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INQUIRY TRAINING LEARNING MODEL FOR DEVELOPING ENVIRONMENTAL FRIENDLY BATIK DYE

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INTRODUCTION

The development of batik in Indonesia is in line with the growing public demand for batik works (creation). However, behind the increasing economic value of the creative industries sector is just emerging issues related to environmental sustainability. The use of synthetic dye such as naphthol and indigosol in the dyeing process of batik cloth is widely used in the production process of batik artisans, however, has been alleged to be harmful to environmental sustainability. In addition, prolong use of chemical colours such as diazonium may also cause cancer.

The use of synthetic colours is considered more practical because it is easily obtained at reasonable price as well as the intensity of the colors that are bright and strong. This is reinforced by Budiyo (2008: 72) that claims that: "The dye synthetic (synthetic dyes) or chemical substances are easy to get, stable and practical use ...". To solve the above problems, some parties started moving to campaign for public awareness to love environmental conservation. This is highlighted by Wardah and Setyowati (1999: 2) who assert that there would be an increase in the awareness and importance of using natural colours since people are afraid of pollution caused by artificial colouring used in batik dye.

Historically, the use of natural dyes is sourced from the surrounding environment which has long been committed by the Indonesian nation.

Coloring textiles, nonwovens or other objects has always been done using this natural color. Natural dyes or vegetable dyes are coloring agents derived from plants. Natural dye is extracted through fermentation, boiling or chemical treatment of chemical substances contained in plant tissues (Sabamuridin, et al, 1999). The same view was expressed by Tirta (2009: 24) that:

The first batik dyes are all made from ingredients derived naturally from the local environment. Art coloring is commonly applied in the archipelago to decorate various textiles. Roots, leaves and bark are boiled and special ingredients are added to separate and mixed dyes. Variations in vegetation and water quality affect the final color tone, so that each region often has distinctive tones for a specific color.

Type of indigo colour is an old age colour in Indonesian batik used in classic batik (Fraser, 1986). The use of indigo-blue color is also used for custom fabric coloured archipelago, also a trade rival the occupiers in 18 to 19 century because of the growing need for colors in Europe at that time (Wardhani & Panggabean, 2002).

Based on the above opinions, all elements of the plants from roots, stems, leaves, fruits, and flowers can be used as a source of natural dyes. The uniqueness of the natural colors is one of the important aspects of the appeal of batik Indonesia in the eyes of the world. This is stated by Atik (2008) that customers are generally at awe of the beauty of batik through its colors and patterns, the workmanship and philosophical values and sacred depicted in a piece of cloth.

The use of natural dyes that are environmentally friendly can be one of the solutions offered to solve the above problems. To obtain a natural dye (ZPA) in the dyeing process of batik fabric processing needs to be done with the right natural pigments. Using a proper fixation is an attempt to strengthen natural colours pigment in the process of dyeing fabrics. The use of natural dyes is deemed necessary. Apart from being a solution, the basis of the use of natural colors is also closely related to natural resources, especially plants that are widely available in the country and it show our efforts to lift the value of local knowledge. The exploration of natural colour can be done by testing the colours gained from the plant through the stages of extraction of color and testing of fixation in the dyeing process.

Based on the above explanation, it is necessary to disseminate and promote the use of natural colors in the dyeing process of batik cloth. Therefore, the author tries to develop a training of inquiry learning model to take courses of Textile and Batik 2 so that the awareness of students to develop natural color batik dye is environmentally friendly.

RESEARCH QUESTIONS

The discussion in this paper aims to answer the following research questions:

1. How inquiry training learning model can be employed in the development of batik dye?
2. What are the results of a inquiry training learning model in the development of batik dye?

AIMS OF THE STUDY

In line with the background and the formulation research questions stated above, the paper aims to:

1. Elaborate a program of the inquiry training learning model in the development of batik dye;
2. Obtain the implementation result of inquiry training learning model dealing with the development of batik dye.

RESEARCH METHODOLOGY

The application of inquiry training learning model is carried out through experimental method involving Textiles and Batik Course conducted at the Laboratory of Textile and Batik Arts Education, Department of Art and Design, Faculty of Education, Indonesia University of Education. Data was collected through observation, interviews and documentation. The collected include: the information of natural dye plants, processing of natural color extracts and dyeing techniques and fixation of the

experimental results in the form of a fabric that has been coloured through natural dyeing process.

