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Etnoscience Study in Basic Science Course

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Abstract

Learning difficulties experienced by students in basic science learning is basic science topics are still very textual. Students become confused and difficult to solved contextual problems. Furthermore, this problem make learning outcome of student in Basic sceine course is still low. One way to link science topics through contextual learning is by integrating local wisdom into science content. One study related to local wisdom is ethnoscience. Ethnoscience is an attempt to reconstruct indigenous knowledge in society (indigenous science) into scientific knowledge (scientific knowledge). This reconstruction process will be useful in supporting the achievement of science concepts in learning. Therefore, it is considered important to research to identify the original scientific concepts in Balinese people which can be included in Basic Science learning. This research is qualitative research that aims to identify and analyze Balinese ethnoscience studies in Basic Science learning. The subjects of this research were students and expert lecturers. Data on student learning difficulties were obtained through observation and interviews, while data on the relevance of Balinese ethnoscience studies in Basic Science learning were obtained through questionnaires, interviews, and literature studies. The results of this study indicate that there are Balinese ethnoscience studies in Basic Science learning, especially in the matter of separating mixtures, diversity of living things, heat, material changes, and biotechnology. With this result, basic science learning will be more contextual using Balinese ethnoscience study as an example. Furthermore, the difficulties in learning science experienced by students can be overcome.

Keywords: *contextual learning; ethnoscience; basic science*

INTRODUCTION

Science learning is a process of providing students with experience of natural phenomena that occur in the environment. Science learning aims to train students' ability to construct knowledge through meaningful hands-on experience. Through meaningful direct experiences, students are expected to be able to grow cognitive thinking skills, psychomotor skills, and social skills (Prabowo, 2015). Science learning currently at various levels of education is still experiencing several problems. Problems that often occur include the availability of learning resources that are less supportive or the application of learning strategies that have not been effective (Insani, 2016).

As primary research, some students in Science Education Study Program still had difficulties in Basic Science course. Some science topics that they learn are still textual based and make students difficult when faced contextual problems. Learning science is theoritically teach students to have the ability problems and making a conclusion based on evidence for the sake of recognizing natural changes and the effect of human's interaction to nature. It means that the students should not only

know and memorize things related to the concepts of science but also understand and implement it in their daily life (Dewi, et al., 2019). However, some students still faced the difficulties when learning science and make their learning outcome is still low. This is supported by the statements of several students who stated that the textbooks used in studying science were still very textual so it's not related with science topic in daily life. In fact, by linking science material with daily life through contextual learning, science learning will be much more meaningful.

One way to link science topics through contextual learning is by integrating local wisdom into science content. Local wisdom can be understood as local ideas, values, the point of views which have a wise characteristic, full of knowledge, have a good value that embedded and followed by its community members (Jundiani, 2018). Local wisdom which are abstract and concrete is important to be implemented in learning process for improving students 'competence and character. The classroom teaching can develop the students' characters in order to make the students become the better ones (Aisah, 2014; Khusniati, 2012; 2014; Dianti, 2014). Student character development, especially character development based on local wisdom, is needed. Learning activities that can develop students' character are exploration, concentration, inquiry from various perspectives (scientific, sociocultural, historical), elaboration, and affirmation (Suastra, 2017). Culture in the form of local wisdom has the potential for Ethnoscience to be a source of knowledge that can be explored to increase students' enthusiasm for learning. Yuliana (2017), states that in science learning, the cultural background of students will have a positive effect on the science learning process if the topic is related with the culture of students.

Ethnoscience is one type of contextual learning. Etnoscience is a cross-disciplinary science that connects the human or cultural anthropology with science learning. The study of the science knowledge that is gained by examining the local knowledge that is contained in the culture of a community or ethnic group (Lestari & Fitriani, 2016). The scope of ethnoscience includes the fields of science, agriculture, ecology, medicine, and flora and fauna (Novitasari, et al: 2017). The birth of ethnoscience cannot be separated from the knowledge found by trial and error and the absence of the ability to translate the findings into scientific knowledge. In the context of science learning, ethnoscience can be defined as an effort to reconstruct indigenous knowledge in society into scientific knowledge (Hadi, 2017). One example of indigenous science that can be reconstructed into scientific knowledge is reflected in Balinese buildings such as *bale kulkul, bale sakenem, bale banjar, sanggah, merajan, pura*. These buildings are constructed in such a way as to be strong enough to withstand shocks, especially those caused by earthquakes. In addition to the element of strength, traditional Balinese buildings also have environmental aspects that refer to the philosophical *Tri Bhuwana (bhur, bwah, swah), Tri Hita Karana* (balance between man-God, human-humans, and human-nature), Tri Mandala (main, middle, and kanista mandala), and *Tri Angga* (head, body, and feet). The

