



Ethnoscience Studies in Making of *Bale Adat*: Literature Review

M. Khairul Wazni¹, Agus Muliadi^{2*}, M. Yamin³

¹Department of Biology Education, Universitas Hamzanwadi, Selong, Indonesia.

²Department of Biology Education, Universitas Pendidikan Mandalika, Mataram, Indonesia.

³Department of Biology Education, Universitas Mataram, Mataram, Indonesia.

Received: April 25, 2023

Revised: June 9, 2023

Accepted: June 25, 2023

Published: June 30, 2023

Corresponding Author:

Agus Muliadi

agusmuliadi@undikma.ac.id

DOI: [10.29303/jppipa.v9i6.3958](https://doi.org/10.29303/jppipa.v9i6.3958)

© 2023 The Authors. This open access article is distributed under a (CC-BY License)



Abstract: This study aims to elaborate on indigenous science contained in the use of materials for making *bale adat* based on scientific concepts. This study is a literature study with data sources from previous research articles that have topics related to ethnoscience learning, indigenous science in the tradition of materials for making *bale adat*, and the potential for integration of indigenous science in learning natural sciences. The procedure in literature study research is carried out in stages, namely collecting library data, reading, taking notes, studying, collecting concepts or manuscripts, then carrying out elaboration and explanation of the collected data/text. The study results show that (1) *bale adat* typical of the *Sasak* tribe consists of several types, namely *bale beleq bencingah*, *bale bonter*, *bale tani*, *bale jajar*, *bale tajuk*, *berugag* (*secepat-sekenam*); (2) Indigenous science in the materials for making *bale adat*, namely: a) the foundation for *bale adat* is made from a mixture of clay, tree sap, straw ash or rice husk, and buffalo dung mixed with water, b) floor of *bale adat* periodically smeared with buffalo dung mixed with water to reduce humidity, c) the walls of *bale adat* or room covering are made of woven bamboo slats known as the local term *pager*, d) woven *pager* are made of ampel bamboo with various motifs and sometimes to beautify the *pager*, the material used is spotted bamboo which has colorful bark, d) *teken*, *ampak*, *lampen*, and *langkar* used in the *bale adat* are made from the part of the tree that is believed to be the strongest or known locally as *kayu galih*, e) roof made of weeds leaves woven into bamboo frame clips which are split into small pieces; (3) indigenous science in the materials for making *bale adat* can be integrated into the school science learning concept, namely in the material: a) material on network structure and function, as well as technology inspired by plant structure, b) material properties and utilization of materials in everyday life.

Keywords: Ethnoscience studies; Making *bale adat*; Review

Introduction

Education is a planned and structured system to develop comprehensive student competence in cognitive, affective and psychomotor aspects (Purwanto, 2011; Darmiwati, 2006) so that they can build their lives and civilization in the future (Hadi & Ahied, 2017; Hadi, et al., 2019). Education and civilization have a positive correspondence (Trianto, 2014), so there is a need for learning that facilitates students in strengthening their understanding of the heritage of their predecessors in the surrounding environment such as culture and customs (Sarini & Selamet, 2019). Education has a

strategic role in introducing culture through organized learning activities (Hadi & Ahied, 2017). This is confirmed by the opinion of Suastra (2011) that education has a formal role in cultivating and acculturating student behavior in preserving culture. The introduction of culture in learning can provide learning experiences for students both in cognitive, affective, and psychomotor aspects (Irawan & Muhartati, 2019). Thus, cultural diversity in the Indonesian nation can be optimized to support multidimensional science learning (Hadi, et al., 2019), given that learning science is the initial foundation in creating students who have dimensional competencies

How to Cite:

Wazni, M.K., Muliadi, A., & Yamin, M. (2023). Ethnoscience Studies in Making of *Bale Adat*: Literature Review. *Jurnal Penelitian Pendidikan IPA*, 9(6), 168-177. <https://doi.org/10.29303/jppipa.v9i6.3958>

such as knowledge, skills and scientific attitudes (Mardiana, 2018; Ali, 2018).

Science learning concept examines natural phenomena in the social life of society (Khoiri & Sunarno, 2018), making it possible to integrate them with socio-cultural studies (Setyowati et al., 2013). According to Puspasari et al. (2019), science learning can provide direct experience for students through exploration activities and applying concepts related to everyday life. This was emphasized by Seroto (2012) that the concept of learning science should originate from and refer to daily activities, in order to facilitate students to think scientifically about every natural condition and surrounding social environment (Listyawati, 2012). Thus, science learning can be developed by integrating the uniqueness and local potential of an area such as culture and tradition (Kartono et al., 2010). Integrated learning of local wisdom is expected as an effort to preserve indigenous science in local culture which has been passed down from generation to generation (Toharudin, et al., 2017). Indigenous science integrated science learning known as ethnosience learning (Sudarmin, et al., 2017) and expected to be a structured and systematic solution to prevent the loss of cultural and traditional characteristics in an area (Kasa, 2011).

Ethnosience learning can facilitate the study of multidimensional scientific concepts, namely product, process, and attitude dimensions (Ali, 2018), as well as procedural dimensions (Chain & Evan, 1990). This is possible because students are facilitated to actively interact with concrete objects in everyday life (Mardiana, 2018; Rizkianawati et al., 2014; Koes, 2003). According to Khoiri & Sunarno (2018) that learning ethnosience contextual by presenting a study of indigenous science contained in local culture in science concept learning activities (Setyowati et al., 2013). Ethnosience learning activities allow students to gain direct experience in exploring and applying science concepts related to everyday life (Puspasari et al., 2019). Thus, ethnosience can be an effective learning approach to reconstruct indigenous science that develops in people's lives to be transformed into scientific science (Khoiri & Sunarno, 2018). According to Akmal et al. (2020), etnosience learning is based on constructivism and prioritizes meaningful learning, where students are facilitated to learn by doing (Alvonco, 2014). Parmin (2017) explains that ethnosience learning can bridge indigenous science to be taught formally in science learning in educational institutions.