RESULTS AND DISCUSSIONS

In general, learning model is a description of the efforts to create a situation of teachers in learning activities that encourage students to learn. This is claimed by Sukmadinata (2004: 243) saying that: "The learning model is a design that describes the details of the process and the creation of environmental situations that allow students/student interaction resulting in a change or development on students". The same opinion is supported by Soekamto and Winataputra (1994) that "Learning Model" is a conceptual framework that describes a systematic procedure in organizing learning experiences to achieve specific learning objectives, and serves as a guide for designers and educators teaching design in planning and implementing learning activities.

According to Joyce and Weil (2000), each model of learning has the following elements, namely: syntagmatic, social systems, principles reaction, system support, and impact instructional and accompaniment. These elements help us in implementing the model. Next, a brief explanation of the elements of the learning model as follows:

- Sintakmatik, are the stages of implementation of the learning model.
- Social System is the situation or atmosphere, and norms applicable in the implementation of the model. The reaction principle is that the pattern of activity that describes the interaction of the teacher in viewing and treating the students, including how teachers should respond to them and use the rules of the game applied in the model.
- Support System is all materials, tools and means that are necessary to carry out the learning model;
- Instructional Impact (instructional effect) is directly based on the learning outcomes as expected in learning objectives and impact Accompaniment (nurturant effect) are other learning outcomes resulting from the learning process as a result of the creation of an atmosphere experienced by learners without the direct guidance from the teacher.

Inquiry training learning model is one of learning models included in the model group of Information Processing (The Information Processing Family). This model focuses on group learning process that encourages students internally to understand the surrounding world by exploring and organizing the data, identifying the problem and finding the solutions and developing the language to express the findings. In particular, goals and assumptions of inquiry training learning model issued by Joyce and Weil (2000: 176) are as follow:

Inquiry originated training in a belief in the development of independent learners; its method requires active participation in scientific inquiry. Children are curious and eager to grow, and inquiry training capitalizes on their natural energetic explorations, giving them specific Reviews directions so that they explore new areas more forcefully. The general goals of inquiry training is to help students develop the intellectual discipline and skills necessary to raise questions and search out answers stemming from their curiosity.

The application of this model can help the learners to conduct research independently in their subject to question an issue or event occurred and that question is examined by collecting and processing data logically. Inquiry training begins with presenting the situation of questions to find the answer. In this way, it is believed that the learner can become more aware of the research process done and at the same time the students can be taught how to conduct scientific research procedure. The most important thing in implementing this learning model is to create an attitude that "knowledge is tentative" meaning that it is always open to be reviewed continuously. Inquiry learning training model can develop students' knowledge thereby facilitating his ideas in the form of cooperation tolerant in understanding a case. The application of inquiry training learning model according to model taken from Suchman's theory stating that:

1. Students naturally inquire when they are puzzled.
2. They can become conscious of learning to analyze and review their thinking strategies.
3. New strategies can be taught directly and added to the students' existing ones.

4. Cooperative inquiry enriches thinking and helps students to learn about the tentative.
5. Emergent nature of knowledge and to appreciate alternative explanations (Joyce and Weil, 2000: 177).

Stages (Syntax) Inquiry Training Learning Model in the Development of Environmentally Friendly Batik Dyes

Inquiry training learning model according to Joyce and Weil (2000) has five phases, namely: Phase I: Exposing problems. Explaining the procedure is done through research, present situation which is mutual or different; Phase Two: Finding and assessing data which is conducted through the object and check the conditions encountered and check the appearance of the problem; Phase Three: assessing the data and experimentation. Isolating the activities are carried out through the appropriate variables and formulate hypotheses of causation; Phase Four: Organizing, formulating and explaining are done by formulating ways or rules to explain what was done previously; and Phase Five: Analyzing phase which is conducted by analyzing a research strategy to gain more effective procedures. On the basis of the above opinion, the steps to implement inquiry learning training model in the development of environmentally friendly batik dye is done in this phase:

Phase One: Exposing Problems

At this stage, the activities carried out involve explanation of the research procedures regarding the processing of natural dyes as environmentally friendly batik dye. Further explanation in the form of activities present opportunities and problems relating to the range of colors that can be generated through the processing of natural dyes for dyeing batik environmentally friendly through the fixation process using lime, lotus, vinegar, and alum.

