using participant observation content analysis and interviews with local scholars. then analyze the content (content analysis) with the

analysis steps. The researcher read all the information obtained then extract the data (segmenting) and can divide the collected data into all issues, 6 Issues as follows, 1. the identity of the umbrella 2. handicraft center 3. Guidelines for the transmission of wisdom 4. materials and equipment for making 5. how to make an umbrella and 6. Knowledge development of local wisdom. Then, gives the data code (coding) and considers all messages for encoding with details. Then the researcher made a codebook.

6. Knowledge development of local wisdom

**Table 2** Preview analyzes the content of the data collection.

| tool | Category | code | message |
|---|---|---|---|
| **Issues Handicraft Center** | | | |
| FN:1 | position | Lo1 | When entering the San Kamphaeng district, it is decorated with umbrellas. And there are shops selling umbrellas between both sides of the road. |
| FN:1 | | Lo2 | Area in front of the center There are photo spots, cafes, and gardens where you can sit and relax under the big trees. |
| FN:3 | | Lo3 | when tourists arrive when parking will walk into the inner area. Then walk straight into the area that makes the umbrella behind and go back to buy products inside |

The researcher made a transcript of interviews with several village scholars, and 8 people, then check with the informants (Member Check) and bring the interview results to the village sage to review the interview data that corresponds to the meaning given by the village sages. The researcher then conducted peer reviewers with peer review of the data and the results of the study to exchange with those who have expertise in the field of chemistry learning management and teaching and learning local wisdom, who is known and practiced teaching in Chiang Mai, to exchange and jointly analyze the results of the study whether it is consistent with the research process. Data collection and analysis to ensure accuracy, then the researcher brought the results of the study examining the triangles. (Triangulation) to check the consistency of the information that is correct, from various data collection methods whether a variety of sources various methods of data analysis, etc.

## 3. Findings

From the interviews with local scholars, it was found that the local wisdom of making umbrellas in BorSang is the local wisdom of the villagers of Ban Bor Sang. In the process of making umbrellas for Bor Sang, four steps, are 1) material preparation for the canopy 2) building an umbrella structure 3) sealing the canopy with the structure and 4) Painting and dyeing, each of which has a body of scientific knowledge as the following details,

**1). Material preparation for canopy**

In the body of knowledge, local wisdom, and umbrella-making, there is a selection of materials used to cover the umbrella with different properties as follows: 1. Type of paper (mulberry paper) and 2. The type of fabric (cotton) by the different properties of

the two types of materials are different. By using the water-absorbing properties of the material as a criterion, it can be seen that the traditional umbrella cover that uses mulberry paper has more water-absorbing properties than the fabric group material. For the reason make the efficiency of use when water is absorbed, its performance decreases causing village sages to develop umbrella products to be able to use them with maximum efficiency as the interview follows:

I: Why are there so many products sold in the Umbrella Craft Center?

FP2: In the past, Bor Sang umbrellas were covered with mulberry paper, but there was a problem with the work, namely, they could only block sunlight. They can't prevent the amount of rain; therefore, customers rarely use the product. In the process of making mulberry paper from jute, there are a variety of methods and the high price is not suitable for use. At present, it is developed to cover umbrellas with silk, cotton, etc.

FP5: Paper [mulberry paper] will only block sunlight. But if it's a fabric [cotton], it will be coated with oil. So they can block sunlight and water. And it is more durable and uses fewer chemicals than paper [mulberry paper].


**Figure 1**: Bor Sang umbrella products that use different materials to cover the umbrella. (A) Cover the umbrella with mulberry paper (B) Cover the umbrella with cotton.