Science learning that prioritizes the process of discovery and the formation of scientific attitudes (Mardiana, 2018) is seen as effective for implementing an ethnosience approach. This is confirmed by Suastra (2009) that learning science is an ideal way to acquire competency skills, maintain attitudes, and develop

mastery of concepts related to everyday life. Ethnosience studies are expected to be a vehicle for students to build scientific experiences about local culture that exist in everyday life (Ali, 2018). According to Hadi, et al. (2019), ethnosience learning facilitates learning activities for students to elaborate on indigenous science contained in the local culture scientifically. Ethnosience studies have a focus on integrating indigenous science values in science learning (Wati et al., 2020; Parmin, et al., 2017; Toharudin, et al., 2017), so that ethnosience learning is known as a system of knowledge and cognition typical of a given culture (Sudarmin et al., 2018). According to Wahyu (2017), an ethnosience-based science learning approach can create an effective learning environment by associating cultural and traditional values (Puspasari et al., 2019), so that more positive benefits can be had for the lives of students (Mardianti et al., 2020; Sudarmin, et al., 2017).

Ethnosience studies are the preservation of local culture and traditions that are unique and diverse in each region (Sarini & Selamet, 2019), so that the contained indogenous science remains sustainable in people's lives (Battiste, 2005). This is because every socio-cultural activity in people's lives cannot be separated from indigenous science which is inherited by its predecessor generations (Toharudin & Kurniawan, 2017). The *Sasak* people of Lombok have various cultures and traditions inherited from their predecessor generations (Arlinovita et al., 2015), one of which is the construction of traditional houses known locally as *bale adat*. *Bale adat* contains preserved indigenous science values such as the use of building materials or materials, the manufacturing process, and architecture (Hikmawati et al., 2020). Widiанти (2017) explains that the *bale adat* is typical of the *Sasak* tribe consisting of several types, namely *bale beleq bencingah*, *bale bonter*, *bale tani*, *bale jajar*, *bale tajuk*, *bale lumbung*, *secepat*, *sekenam*. Several places in Lombok still preserve indigenous science in making *bale adat* as taught by ancestors from generation to generation like *bale adat* Segenter in Bayan District, *bale adat* Sade in Pujut District, and *bale adat* of Limbungan in the village of Perigi, Suela District (Widiанти, 2017). The community makes a *bale adat* from materials sourced from the surrounding nature such as *kayu galih*, bamboo, reed leaves, clay, and tree sap (Wir'aeni, 2017). The tradition of smearing buffalo dung on the floor of the house is still preserved to prevent dampness of the earthen floor of the house (Widiанти, 2017; Wir'aeni, 2017).

Indogenous science contained in the tradition of using materials for making *bale adat* can be integrated into learning science concepts (Sudarmin et al., 2018). One of the important dimensions in studying science is to construct the relationship between science and technology and society (Chiapetta & Koballa, 2010).

Ethnoscience learning is important for students to build an attitude of loving local wisdom through the introduction of indigenous science contained in the local culture (Sudarmin, et al., 2017; Parris & Linder-VanBerschot, 2010). In addition, ethnoscience studies are effective for developing the character of conservation and tolerance of students for the diversity of local cultures and traditions in each region (Hikmawati et al., 2020; Akmal et al., 2020; Wahyu, 2017). According to Sudarmin, et al. (2017), ethnoscience studies can strengthen cultural literacy and fortify students from acculturation of foreign cultures transformed by today's massive electronic media. Krajcik et al. (1999) explained that learning ethnoscience is more oriented towards an integrated (interdisciplinary) understanding rather than just an in-depth understanding (Chiapetta & Koballa, 2010). Thus, it is important to conduct a study to elaborate on the indigenous science contained in the tradition of using materials for making *bale adat* based on scientific concepts.

Method

This study is a literature study (*library research*) (Andi, 2012; Creeswell, 2012), to elaborate on the indigenous science contained in the use of materials for making *bale adat* of the *Sasak* tribe of Lombok based on scientific science concepts (Khoiri & Sunarno, 2018). The method used in this literature study is a systematic approach to analyzing data in a simplified approach. The articles used are focused on articles published in Sinta accredited national journals and are available on the Google Scholar database. The articles used as sources of research data have relevant topics on ethnoscience learning, indigenous science in the tradition of materials for making *bale adat*, and the potential for integration of indigenous science in science learning. This is in accordance with the opinion of Sukmadinata (2007) that literature study research data is data that has a certain quality of meaning that is expected to find meaning in reality, events, social activities, perceptions and

thoughts that are put forward as the main object of analysis or research discourse.

The procedure in literature study research is carried out in stages, namely collecting library data, reading, taking notes, studying, collecting concepts or manuscripts, then elaborating and explaining the collected data/texts about ethnoscience-based science learning in the tradition of using materials for making *bale adat* (Rahayu, 2018). This is in accordance with the opinion of Zed (2018) that literature study is not just a matter of reading and recording literature, but a series of activities related to methods of collecting library data, reading, and recording and processing research materials.