Phase Two: Finding and Assessing Data

S.No	Common name of the plant	Botanical name	Part used	Color obtained
1	Siam weeds	<i>Eupatorium odoratum</i>	Whole plant	Yellow
2	Goat weed	<i>Ageratum conyzoides</i>	Whole plant	Yellow
3	Jack fruit tree	<i>Artocarpus heterophyllus</i>	Bark	Yellow
4	Gulmohar	<i>Delonix regia</i>	Flower	Olive green
5	Teak	<i>Tectona grandis</i>	Leaves	Yellow
6	Babool	<i>Acacia nilotica</i>	Leaves, bark	Yellow/brown
7	Water lilly	<i>Nymphaea alba</i>	Rhizomes	Blue
8	Dahlia	<i>Dahlia variabilis</i>	Flowers	Orange
9	Amla	<i>Emblica officinalis</i>	Bark, fruit	Grey
10	Indian Jujube Ber	<i>Ziziphus mauritiana</i>	Leaf	Pink
11	Drumstick	<i>Moringa pterygosperma</i>	Leaf	Yellow
12	Sausage tree	<i>Kigelia pinnata</i>	Petals, heartwood, bark	Yellow, pink
13	African tulip tree	<i>Spathodeacompanulata</i>	Flower	Yellow/orange
14	Tamarind	<i>Tamarindus indica</i>	Leaves, seeds	Yellow, brown
15	Golden dock	<i>Rumex maritimus</i>	Seeds	Brown
16	Eucalyptus	<i>Eucalyptus camaldulensis</i>	Bark	Yellow and brown
17	Red sandalwood	<i>Pterocarpus santalinus</i>	Wood	Red

Source: Sujata Saxena and ASM King (Muthu, 2014: 45)

Table 1 :Colors extracted from natural resources

The activities carried out at this stage are to choose the nature of the object and the conditions encountered. At this stage the students search for relevant references and choose plant material that is expected to produce a batik dye. Theoretically every part of the plant from the roots, stems, bark or roots, leaves, fruits, flowers can produce natural dyes. In this phase, some activities conducted to examine the parts of plants that will be processed according to the research objectives. Some examples of plants producing colors that are produced as well as parts of the plant used among them.

Phase Three: Assessing Data and Experimentation

The activities carried out at this stage are to isolate variables such as the type and parts of plants, long dyeing and fixation materials to be used. In

general, the process of experimentation include the following activities: processing of natural materials so that it becomes extract batik dye cloth, fabric dyeing process, the fabric color fixation process with the aim of directing and strengthen the natural dyes on fabric batik, analyze and record the experimental process. As part of the research activities, at this stage the proposed formulation of hypotheses to be tested through experiment.

Processing practices extract natural dyes made procedurally using a formula of natural ingredients comparison to the amount of water used in the boiling process of materials which are: 1: 10. This means that for each kg of natural ingredients boiled in 10 liters of water so as to be 5 liters of extract dye after boiling process. In detail, the natural material process into extract natural dyes described in Batik and Handicraft Institute of Yogyakarta (2007) as follows:

1. Natural dyes derived from plants such as wood/bark/roots/seeds/peel fruits/flowers/leaves cut into small pieces (except interest and other materials that are already in small sizes), weighed according to the weight of fabric. For one piece of fabric (2.5 m with a weight of 500 g) requires 1 kg of natural dyes.
2. Then the material is put into 10 liters of water, heated to educate until the water 4-5 liters, then after cold filtered/separated from the material.
3. Material (have dimordant advance/pramordanting) to be colored (first moistened first with TRO) inserted into the solution (b) while inverted so that absorption (adsorption) evenly dam entered into as well as material, and allowed to stand for 15 minutes.
4. Then lifted, aerated in the shade, after the dry process of coloring (dyeing) is repeated several times according to the oldness of the desired color.
5. The last process, the material carried mordanting process end or "sarenan".

To produce good dye color, the results need to be given a reinforcing material (fixation). Material fixation according Susanto (1980: 71) are included: lemon, lime, vinegar, saltpetre, borax, alum, rock sugar, brown

sugar, palm sugar, lotus, drops, water chalk, tape, banana klutuk, guava leaves. Batik cloth dyeing process in accordance with the standardization of Research and Development Batik Yogyakarta proposed Ruwahdi and Suharno (2000), the composition of ingredients and steps in conducting experiments natural dyes, as follows:

1. Ingredients: 1 kg of mangga leave, 10 liters to 5 liters of boiled water, Chill.
2. Method of dyeing: Cloth soaked with TRO; Dip a cloth for 15 minutes and leveled; Dry (dry, open); Dip again (at least 2 times); Drain; Dip 3-4 times; Fixed with fixation material.
3. The composition of fixation as follows: 250 gram Alas for 5 liters of water, 250 gram chalk to 5 liters and 375 grams of alum to 5 liters of water. Each of these ingredients are dissolved and crystal clear water taken.