reconstruction of the original science of the Balinese people in terms of making traditional buildings into scientific science is reflected in the concept of environmental conservation (ecosystem), namely the manufacture of traditional buildings must also think about the concept of ecology in it (Sudiana, 2015).

Basic Science course contains several science topics that can be linked to the reconstruction of indigenous science to make learning process more meaningful. The process of reconstructing the indigenous science into scientific knowledge is not easy. Not all indigenous science of Balinese people can be reconstructed into the scientific knowledge concepts contained in this course. However, if this process is successful, the meaning of indigenous science into scientific science will be useful in supporting the achievement of scientific concepts in learning (Ilhami, 2020). Therefore, it is considered important to conduct research to identify and analyze Balinese indigenous science which can be contained in this course.

METHOD

The research was qualitative research with students and expert lecturers as a subject. Ethnoscience study in basic science course data was obtained from expert lecturers. Expert lecturers who act as informants include expert lecturers from Chemistry, Physics, and Biology Department. Students as a subject in obtaining preliminary study data regarding the difficulties experienced in Basic Science courses. The informants in this study were taken purposively, which means that the informants were selected based on criteria that suitable as requirements to become research subjects. The criteria is the experts who are deliberately appointed are believed to have expertise in their respective fields according to the research topic.

Data on student learning difficulties in attending Basic Science lectures were collected through questionnaires and interviews. The questionnaire was made in the form of a google form to be filled out by students. In addition to questionnaires, to strengthen data on learning difficulties, interviews were also conducted. This data was taken during the preliminary study and used as the basis for conducting qualitative research on the relevance of Balinese ethnoscience studies in Basic Science courses. The relevance of ethnoscience studies in Basic Science courses was collected through questionnaires, interview and document studies. Questionnaires was filled by the experts regarding the relevance between science concept and Balinese ethnoscience (Table 1). Interview activities were carried out by asking the informants directly to obtain data on the relevance of ethnoscience studies in the Basic Science course. Interviews with key informants and respondents used semi-structured interviews, independent interviews and in-depth interviews. Interviews were conducted with expert lecturers in the fields of Physics, Chemistry, and Biology.

Table 1. Questionnaires Relevance Between Balinese Ethnoscience And Science Knowladge

No	Balinese Ethnoscience	Science Knowledge in Basic Science Course	Relevance		Additional Information
			Yes	No	
1	Salt production	• Separating mixture (filtrations, crystallization, and evaporation) • Heat transfer using sunlight in drying process			
2	Making "*Arak* Bali*"*	• Separating mixture (distillation) • Physical changes from alcohol in "*tuak"* which evaporates and it cooled for becoming liquid and come out as a distillate			
3	"*Subak* Bali"	• Diversity of living things in *Subak* ecosystem • Interaction between living and non-living things in *Subak* ecosystem • Water distribution system in *Subak* irrigation			
4	*Upacara Tawur*	• Diversity of living things which use in *Upacara Tawur* • Classification of living things (animal and plant) which use in *Upacara Tawur*			
5	Refining Gold and Silver	• Physical changes which occur during processing gold and silver • Chemical changes which occur during processing gold and silver • Heat transfer			
6	Making "*tuak*"	• Diversity of living things (palm and coconut tree classification and their morphology) • Biotechnology in making "*tuak"*			

The data analysis technique which used in this study is qualitative proposed by Miles and Hubberman. This technique consists of data collection, data condensation, data display and the last step is drawing conclusions (Miles & Hubberman, 2014).