The change in chemical reactions of materials can be divided into2 forms: change in physical properties and chemical changes in the process of making paper. There is a process of making mulberry paper from pulp from the jute tree. The scientific name is Broussonetia Papyrifera. Chemical change has an observable point. The formation of new substances in the reaction showed that the chemical change in this process is the use of chemicals to perform chemical reactions to change the structure of the reactants. Figure 2 shows the process of making mulberry paper. Marked steps the (asterisk) chemically altered, found to have 2 steps: Step 2) soak the membranes in water and bring them to boil in sodium hydroxide (NaOH) solution for about 3 hours and wash until the solution is not alkaline; Washing and bleaching with hydrogen peroxide (H2O2). This two-step transformation is a chemical change that takes place and in other steps, it is the physical change of the reaction by simple classification. This may be done in the process of physical transformation when the product changes and the product can be converted back to a new substrate in the papermaking process.

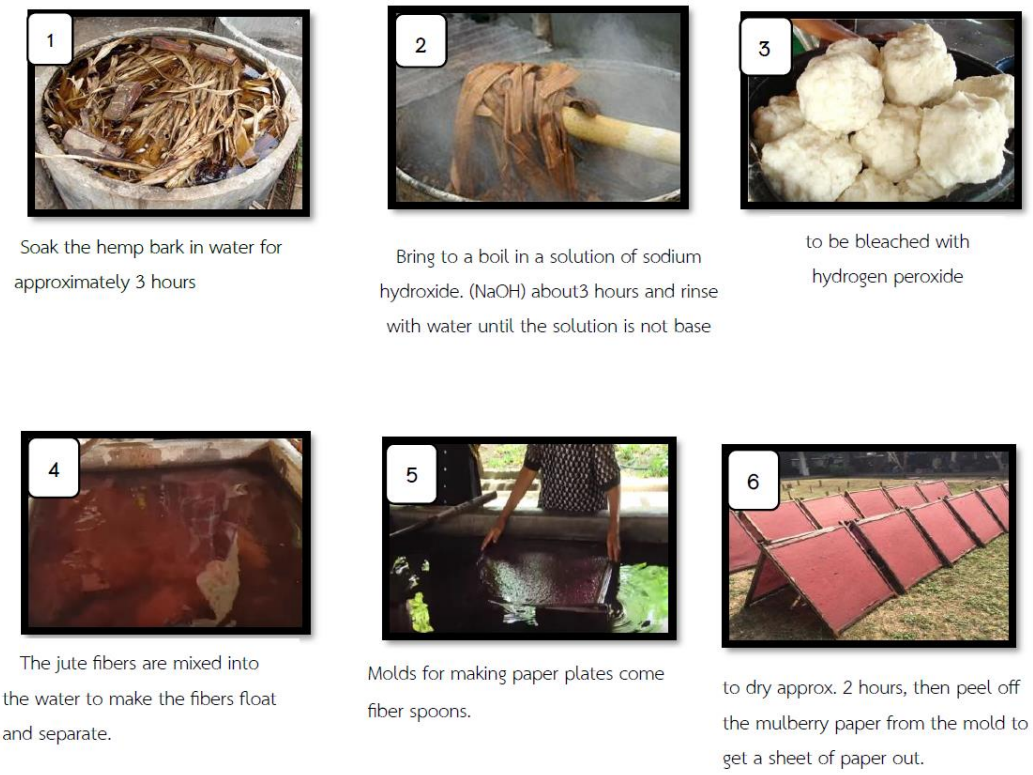


**Figure 2** shows the process of making mulberry paper from jute trees. to be used as a material to cover the umbrella.

The material used to cover the umbrella Materials based on natural polymers are selected according to the monomer structure, Homo-polymer. The material used to cover the umbrella is cotton and mulberry paper. Because it is a locally selected material that can be used locally. When analyzed, the two species were similar. It is composed of glucose monomer molecules connected by beta-glycosidic bonds (β Glycosidic linkage) known as the helix of the cellulose structure. In the process of preparing the material to cover the umbrella, there will be a process of dying to achieve beauty. The study found that in glucose molecules, there are groups that show negative ions. In the dyeing process, the solvent that is commonly used is water. In most processes, the water used has a weak pH value, causing the Hydroxy group on the cotton fabric to be ionized, causing more negative ions. The correction of the dyeing process that is commonly used by the villagers is the addition of metal mordant to create a complex with the complex color. Metal mordant that the villagers use most but do not adversely affect the environment is alum, and salt, the color used in dyeing is a kind of polyphenol. The dye can be absorbed in natural fibers. In addition, 80% natural color structure has a structure similar to acid dyes with a hydroxyl group. The -OH group helps the paint dissolve in water and exhibit a negative charge. When the paint dissolves in water, some colors consist of the pigment group as the main component of the color content. Therefore, each type of paint has a different dyeing process.