From the research Ruwana (2008) clearly reveals the best lotus variation as fixation affects the color washing result is 30 grams/liter. Meanwhile, according to Budiyo (2008) that a comparison of fixation with water, namely: a) Tawas 50 grams/liter of water, b) Lime 50 grams/liter of water, c) Tunjung 5-10 grams/liter of water. Based on the two guides above, it can be concluded that the setting composition based on the above guidelines can be adjusted based on the level of need. The more material, the composition of the water used is isolated volume, as well as the less material, the composition of the water is reduced.

Phase Four: Organizing, formulating and Explaining

The activities carried out at this stage are to organize, formulate ways or rules to explain what was done before. The aspects that must be considered at this stage: a) handler types of natural materials that would be instructed need to be smoothed; b) determination of the length often amount of dyeing process. Usually, the longer and the more the process of dyeing, color is the result of getting older; c) determination of the fixation material to be used. To present the experimental results prepared in the form of a data table (See Figure 2).

Phase Five: Analyze the Process of Research

It was done by analyzing the research strategy to gain more effective procedures. At this stage of the study was also conducted and the test results of the processing of natural dyes produced based on the research process in the dyeing process of batik cloth through the use of natural dyes.

Lecturer's Activity	Main Phases	Students' Activity
<ul style="list-style-type: none"> • General lecture • Punctuation 	<div style="border: 1px solid black; padding: 5px; display: inline-block;">Exposing Problems</div> 	<ul style="list-style-type: none"> • Under standing research procedure • Accepting new journals
<ul style="list-style-type: none"> • Emphasising the question • Asking the spending money • Supervising hypothesis 	<div style="border: 1px solid black; padding: 5px; display: inline-block;">Finding and identify Collective journals</div> 	<ul style="list-style-type: none"> • Problem formulation • Identifying main problem • Finding and not flexibly • Hypothesis
<ul style="list-style-type: none"> • Training and supervising • Discussion • Keep discussion 	<div style="border: 1px solid black; padding: 5px; display: inline-block;">Eksperimentation and Data identification</div> 	<ul style="list-style-type: none"> • Is there any exercise • Tests hypothesis
<ul style="list-style-type: none"> • Conclusion • Suggestion and recommendation 	<div style="border: 1px solid black; padding: 5px; display: inline-block;">Concluding and recommendation</div>	<ul style="list-style-type: none"> • Is there any discussion before conclusion • Give recommendation

(Adapted from Soekamto and Winatapura, 1994: 94)

Figure 1 : Model of Learning Research Training

Based on the above figure, the social system in the teaching model of research training can be organized more structurally by the teacher to control the entire process of interaction and describes the research procedure to be followed. In addition to classroom management aspect, it should be noted that it will be the principles and norms involved in this model as the intellectual cooperation, equality, honesty and responsibility. The intellectual environment was also characterized by the open nature of the various ideas that are relevant.

RESULTS OF INQUIRY TRAINING LEARNING MODEL IN THE DEVELOPMENT OF ENVIRONMENTALLY FRIENDLY BATIK DYES

The results of the study can be seen from the level of achievement of learning objectives that have been applied. To measure the success of the learning process and results can be seen from the impact of instructional (instructional effect) and impact accompaniment (natural effect).

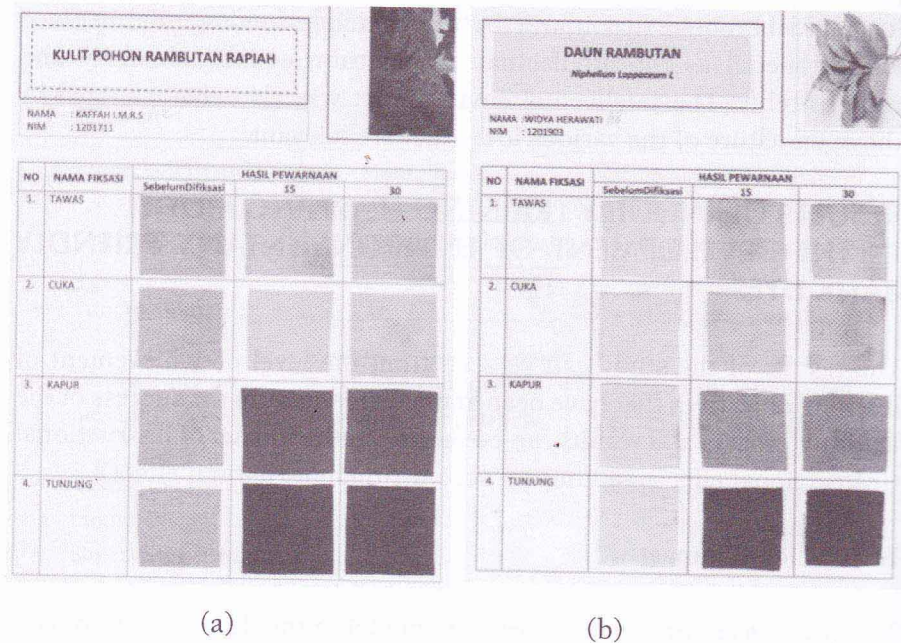
Instructional Impact

The goals of inquiry training learning model in the development of eco-friendly batik dye, are:

1. Students can name the plant and the resulting color.
2. Students can explain the treatment process extracts natural pigments of plant materials.
3. Students can practice dyeing process which concludes with the fabric color fixation.
4. Students can conclude the results of experiments based on the type of color and fixation uses.