Result and Discussion

Description of Indigenous Science in Bale Adat

Sasak people in Lombok have several tourist destinations which are famous for preserving traditional houses typical of the *Sasak* tribe, known locally as *bale adat*. *Bale adat* that are still being preserved can be found in several destinations, namely *bale adat* Segenter in Bayan District, *bale adat* Sade in Pujut District, and *bale adat* of Limbungan in the village of Perigi, Suela District (Wir'aen, 2017). *Bale adat* is one of the favorite tourist destinations in Lombok because it has a unique and distinctive design and manufacturing materials as inherited from the ancestors of the *Sasak* people. The unique and distinctive *bale adat* is a form of indigenous knowledge construction of the *Sasak* people which is still maintained today (Hikmawat et al., 2020). Widiанти (2017) explains that *bale adat* is typical of the *Sasak* tribe consisting of several types, namely *bale beleq bencingah*, *bale bonter*, *bale tani*, *bale jajar*, *bale tajuk*, *bale lumbung*, *secepat*, *sekenam*. The *Sasak* people have local wisdom in utilizing every type of *bale adat* in their daily life (Wir'aen, 2017). Based on the analysis of the results of research by Widiанти (2017) and Puspita (2017), it can be explained that indigenous science can be explained in the construction and function of *bale adat* typical of the *Sasak* tribe as presented in the following table 1.

Table 1. Description of Indigenous Science in the Construction and Functions of *Bale Adat*

<i>Bale Adat</i> Type	Indigenous Science Society
<i>Bale Beleq Bencingah</i>	<ul style="list-style-type: none"> ▪ <i>Bale beleq</i> became one of the important facilities in a kingdom which was intended as a place for large royal activities so that it was often also called <i>bencingah</i>. ▪ <i>Bale beleq</i> became a place for government events such as the appointment of government officials, the coronation of the crown prince, the strengthening of the kingdom's chieftains (priests), and a place to store royal heirlooms.
<i>Bale Bonter</i>	<ul style="list-style-type: none"> ▪ <i>Bale bonter</i> is generally owned by <i>Perkanggo</i>/Visual Officers. ▪ <i>Bale bonter</i> is usually built in the middle of a settlement or in the center of village or village government which is used as a place for <i>pesangkepan</i> or customary trials to resolve problems of violations of customary law. ▪ <i>Bale bonter</i> is also called the <i>gedeng</i> of inauguration and a place to store historical objects or family heirlooms.

Bale Adat Type	Indigenous Science Society
Bale Tani	<ul style="list-style-type: none"> ▪ <i>Bale tani</i> is in the form of a pyramid or joglo which is used as the residence of the <i>Sasak</i> people who work as farmers. ▪ <i>Bale tani</i> has an earthen floor with rooms consisting of one room for the foyer (<i>sesangkok</i>), one room for the bedroom (<i>dalem bale</i>), and a cooking room (<i>pawon</i>). ▪ <i>Bale tani</i> in the <i>dalem bale</i> used as a place to store items (properties) owned or a daughter's bed, while other family members sleep in a <i>sesangkok</i>.
Bale Jajar	<ul style="list-style-type: none"> ▪ <i>Bale jajar</i> is a residential building for people of the middle to upper economic class. ▪ <i>Bale jajar</i> has almost the same form as <i>bale tani</i> and the only difference is the number of <i>dalem bale</i>. <i>Bale jajar</i> has two rooms (<i>dalem bale</i>) and are separated by a corridor from <i>Sesangkok</i> to <i>Pawon</i>. ▪ <i>Bale jajar</i> buildings are usually located in large residential complexes and are characterized by the presence of a towering <i>sambi</i> as a storage area for household or other family needs.
Bale Tajuk	<ul style="list-style-type: none"> ▪ <i>Bale tajuk</i> is one of the supporting facilities for residential buildings that have large families. ▪ <i>Bale tajuk</i> is pentagonal in shape with five poles. ▪ <i>Bale tajuk</i> building usually in the middle of a family environment and used as a place for extended family meetings and training to add insight and manners.
Bale Berugag (Sekepat-Sekenem)	<ul style="list-style-type: none"> ▪ <i>Bale berrugag</i> has the shape of an equilateral quadrangle (square) without walls with four pillars (<i>sekepat</i>) and six poles (<i>sekenem</i>). ▪ <i>Bale berugag</i> usually found in front of the left or right side of the <i>bale jajar</i> which is used as a place to receive guests, because according to the custom of the <i>Sasak</i> people, not everyone is allowed to enter the house.

Bale adat is still used by the community (living monument) as a place to live and at the same time becomes a tourist destination as is done by the people of Sade Traditional Village (Widianti, 2017). *Bale adat* of the *Sasak* people has a unique and distinctive manufacturing material as inherited from their ancestors from generation to generation (Wir'aeni, 2017) of the *Sasak* tribe. The *Sasak* people have unique indigenous knowledge/indigenous science and have a tradition of using materials for making *bale adat* (Hikmawati et al., 2020). This is confirmed by Sukawi & Zulfikri (2010) that building construction such as the use of *bale adat*

building materials is the main factor that must be considered by the *Sasak* people as it has been inherited by their predecessors. The materials for making a *bale adat* still follow the original knowledge that has been passed down from generation to generation by using natural materials that are often found around the community, such as wood, bamboo, weeds, clay, and tree sap (Wir'aeni, 2017). Based on the analysis of research results by Sukawi & Zulfikri (2010) and Julita & Hidayatun (2019) it can be explained that indigenous science is in the tradition of using materials for making *bale adat* as presented in the following table 2.