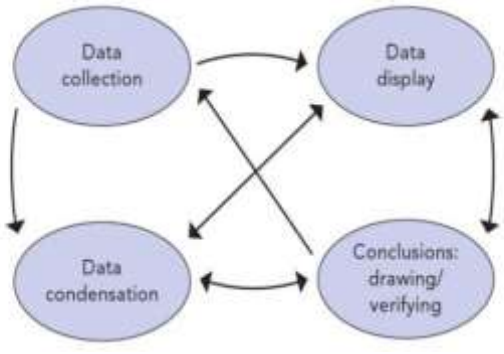

Figure 1. Component of Data Analysis

RESULT AND DISCUSSION

RESULT

Results of a preliminary study conducted to determine student learning difficulties in Basic Science course showed that 15 from 25 students who filled out the questionnaire stated that the main difficulties they experienced were due to the lack of contextual examples in Basic Science course. Basic science courses which contain essential science concepts are very textual, and make students difficult when faced with contextual problems. The lack of contextual learning resources is also one of the reasons why students find it difficult to understand some basic science concepts. Beside that, the online class during the pandemic is also the reason of their difficulties. Furthermore, the results of the basic science learning difficulty questionnaire are shown in Figure 2.

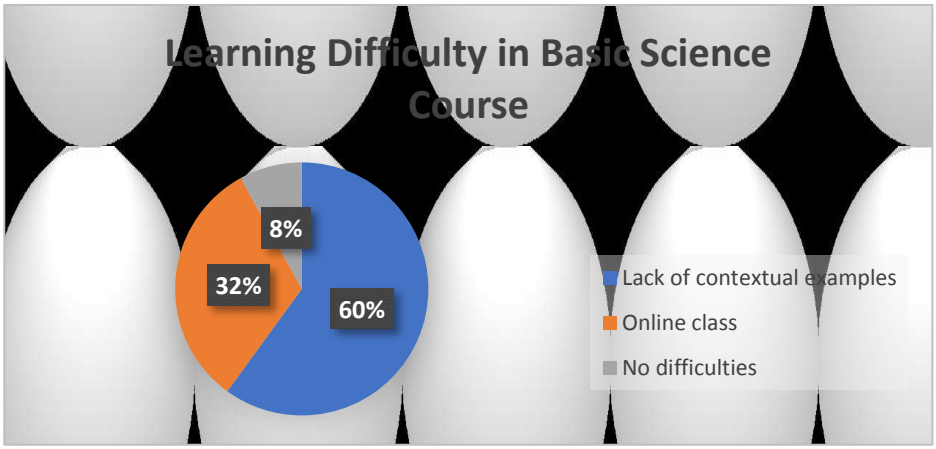

Figure 2. Student's Learning Difficulty

Data of student learning difficulties as preliminary research then followed up by identifying and analyzing Balinese ethnoscience studies in Basic Science courses. Ethnoscience is the original science that belongs to a society. The original science can be reconstructed into scientific knowledge to reveal which scientific knowledge can explain various indigenous sciences. This is later expected to provide knowledge to students that the scientific knowledge concepts learned in the Basic Science course are closely related to various Balinese indigenous sciences. Identification and analysis of various Balinese ethnosciences that can be explained scientifically is done through distributing questionnaires to three expert lecturers in Physics, Chemistry, and Biology. In addition, a literature study was also conducted to reveal the relevance of Balinese ethnoscience in Basic Science courses. The result of various Balinese ethnosciences that can be explained scientifically through questionnaires can be seen in Table 2.

Table 2. Relevance between Balinese Ethnoscience and Science Knowledge in Basic Science Course

No	Balinese Ethnoscience	Science Knowledge in Basic Science Course
1	Salt production	• Separating mixture (filtrations, crystallization, and evaporation) • Heat transfer using sunlight in drying process • Food additive substance (salt) • Electrolyte solution
2	Making "*Arak* Bali*"*	• Separating mixture (distillation) • Physical changes from alcohol in "*tuak"* which evaporates and it cooled for becoming liquid and come out as a distillate • Heat transfer in conduction and convection • Chemical changes when "*nira*" is fermented • Addictive substance (alcohol) which contain in "*arak*"
3	"*Subak* Bali"	• Diversity of living things in *Subak* ecosystem • Interaction between living and non-living things in *Subak* ecosystem • Water distribution system in *Subak* irrigation
4	*Upacara Tawur*	• Diversity of living things which use in *Upacara Tawur* • Classification of living things (animal and plant) which use in *Upacara Tawur*
5	Refining Gold and Silver	• Physical changes which occur during processing gold and silver • Chemical changes which occur during processing gold and silver • Heat transfer
6	Making "*tuak*"	• Diversity of living things (palm and coconut tree classification and their morphology) • Biotechnology in making "*tuak"*
7	Making "*loloh*" (*loloh cemcem*)	• Diversity of living things (*daun cemcem* classification and morphology) • Extraction and filtration in making *loloh cemcem*
8	Making brick	• Heat transfer in making brick • Pressure concept when brick molding process • Physic and chemist properties that must be considered when making bricks
9	Making traditional "*dodol*"	• Heat transfer in making traditional *dodol* • Food additive substance that use in making traditional *dodol* (dyne and sweeteners)
10	Making palm sugar	• Physical changes/evaporation (liquid *nira* will thicken over time)