Figure 2 presents an example of a student portfolio through the implementation of inquiry training learning model. In general, the range of colors produced from the natural color generally ranging from beige toward even blackish brown. Based on experience and the results of its work, the students are informed that the resulting color refraction varies.

It is closely related to the type of fixation used and the long duration of immersion. The color of the fabric before and after also showed changes, after fixed fabric colour is getting older.



Source: Sobandi (2014)
Figure 2. Results of Materials Leather Fabric Dyeing with (a) Rambutan Tree Rapih and (b) leaves Rambutan

The research is in line with research findings Sobandi (2013) that the use of fixation alum, lime, lotus and vinegar to determine the direction of color as follows: Use of fixation lotus reproduce colors somewhat blackish, use whitening reproduce colors tend to brown, fixation vinegar raises reddish beige, and alum resulted in a lighter color corresponding original color. This was confirmed by the results of research done by Manurung (2012) who asserts that the presence of mordant was able to strengthen the bond between the who dyes with fiber cloth, and the possibility of adding the active center of the fiber cloth is evident from the mass of dye that is absorbed and the sharpness of the color produced, better than without mordant.

Sutara's research results (2009: 217-223) showed: a) the light brown color of the thread into a can using a solution of mangosteen and fixed with a solution of lime; b) black color is obtained from the process of immersion in boiling water with a mixture of leaf powder rijase leaf powder *Muntingia calabura* with fixation using a solution of lime; c) yellow color derived from wood cooking water *tegeran* which was then fixed with a solution of lime; d) the blue color is obtained from the leaves of indigo fixed lime solution; f) a mixture of guava leaves *kelutuk*, arum leaves and turmeric pose a moss green colour.

Dyeing process is a process of incorporation or chemical reaction between the fiber and the dye. According to Hasanuddin, et al. (2011), so that the reaction in the dyeing process goes well it is necessary under certain conditions, namely: There is harmony between the fibers with the dye; Fibers in a pure state; Need atmosphere solution (acidic, basic, neutral) as appropriate; Special natural dyes, the color needs to be raised.

Impact of Accompaniment

Accompaniment impact (instructional effect) of the process of inquiry and learning outcomes of training in the development of eco-friendly batik dye, as follow:

1. Students have a thorough and diligent attitude in solving the problems they face;
2. Students have an independent attitude in finding a variety of natural dyes of the experiments carried out;
3. Students have an open attitude and analysis of the findings obtained;
4. Students have an honest attitude towards the results of the experiment; and
5. Students have the ability to cooperate with other students.
6. Students have an awareness of the dangers of pollution that threaten the environment.

Application of inquiry training learning model can improve students' ability to face the problems it faces. It can be seen from the above description in the form of instructional impact and accompanist learning

model execution will be successful when others support the system and the necessary means such as the availability of relevant references, availability of tools and materials research.

CONCLUSION

Based on the description of the results obtained from the implementation and development of learning models above, two aspects can be concluded. First, the inquiry training learning model consists several phases: a) exposing the problem; searching and analyzing the data; reviewing data and experimentation; organize, formulate and explain; and analyze the research process. Implementation of the learning model will run smoothly all the elements of learning models such as: sintakmatik, social system, the principle of reaction, support systems, and the impact of instructional and accompanist well designed. Second, the results of inquiry training learning model in the development of environmentally friendly batik dyes show that the competence of students is increasing. It can be seen from the level of achievement of learning objectives of good instructional impact (instructional effect) as well as the impact of accompaniment (nurturant effect). The results obtained by the impact of instructional, of which the student can: name the plant and the colors it produces, explains the treatment process extracts natural pigments of plant materials, practice the process of dyeing fabric color that ends with fixation, and concluded the results of experiments based on the type of color and fixation uses. While the impact of accompaniment of the learning process can improve the attitude of conscientious, diligent, independent, tolerant, analytical skills, ability to work together, to be honest, as well as an awareness of the dangers of pollution that threaten the environment.

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