Table 2. Description of *Indigenous Science* in Materials for Making *Bale Adat*

Bale Adat Structure	Indigenous Science Society
Foundation	<ul style="list-style-type: none"> ▪ The foundation functions as a place for the pillars and at the same time as the floor of the room and the stairs of the house. ▪ <i>Bale adat</i> foundations are made from a mixture of clay, tree sap, straw ash or rice husk, and buffalo dung mixed with water. ▪ The floor of the <i>bale adat</i> is smeared with buffalo dung which is mixed with water periodically to reduce humidity.
Wall	<ul style="list-style-type: none"> ▪ The wall functions as a room cover, not as a supporting structure for the building. ▪ <i>Bale adat</i> walls or room coverings are made of woven bamboo slats known locally as <i>pager</i>. ▪ <i>Pager</i> matting is made from ampel bamboo with various motifs and sometimes to beautify the <i>pager</i>, spotted bamboo material which has colorful bark is used.
Pole	<ul style="list-style-type: none"> ▪ The pillar serves as the main support for the roof which is positioned in the middle of <i>bale adat</i> building and is known by the local term as <i>teken</i>. ▪ The pillars are given flat stone plinths so that they do not come into direct contact with the ground floor of <i>bale adat</i>. ▪ At the top of the pole there is a frame of wooden plates known locally as an <i>ampak</i> and assembled with other frames called <i>lampen</i> and <i>langkar</i>. ▪ <i>Teken</i>, <i>ampak</i>, <i>lampen</i>, and <i>langkar</i> used in the <i>bale adat</i> are made from the part of the tree that is believed to be the strongest, known locally as <i>kayu galih</i>. ▪ The pillars on the edge of <i>bale adat</i> are made of thorn bamboo which is known by the local term as <i>trenng aur</i>. Between the poles and other wooden frames are nailed using 'nails' from <i>trenng aur</i>.
Roof	<ul style="list-style-type: none"> ▪ The roof is a building structure that functions to cover <i>bale adat</i> room.

<i>Bale Adat</i> Structure	Indigenous Science Society
	<ul style="list-style-type: none"> ▪ The roof is made of thatch/alang-alang leaves which are woven in bamboo frame clamps which are split into small pieces. ▪ The woven weed leaves are arranged in layers like roof tiles on a rib frame that functions as rafters. ▪ The roof is attached to the batten frame using a 'rope' made of rope bamboo known locally as <i>treng tali</i>.

Based on the explanation in the table above, it shows that the Sasak people have creativity in constructing traditional house buildings by utilizing natural materials around them. Original knowledge or original science of the *Sasak* people in making *bale adat* is a product of thinking obtained from daily experience (trial and error) (Mukti et al., 2022), thus producing cultural works that are unique and unique to the *Sasak* tribe. This is in accordance with the opinion of Santyaningtyas & Noor (2016) that the behavior, expressions, knowledge, and skills used all the time by a particular community and group, are usually claimed by them as their cultural heritage. Thus, *bale adat* is a cultural work that is uniquely owned by the *Sasak* people who have indigenous science values that allow for elaboration in science learning activities. Indigenous science contained in the tradition of using materials for making *bale adat* can be integrated into learning science concepts (Sudarmin et al., 2018). One of the important dimensions in studying science is to construct the relationship between science and technology and society (Chiapetta & Koballa, 2010).

Description of Ethnoscience Studies in Materials for Making Bale Adat

The tradition of the people of the *Sasak* tribe of Lombok in using materials for making *bale adat* has original scientific content (*indigenous science*) which can be studied scientifically and developed in science learning in schools such as learning the concept of

network structure and function, as well as the concept of material properties and their use in everyday life. This is confirmed by Khoiri & Sunarno (2018) that learning science has a study of natural phenomena in people's social life, making it possible to integrate with native science in culture community (Setyowati et al., 2013). Ethnoscience studies can present active learning with direct learning experiences through exploration activities and applying concepts related to everyday life (Puspasari et al., 2019). This was confirmed by Seroto (2012) that science learning should originate from and refer to daily activities, in order to facilitate students to think scientifically about every natural condition and the surrounding socio-cultural environment (Listyawati, 2012). Thus, it is necessary to study ethnoscience in local culture such as the tradition of using materials for making *bale adat* to support science learning (Kartono et al., 2010). Ethnoscience studies on local wisdom are expected to be one of the efforts to preserve *indigenous science* in local culture which has been passed down from generation to generation (Toharudin, et al., 2017; Toharudin & Kurniawan, 2017), so that it can be an effective solution structured and systematic to prevent the loss of cultural and traditional characteristics in an area (Kasa, 2011).

Based on the literature study, it can be explained the relationship between indigenous science in the tradition of using materials for making *bale adat* and scientific science as presented in the following Table 3.

Table 3. Description of Reconstruction of *Indigenous Science* in Making *Bale Adat* with Scientific Science

Indigenous Science Society	Scientific Science
<p><i>Bale Adat</i> foundations are made from a mixture of clay, tree sap, straw ash or rice husk, and buffalo dung mixed with water.</p> <p>The floor of <i>bale adat</i> is smeared with buffalo dung which is mixed with water periodically to reduce humidity</p>	<ul style="list-style-type: none"> ▪ <i>Bale adat</i> floors is effective in producing floors that are as strong as cement floors, because the rice straw ash is pozzolanic and meets the minimum requirements of ASTM classes N, F and C pozzolan and suitable for use in replacement of Portland cement (El-Sayed & EL-Samni, 2006). This is reinforced by the results of research by Malasyi, Wesli & Fasdarsyah (2014) that the silica content (SiO₂) in rice straw ash can be used as a substitute for cement preparations. ▪ The mixture will have the same adhesion as cement, which is possible because cement is made from similar materials, namely limestone containing Calcium Oxide (CaO), clay or clay containing Silica Oxide (SiO₂), Aluminum Oxide (Al₂O₃), Iron Oxide (Fe₂O₃) and Magnesium Oxide (MgO) (Sagel, 1997; Malasyi, Wesli & Fasdarsyah, 2014). ▪ Buffalo manure contains silica (SiO₂) which can have pozzolanic properties so that it can serve to glue and harden the floor surface of <i>bale adat</i> such as cement. This is in accordance with the results of Astuti (2016) that buffalo dung contains an element of silica of 9.6% per kilogram, so it has the same properties as cement, namely pozzolanic and can protect <i>bale adat</i> floor from cracks and moisture.