**2). Building an umbrella structure**

There is a selection of materials that have different components of the umbrella structure depending on the purpose of use. The first thing that should be known is the components of the umbrella are unique as shown in Figure 3 making the village sage choose different materials to make the structure of the umbrella for maximum efficiency in use as the interview follows:

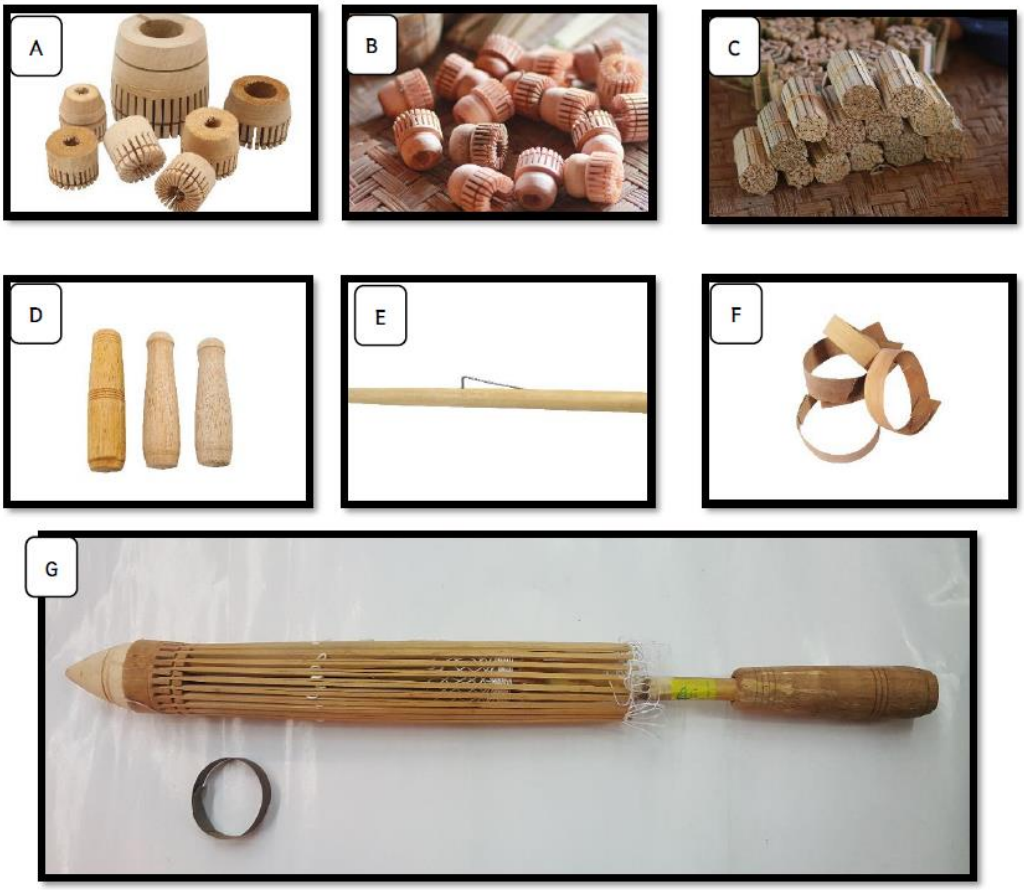


**Figure 3**: shows the components of the umbrella (A) umbrella head (B) bow (C) support (D) rod (E) horse (F) yard stripe (G) umbrella structure that puts all the parts together.