		• Heat transfer during heating and mixing palm sugar dough
11	Making "*tape*"	• Filtration (filtering *air tape*) • Physical changes • Chemistry changes
12	Making "*gamelan*"	• Physical changes and heat transfer when copper and tin smelting process • The concept of pressure during the forging process which is the process of changing the shape of the metal by burning it until it turns red and then applying pressure from the hammer • The concept of vibration, waves, and sound in finishing process. This process is related to the process of finishing and harmonizing the sound. Gamelan musical instruments have a frequency of 20–20,000 Hz which will cause vibrations and produce regular sounds
13	Traditional process of making coffee powder	• Heat transfer in radiation during coffee bean drying • Physical change (coffee bean turn into coffee powder) when grinding process • Pressure concept in grinding process
14	Making Traditional Clothes *Kain Bebali*	• Additive substance (natural dynes) which use various types of plants as natural dyes to make *Bebali* cloth • Extraction process in making natural dynes • Force concept during yarn spinning and weaving process
15	Chewing *sirih*	• Chemical component in *daun sirih* can be very useful such as essential oil consisting of phenol and phenol derivative compounds, alkaloids, saponins, tannins, and flavonoids. • Acid concept in *daun sirih* properties and used to paralyze the activity of bacteria that are harmful for humans

DISCUSSION

Identification and analyzing Balinese ethnoscience studies in Basic Science course is carried out to describe the relevance of indigenous science concepts in Balinese ethnoscience which can be explained scientifically. The results of the questionnaire analysis given to three expert lecturers were strengthened by the results of a literature study to find Balinese ethnoscience studies containing scientific knowledge concepts. It is not easy to find the relevance between ethnoscience studies and scientific knowledge in Basic Science courses. The main difficulty was encountered in the early stages of scientific reconstruction which identify indigenous science that could be transformed into scientific knowledge. It is undeniable that not all Balinese science can be transformed into scientific

science. There are several requirements to transformed indigenous science become scientific knowledge, including (a) science and culture as an object of study must be related each other's; (b) the indigenous science which being studied is useful in life; (c) must be contain science education content; and (d) the methodology that used must be related between indigenous science and scientific knowledge (Parmin et al, 2017).

Several scientific knowledge in Basic Science course which identified in Balinese ethnoscience study include the concepts of heat transfer, mixture separation, fermentation, diversity and classification of living things, changes in matter, additives, force, pressure, vibration, waves, and sound. The concept of heat can be seen in several Balinese ethnoscience studies, such as salt production, making wine, gold processing, making brick, *gamelan*, making "*dodol*", and traditional coffee powder making. The concept of radiation can be found in salt production when the process of drying the sea water in the sun. After several time it will evaporate and leave crystal grains which will later become salt. Radiation is the concept of heat transfer that emitted by matter in the form of photons or electromagnetic waves. All of the energy from the sun that reaches the earth arrives as solar radiation. Solar heat that reaches the earth is one example of a real form of heat transfer by radiation (Wahyono & Rochwani, 2019). The concept of heat transfer in conduction and convection was discovered during the process of making *arak Bali* when heating the fermented *nira kelapa* in a jug. When the *nira kelapa* is heated in a jug/*kekep* using firewood, the convection occurs. *Nira* at the bottom first receives heat from the flame than the top. *Nira kelapa* that exposed to heat will expands and less dense, its density becomes smaller so it moves upwards. Meanwhile *nira kelapa* which is cooler and kind of bigger will replaced that position. *Nira kelapa* then becomes hot and begins to move up. This process occurs continuously and make a flow of *nira kelapa* which carries heat so that will be boil.