Indigenous Science Society	Scientific Science
<p><i>Bale adat</i> walls or room coverings are made of woven bamboo slats known locally as <i>pager</i>.</p>	<ul style="list-style-type: none"> ▪ Bamboo <i>pager</i> are strong enough from rainwater and hot temperatures because the bamboo stems contain silica, namely one of the inorganic materials that has the advantage of having high stability against mechanical influences, temperature, and acidity conditions (Sriyanti, Taslimah, Nuryono & Narsito, 2005).
<p><i>Pager</i> matting is made from ampel bamboo with various motifs and sometimes to beautify the <i>pager</i>, spotted bamboo is used which has colorful bark.</p>	<ul style="list-style-type: none"> ▪ Spotted bamboo has an anatomical structure, especially in the hypodermis cells which contain anthocyanin substances, so that it has a distribution of reddish hues between the green color of the bark (Ramdhini, et al., 2021).
<p><i>Teken</i>, <i>ampak</i>, <i>lampen</i>, and <i>langkar</i> used in the <i>adat bale</i> are made from the part of the tree that is believed to be the strongest or known by the local term as <i>kayu galih</i>.</p>	<ul style="list-style-type: none"> ▪ Secondary growth is caused by the activity of the vascular cambium, causing an increase in the amount of vascular tissue in the stem. In general, the secondary growth of the vascular cambium produces continuous loops of xylem and phloem and causes changes in the dense texture of the interior of the stem.
<p>The roof is made of weeds leaves which are woven in bamboo frame clamps which are split into small pieces.</p>	<ul style="list-style-type: none"> ▪ Sclerenchyma cells in stems undergo lignification, which is the process of secondary cell wall hardening in plants due to the accumulation of lignin and cellulose. The lignification process generally begins when the plant begins to age. It is this lignification that plays an important role in the mechanical stability of the plant because the cell wall becomes tough and very strong (Ramdhini, et al., 2021). ▪ The weeds contain chemical elements, namely 5.42% ash, 3.67% silica, 28.58% pentosan, 21.42% lignin, and 48.12% cellulose. The high cellulose and lignin content, coupled with the silica content, affects the mechanical (strength), physical (shrinkage) and chemical properties so that it makes it stronger and more durable than rice straw (Sriyanti, Taslimah, Nuryono & Narsito, 2005). In addition, the morphological structure of thatch leaves has advantages compared to rice straw, namely the straight leaf shape with parallel and unbranched leaf veins makes it easier for rainwater to flow.

Based on the results of the analysis of the relevance of indigenous peoples' science to scientific science above, ethnoscience studies in the tradition of using materials for making *bale adat* can facilitate the study of multidimensional scientific concepts, namely product, process, and attitude dimensions (Ali, 2018). This is possible because students will be facilitated to actively carry out scientific analysis of scientific concepts with concrete objects in everyday life such as materials for making *bale adat* (Mardiana, 2018; Rizkianawati et al., 2014; Koes, 2003). *Indigenous science*-based science learning in materials for making *bale adat* will present contextual learning (Khoiri & Sunarno, 2018; Setyowati et al., 2013), because students will carry out studies directly in exploring the materials for making *bale adat* (Puspasari et al., 2019). Thus, ethnoscience can be an effective learning approach to reconstruct indigenous science in materials for making *bale adat* into scientific science (Khoiri & Sunarno, 2018). This is confirmed by Akmal et al (2020) that ethnoscience learning is based on a constructivism view and prioritizes meaningful learning, where students are facilitated to learning by doing (Alvonco, 2014). Meanwhile, according to Parmin (2017) that learning ethnoscience can bridge *indigenous science* to be studied formally in science learning in educational institutions.

Opportunities for Ethnoscience Based Science Learning

Ethnoscience as a set of knowledge owned by the community, tribe, and nation in an area which is obtained by certain traditional methods and empirically, its truth can be tested and accounted for (Sudarmin, 2014). The original knowledge of the community is known as indigenous science and can be taught in the concept of learning science (Parmin, 2017). This is confirmed by the opinion (Sudarmin et al., 2017) that local culture found in society can be used for education or learning. The ethnoscience of *bale adat* contains the concept of indigenous science in the use of materials for making it and can be integrated into natural science concepts such as the concept of network structure and function, as well as the concept of material properties and their use in everyday life (Muliadi, Sarjan & Rokhmat, 2022). Integrating indigenous science in science learning allows students to interact with concrete objects in everyday life (Koes, 2013). According to Akmal et al. (2020) that *bale adat* ethnoscience approach is effective for organizing constructive science learning and building meaningful learning. Indigenous science-based learning in everyday life can strengthen product, process, and attitude dimensions (Kartono, Hairida & Bujang, 2010).