I: components that are used to make the frame of the umbrella, how do we use the same or different components?

FP6: The umbrella head is made of softwood such as trotters., Mushroom ridge, Kham Kham wood, and Kae wood. Components are used to secure the spokes by threading the thread to form an umbrella frame. The size of the head depends on the size of the umbrella and has different characteristics.

Bob is made of softwood as well as the inner part of the umbrella. Next down from the head is used to fix the ribs as a pusher for the umbrella horse to lock-in. Nylon threads are used to attach the bobbins to the struts.

The pole spokes are made of Gold bamboo because they are tough and durable. The bamboo spokes extend from the bottom of the ribs in terms of size and number, depending on the size of the umbrella. 10-14 inches will use 24 teeth, 17-20 inches will use 28 teeth, 40-60 inches will use 36 teeth, and the smallest will be 5 inches, will use 16 teeth in total. The number of spokes will be the same for both the support. For example, for a 20-inch umbrella, 28 spokes will be used for both the support.

The handle is made of small bamboo or softwood. It looks like the part that uses the handle of the umbrella. There are different sizes and styles of wood. There are sizes from size to size.10-12 inches and 14-20 inches. There are two types of wood used to make a rod. Or a hand holding a wooden stick to produce a rod for the same paper umbrella and the satin umbrella. Bamboo will be used to make rods for cotton umbrellas. The design of the wand depends on the craftsman who made it.

The horse (latch) for the small umbrella is made of steel springs. The large umbrella is made of bamboo hone. As usually attached to the long handle of the umbrella, the height or the low depends on the size of the umbrella.

The casing is made of palm leaves, acting as an up down movement. when unfolding or closing the umbrella it looks like a long, small brown leaf. Before using it, it is necessary to soak it in water for the toughness and durability of the palm leaves or casings. The size of the patio casing depends on the size of the umbrella.

I: What are the essential components of building an umbrella structure?

FP7: Making umbrella spokes. After getting bamboo, cut it into pieces. If it is bamboo with long segments, cut between the joints. But if it is a short piece of wood, cut it so that the joint is in the middle of the length of the log, which is cut equal to the size of the umbrella that will be made. For example, for an umbrella size 20 inches, cut bamboo 20 inches long, etc. When cutting bamboo into long pieces use a knife to scrape off the surface of the wood, then mark for drilling holes. Drill holes and string them together. Then it was assembled into an umbrella frame. as in Figure 4.


**Figure 4** Showing the process of making umbrella spokes (A) Steps to sharpening umbrella spokes (B) Complete umbrella spokes awaiting assembly.

**3). Sealing the canopy with the structure**

Take a piece of paper or cotton made on the umbrella frame by using the paste mixed with the rubber of the Tako fruit. The rubber from the Tako fruit is obtained by crushing the Tako fruit thoroughly. Then bring it to the marinade for approx.3 months, then used Tako latex will help fabric or paper. It can resist the growth of mold on the umbrella surface. When dried and then used to paint mixed with local rubber oil called Tang Eu oil. This umbrella is painted by applying a damp cloth over the desired umbrella. In the past, only 2 colors were applied to the umbrella. is red and black Red is derived from the color of red clay that is present in the mountains. The black part is obtained from fire soot mixed with rubber oil. In addition to cotton or paper umbrellas, silk, satin, or other materials can be used to cover the umbrella. as Figure 5.

**Figure 5** Shows the umbrella cladding process. (A) Apply Tako rubber to the umbrella frame. (B) White paper cladding on the umbrella frame.

The physical changes of the umbrella cladding process are evaporation of moisture on white paper. Then take the umbrella covered with white paper to dry in the sun. For the reason that to let the delight evaporate, then covered with another layer of mulberry paper. The transformation process that takes place at every step depends on placing the umbrella in the sun for evaporating the water mixed in the rubber from the Tako fruit, to make the rubber binder to the umbrella wrapper. The change of substance that occurs is physical because in the process of such change no new substances were formed.