The concept of separation mixture is also commonly found in Balinese ethnoscience studies such as separation by filtration, evaporation, crystallization and distillation. Separation by filtration, evaporation, and crystallization are found during the process of producing salt. Separation of the mixture by filtration occurs during the sea water filtration process which aims to clean sea water from impurities before drying. Suardana (2014) states that filtration is carried out to separate solid substances that cannot be dissolved in liquids. When dried in the sun, the concept of evaporation can be observed in this process. Then, the formation of salt crystals that occurs after the *yeh nyah* is dried in the sun for several days will form salt crystals that go through the crystallization process. Separation of the mixture by distillation occurs making *arak Bali*.

Fermentation concept in Basic Science course can be identified through the study of Balinese ethnoscience in the process of making *arak*. In the process of making *arak*, it uses fermented *nira kelapa* for 1 to 2 days with added coconut fiber as a natural preservative. Generally, the process of

making Balinese Arak goes through two stages, i.e the fermentation stage and the distillation stage. Distillation stage is needed to increase the alcohol composition in *arak*. Fermentation is a process that helps break down large organic molecules via the action of microorganisms into simpler ones (Sharma, et al. 2020).

Diversity and classification of living things are also identified in Balinese ethnoscience studies, especially in various *Panca Yadnya* ceremonies such as *tawur*, *otonan*, *pawiwahan*, *mepandes*, and various other ceremonies. *Panca Yadnya* ceremony uses various plants and animals in making *banten*. Various types of plants and animals used can be studied based on their morphological structure and level of classification. In addition, the concept of *subak Bali*, also related to scientific knowledge in basic science courses, i.e about the diversity of living things which found in *subak* ecosystem and also various types of interactions of living things in that ecosystem.

The concept of matter change can also identify in various types of Balinese ethno-science studies. In the process of making palm sugar and making *tape*, there are physical and chemical changes. Physical changes are closely related to changes in form (Rino, et al 2019). In the process of making palm sugar, physical changes occur when the liquid sap water will thicken (evaporation) over time.

The concept of additives and addictive substances also found in basic science course. These concepts were identified in several Balinese ethnoscience, such as salt as a food additive, dyes and sweeteners used in making *dodol*, and alcohol composition (addictive substance) in *arak* Bali. Pandey & Upadhyay (2012: 1) states that additives are substances added to food with the aim of improving the taste, quality, and appearance of food ingredients.

Physical concepts such as force, pressure, vibration, waves, and sound are also found in several Balinese ethnoscience study. In process of making gamelan, the concepts of vibration, waves, and sound are seen during the finishing process. The finishing process is related to the process of finishing and harmonizing the sound. Gamelan musical instruments have a frequency of 20–20,000 Hz which will cause vibrations and produce regular sounds. The concept of pressure is used in the process of making bricks when the molding process is carried out. The concept of force can also be observed when the process of spinning yarn and weaving of *Bebali* cloth is carried out.

Scientific knowledge in Basic Science course is in fact widely identified in Balinese ethnoscience studies. With the discovery of several scientific knowledge in Balinese ethnoscience studies, it is expected that students will find it easier to remember and learn these concepts through contextual examples around them. The application of ethnoscience in science learning fosters the curiosity and activeness of students in finding information related to the material they are studying. Ethnoscience can foster a sense of pride in the culture of local wisdom and increase students' understanding of the potential of the area they have (Nuralita, 2020). Contextual learning in a learning

system will produce meaningful learning by connecting academic content with the context of students' daily lives. Students will be more motivated, and play an active role in learning concepts and applying and relating to the real world (Usman, 2017).

CONCLUSION AND SUGGESTIONS

Based on the results and discussion above, the following two conclusions were drawn:

1. The validity of preview-review bilingual instructional tools with discovery learning model setting was 3.60 for the content and 3.55 for the language which is in very good category
2. The developed of preview-review bilingual instructional tools with discovery learning model setting was effective in enhancing conceptual understanding and speaking ability based on average gain score

Based on the discussion, it is suggested to the lecturer in Basic Science 1 to use the preview-review bilingual instructional tools during her lecture, for enhancing student's conceptual understanding and speaking ability

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