Ethnoscience integrated science learning can be carried out with various models, one of which is the project-based learning model in order to be able to

involve active students in a series of scientific processes through science process skills (Muliadi, 2019). The 2013 curriculum also emphasizes modern pedagogic dimensions that use a scientific approach or known as a scientific approach (Sulistiyowati et al., 2020), for example with discovery learning models, inquiry learning, problem-based learning, and project-based learning (Rusman, 2017). According to Mirnawati, Fuldiaratman & Yusnidar (2021) that one of the learning models and approaches recommended by the 2013 Curriculum is the Project Based Learning (PjBL) model and the Ethnoscience approach. Project based learning model with *bale adat* ethnoscience approach can provide opportunities for students to be active in learning and students will construct their own knowledge through projects linking indigenous science and scientific science (Sulistiyowati et al., 2020). Project-based learning has the advantage of its characteristics, namely helping students make decisions and frameworks, assisting students in designing a process to determine outcomes, training students to be responsible for managing information, then students can produce a real product of the results of the students themselves (Widyasari et al., 2018). Thus, the use of the Project Based Learning model with an

ethnoscience approach can improve students' understanding of concepts, science process skills, conservation attitudes, and creative thinking abilities (Mirnawati, Fuldiaratman & Yusnidar, 2021; Sudarmin, 2014).

Integrating the concept of science in indigenous science in *bale adat* can be carried out in stages, namely (1) *Observation*, gathering information on indigenous science in the materials for making *bale adat*; (2) *Transformation*, mapping scientific concepts that are relevant to *indigenous science* in the materials for making *bale adat*; (3) *Integration*, reconstructing learning relevant science concepts by integrating indigenous science in materials for making *bale adat*. Thus, the reconstruction of the community's original knowledge into scientific knowledge can be used as a source of learning in learning Natural Sciences (IPA) in schools. Students are expected to be able to reconstruct knowledge obtained from the environment into scientific knowledge so that learning becomes meaningful (Mukti, Rahmawati & Marzuki, 2022). The potential for integrating the concept of science learning in indigenous science-based schools in the tradition of using materials for making *bale adat* as presented in the following Table 4.

Table 4. The Potential of *Indigenous Science* in Materials for Making *Bale Adat* to be Constructed in Learning Science

<i>Indigenous Science in Indigenous Bale Materials</i>	Linkages in Science Learning	
	Basic competencies	Learning materials
The tradition of using materials for making <i>bale adat</i> , namely (a) <i>teken</i> , <i>ampak</i> , <i>lampen</i> , and <i>langkar</i> used in <i>traditional bale</i> are made from the part of the tree that is believed to be the strongest known locally as <i>kayu galih</i> ; (b) the walls of the <i>bale adat</i> or room covering are made of woven bamboo slats known by the local term as <i>pager</i> ; (c) the roof is made of thatch/alang-alang leaves which are woven in bamboo frame clamps which are split into small pieces.	Analyzing the interrelationships of plant tissue structures and their functions, as well as technologies inspired by plant structures	Network structure and function; Technology inspired by plant structure
The tradition of using materials for making the foundation of a <i>bale adat</i> is from a mixture of clay, tree sap, straw ash or rice husk, and buffalo dung mixed with water. Then the floor of the <i>bale adat</i> is smeared with buffalo dung mixed with water periodically to reduce humidity.	Linking the concept of matter particles, the structure of simple substances with the properties of materials used in everyday life, as well as the impact of their use on human health	Material properties; Utilization of materials in everyday life

Conclusion

Based on the results and discussion, it can be concluded that (1) *bale adat* typical of the *Sasak* tribe consists of several types, namely *bale beleq bencingah*, *bale bonter*, *bale tani*, *bale jajar*, *bale tajuk*, *bale lumbung*, *secepat*, *sekenam*; (2) indigenous science in the materials for making *bale adat*, namely: a) the foundation for *bale adat* is made from a mixture of clay, tree sap, straw ash or rice husk, and buffalo dung mixed with water, b) floor of *bale adat* periodically smeared with buffalo dung mixed with water to reduce humidity, b) the walls of the *bale adat* or room covering are made of woven bamboo slats known

as the local term *pager*, c) woven *pager* are made of ampel bamboo with various motifs and sometimes to beautify the *pager*, the materials used are spotted bamboo which has colorful bark, d) *teken*, *ampak*, *lampen*, and *langkar* used in *bale adat* are made from the part of the tree that is believed to be the strongest or known locally as *kayu galih*, e) a taps made of weeds leaves woven into bamboo frame clamps which are split into small pieces ; (3) indigenous science in the materials for making *bale adat* can be integrated into the school science learning concept, namely in the material: a) material on network structure and function, as well as technology inspired by

plant structure, b) material properties and utilization of materials in everyday life.

Acknowledgements

We would like to thank to all the parties that help to complete the research entitled "Ethnoscience Studies in Making of *Bale Adat*: Literature Review".

Author Contributions

M. Khairul Wazni: developing literature study topics and defining literature analysis methodology.

Agus Muliadi: analyzing literature related to literature study topics, writing draft articles, revising, and editing final articles.

M. Yamin: browsing and mapping literature related to the topic of literature study.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