**4). Painting and dying**

Painting and drawing patterns on umbrellas are the identity of the community at Bor Sang Umbrella Handicraft Center. By which the color of the umbrella will use the color of the pattern of the umbrella, it will be mostly natural patterns, which are designed according to the craftsmanship. Unless there is an order of products according to customer's size and color and customers can design patterns or messages according to their needs to be given as souvenirs on special occasions as well. By the nature of the basic patterns of the Bor Sang umbrella, identity is patterns related to nature, such as floral patterns, bird patterns, and butterfly patterns, which have evolved according to demand and time to change, with the development of artificial patterns up to many different patterns to meet the needs of consumers

coloring by color acrylic (Acrylic Color) to draw the pattern of the umbrella. Since acrylic paints are synthetic polymers in the form of functional group emulsion cross-linked esters of Acrylic and Methacrylic Acid, it is a viscous liquid. In general, applications are used with volatile solvents. Because when painting on the surface of the umbrella, the painted color needs to evaporate quickly. As in the interview as follows:

I: In the process of applying patterns and colors, what colors do you use?

FP7: The color used in the umbrella is acrylic paint. Because it dries easily and is long-lasting.

FP4: Popular motifs such as butterflies, birds, flowers, and elephants, and also developed into other products such as fans and mobile phone cases.


**Figure 6**: Shows the acrylic handicraft center products (A), umbrellas (B) phone cases, and (C) fans.

From the analysis of scientific knowledge of umbrella making which corresponds to the indicators of science learning subject in the core curriculum of basic education, B.E.2008 (Revised 2017) consistent with 1. Substance 2 Physical Science at the elementary school level until the upper secondary and 2. Additional science Chemistry at the upper secondary level with 4 steps as shown in Table 3.

**Table 3**: shows the process of making an umbrella for Bor Sang of San Kamphaeng District, Chiang Mai Province with the concept of science and related indicators according to the core curriculum of Thailand.

| **Umbrella making process** | **Chemical science concept** | **Corresponding learning metrics** | |
|---|---|---|---|
| | | **physical science** | **Additional science, chemistry** |
| **1. Material preparing for canopy** | material properties | V.2.1 P.1/1-2 | - |
| | chemical reaction | V.2.1 Grade 5/3-4, Grade 3/7-8 | - |
| | Polymer Chemistry | V.2.1 m.3/1-2 | chemical1 M. 6/11-15 |
| **2. Building an umbrella structure** | material properties | V.2.1 P.1/1-2 | |
| **3. Sealing the canopy with the structure** | chemical reaction | V.2.1 Grade 5/3-4, Grade 3/7-8 | |
| **4. Painting and dying** | Polymer Chemistry | V.2.1 m.3/1-2 | chemical1 M. 6/11-15 |

## 4. Conclusion

The study found that local learning resources that promote science learning management in local contexts can promote learning management at the primary and secondary levels of Thailand. The science teacher must study the body of knowledge from the local wisdom both in terms of materials and equipment. In the process of doing local wisdom studied science teachers then have to analyze the body of science related to the procedures or materials studied. Then when teachers can analyze the body of knowledge, Teachers will be able to analyze indicators and learning material from the basic education curriculum connected and consistent with the context of the community and enable learners to learn meaningfully and create a body of knowledge and can arouse the interest of learners in learning. Science teachers can provide guidelines for science

learning management that rely on the integration of knowledge in the same course across learning subjects or can be integrated across groups of learning subjects.

Study limitations science learning resources of science teachers found that it is difficult to apply local wisdom to drive activities to promote science learning that can enable teachers to use continuity in teaching-learning activities. Because the process of local wisdom sometimes does not correspond to the teaching and learning process according to the indicators. As a result, in the development of science teaching and learning management guidelines, teachers should use the activities of the Department of Science Teaching to summarize the body of knowledge and be able to link scientific concepts with linking activities in daily life. And such teaching will cause learners to change their attitude toward science learning. Guidelines for learning management should be developed for science teachers to gain understanding and competence in good learning management.

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