References

- Ali, L. U. (2018). Pengelolaan Pembelajaran IPA Ditinjau Dari Hakikat Sains Pada SMP Di Kabupaten Lombok Timur. *Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, 6 (2), 103-112. <https://doi.org/10.33394/jps.v6i2.1020>
- Alvonco, J. (2014). *Practical Communication Skill*. Jakarta: Elex Media Komputindo.
- Andi, P. (2012). *Metode Penelitian Kualitatif dalam Perspektif Rancangan Penelitian*. Jogjakarta: Ar-Ruzz Media.
- Akmal, A.U., Lia, Lestari, T., Asra, A., Effendy, Festiyed, Skunda. (2020). Analisis Etnosains dalam Pembelajaran IPA di Sekolah Dasar Kota Padang dan Bukittinggi. *Jurnal Inovasi Pendidikan dan Pembelajaran Sekolah Dasar*, 4 (2), 68-77. <https://doi.org/10.24036/jippsd.v4i2.111385>
- Arlianovita, D., Setiawan, B. & Sudiby, E. (2015). Pendekatan Etnosains dalam Proses Pembuatan Tempe terhadap Kemampuan Literasi Sains. *Seminar Nasional Fisika dan Pembelajaran 2015*. 101-107.
- Battiste, M. (2005). Indigenous Knowledge: Foundations for First Nations. *WINHEC: International Journal of Indigenous Education Scholarship*, 1, 1-17.
- Chain & Evan. (1990). *Sciencing An Involvement Approach to Elementary Science Methods*, (Edisi ke III. Korinna: Merrill.
- Chiapetta, E.L. & Koballa T. R. (2010). *Science instruction in the middle and secondary school*. Boston: Allyn & Bacon.
- Creswell JW. (2012). *Educational research: planning, conducting and evaluating quantitative and qualitative research*. Pearson Education, Inc.
- Darmiawati. (2006). *Implementasi Model Pembelajaran Perubahan Konseptual Untuk Meningkatkan Prestasi Belajar*. Banda Aceh: FKIP Unsyiah.
- El-Sayed, M.A. & EL-Samni, T.M. (2006). Physical and Chemical Properties of Rice Straw Ash and Its Effect on the Cement Paste Produced from Different Cement Types. *Journal of King Saud University – Engineering Science*, 19 (1), 21-29. [https://doi.org/10.1016/S1018-3639\(18\)30845-6](https://doi.org/10.1016/S1018-3639(18)30845-6)
- Hadi, W.P. & Ahied, M. (2017). Kajian Etnosains Madura dalam Proses Produksi Garam sebagai Media Pembelajaran IPA Terpadu. *Jurnal Rekayasa*, 10 (2), 79-86.
- Hadi, W.P., Muharrami, L.K., Hidayati, Y., Rosidi, I. & Maryamah, S. (2019). Development of Magazine on Madura Salt Theme With Ethnoscience Approach to Improve Student's Character. *Unnes Science Education Journal*, 8 (2), 118-129. <https://doi.org/10.15294/usej.v8i2.31524>
- Hikmawati, Suastra, I.W. & Pujani, N.M. (2020) Local wisdom in Lombok island with the potential of ethnoscience for the development of learning models in junior high school. *Journal of Physics: Conference Series*, 1-12. <https://doi.org/10.1088/1742-6596/1816/1/012105>
- Irawan, B. & Muhartati, E. (2019). Identifikasi Nilai Etnosains pada Kearifan Lokal Berkarang dan Menyondong Ikan Pada Masyarakat Pesisir Bintan. *Pedagogi Hayati*, 3 (1), 53-58. <https://doi.org/10.31629/ph.v3i1.1595>
- Julita, I. & Hidayatun, M.I. (2019). Perubahan Fungsi, Bentuk dan Material Rumah Adat Sasak Karena Modernisasi. *ATRIUM: Jurnal Arsitektur*, 5 (2), 105-112. <https://doi.org/10.21460/atrium.v5i2.90>
- Kartono, Hairida, & G. Bujang. (2010). *Penelusuran Budaya Teknologi Lokal dalam Rangka Rekonstruksi dan Pengembangan Sains di Sekolah Dasar*. Pontianak: FKIP, Universitas Tanjungpura.
- Kasa, I.W. (2011). Local Wisdom In Relation To Climate Change. *Journal of International Society for Southeast Asian Agricultural Sciences (J.ISSAAS)*, 17 (1), 22-27.
- Khoiri, A. & Sunarno, W. (2018). Pendekatan Etnosains Dalam Tinjauan Fisafat (Implementasi Model Pembelajaran STEM: Science, Technology, Engineering, and Mathematic). *SPKETRA: Jurnal Kajian Pendidikan Sains*, 4 (2), 145-153. <http://dx.doi.org/10.32699/spektra.v4i2.55>
- Koes, S. H. (2003). *Strategi pembelajaran Fisika*. Malang: Universitas Negeri Malang.
- Krajcik, J.S., Czerniak, C.M, & Berger, C. (1999). *Teaching children science: A projectbased approach*. Boston: McGraw Hill College.

- Listyawati, M. (2012). Pengembangan Perangkat Pembelajaran IPA Terpadu di SMP. *Jurnal Pendidikan IPA*, 1 (1), 61-69. <https://journal.unnes.ac.id/sju/index.php/jise/article/view/46>
- Malasyi, S., Wesli & Fasdarsyah. (2014). Analisis Pengaruh Penggunaan Abu Jerami Terhadap Kuat Tekanan Beton. *Jurnal Teras*, 4 (2), 41-49.
- Mardiana. (2018). Penerapan Pembelajaran IPA Berbasis Konstruktivisme dalam Meningkatkan Sikap Ilmiah pada Siswa Madrasah Ibtidayah. *Jurnal Ilmiah AL-MADRASAH*, 3 (1), 61-80. <http://dx.doi.org/10.35931/am.v0i0.69>
- Mardianti, I., Kasmantoni & Walid, A. (2020). Pengembangan Modul Pembelajaran IPA Berbasis Etnosains Materi Pencemaran Lingkungan Untuk Melatih Literasi Sains Siswa Kelas VII di SMP. *BIO-EDU: Jurnal Pendidikan Biologi*, 5 (2), 97-106. <https://doi.org/10.32938/jbe.v5i2.545>
- Mirnawati, Fuldiaratman & Yusnidar. (2021). Penerapan Model Project Based Learning (PJBL) Berbasis Etnosains pada Materi Koloid dan Kaitannya dengan Kemampuan Berpikir Kreatif Siswa di SMA Negeri 2 Kota Jambi. *Jurnal Penelitian Pendidikan Kimia*, 8 (1), 85-96.
- Mukti, H., Rahmawati, B.F. & Marzuki, M. (2022). Kajian Etnosains Dalam Ritual Belaq Tangkel Pada Masyarakat Suku Sasak Sebagai Sumber Belajar IPA. *Educatio: Jurnal Ilmu Kependidikan*, 17 (1), 41-53. <https://doi.org/10.29408/edc.v17i1.5520>
- Muliadi, A., Sarjan, M. & Rokhmat, J. (2022). Pendidikan Ipa Multidimensional Pada Etnosains Bale Adat Sasak: Perspektif Filsafat. *Jurnal Ilmiah Mandala Education*, 8 (4), 2799-2811. <http://dx.doi.org/10.58258/jime.v8i4.3987>
- Muliadi, A. (2019). Pembelajaran Biologi Berbasis Entrepreneurship. *Proceeding National Conference: Education, Social Science, and Humaniora*, 1 (1), 269-275.
- Parrish, P. & Linder-VanBerschoot, J. (2010). Cultural dimensions of learning: Addressing the challenges of multicultural instruction. *The International Review of Research in Open & Distributed Learning*, 11 (2), 1-19.
- Parmin. (2017). *Etnosains*. Semarang: Swadaya Manunggal
- Parmin, P., Sajidan, S., Ashadi, A., Sutikno, S. & Fibriana, F. (2017). Science Integrated Learning Model to Enhance The Scientific Work Independence of Student Teacher in Indigenous Knowledge Transformation. *Jurnal Pendidikan IPA Indonesia*, 6 (2). <https://doi.org/10.15294/jpii.v6i2.11276>
- Purwanto. (2011). *Evaluasi Hasil Belajar*. Yogyakarta: Pustaka Pelajar
- Putra, H.S.A. (2021). Ethnoscience A Bridge To Back To Nature. *E3S Web of Conferences*, 1-9. <https://doi.org/10.1051/e3sconf/202124901002>
- Puspasari, A., Susilowati, I., Kurniawati, L., Utami, R.R., Gunawan, I., Sayekti, I.C. (2019). Implementasi Etnosains dalam Pembelajaran IPA di SD Muhammadiyah Alam Surya Mentari Surakarta. *Science Education Journal (SEJ)*, 3 (1), 25-31. <https://doi.org/10.21070/sej.v3i1.2426>
- Puspita, P. (2017). 7 Rumah Bale Suku Sasak yang Menarik Wisatawan Bule. (Online) <https://bobo.grid.id/read/08673866/7-rumah-bale-suku-sasak-yang-menarik-wisatawan-bule?page=all> (diakses 10 Mei 2023).
- Rahayu, A.S. (2018). *Pengantar Pemerintahan Daerah Teori Hukum dan Aplikasinya*. Jakarta: Sinar Grafika.
- Ramdhini, R. N. (2021). *Anatomi Tumbuhan*. Yayasan Kita Menulis.
- Rizkianawati, A., Wiyanto & Masturi. (2014). Implementasi Model Pembelajaran *Multidimensional* pada Pembelajaran Fisika untuk Meningkatkan Keterampilan Proses Sains Siswa. *Unnes Physics Education Journal*, 4 (2), 62-68. <https://doi.org/10.15294/upej.v4i2.7429>
- Rusman. (2017). *Belajar dan Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta: PT Kharisma Putra Utama.
- Sarini, P. & Selamet. K. (2019). Pengembangan Bahan Ajar Etnosains Bali Bagi Calon Guru IPA. *Wahana Matematika dan Sains: Jurnal Matematika, Sains, dan Pembelajarannya*, 13 (1), 27-39. <https://doi.org/10.23887/wms.v13i1.17146>
- Seroto. (2012). Student Teachers Presentations of Science Lessons in South African Primary Schools: Ideal and Practice. *International Journal Education Science*, 4 (2), 107-115. <https://doi.org/10.1080/09751122.2012.11890033>
- Santyaningtyas, A. C., & Noor, M. Z. M. (2016). Preserving of traditional culture expression in Indonesia. *Asian Social Science*, 12 (7), 59-65. <https://doi.org/10.5539/ass.v12n7p59>
- Setyowati, R., Parmin, P. & Widyatmoko, A. (2013). Pengembangan Modul IPA Berkarakter Peduli Lingkungan Tema Polusi Sebagai Bahan Ajar Siswa SMKN 11 Semarang. *Unnes Science Education Journal*, 2 (2), 245-253. <https://doi.org/10.15294/usej.v2i2.2031>
- Sriyanti, S., Taslimah, T., Nuryono, N. & Narsito, N. (2005). Sistesis Bahan Hibrida Amino-Silika dari Abu Sekam Padi melalui Proses Sol-Gel. *Jurnal Kimia Sains dan Aplikasi*, 8 (1), 1-8. <https://doi.org/10.14710/jksa.8.1.1-8>
- Suastra, I W. (2009). *Pembelajaran Sains Terkini: Mendekatkan Siswa dengan Lingkungan Alamiah dan*

- Sosial Budayanya*. Singaraja: Penerbit Universitas Pendidikan Ganesha.
- Sudarmin. (2014). *Pendidikan karakter, etnosains dan kearifan lokal (pertama ed.)*. Semarang: Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Negeri Semarang.
- Sudarmin, Sumarni, W. & Mursiti, S. (2018). The learning models of essential oil with science technology engineering mathematic (STEM) approach integrated ethnoscience. *Journal of Physics: Conference Series*, 1-7. <https://doi.org/10.1088/1742-6596/1321/3/032058>
- Sudarmin, Febu, R., Nuswowati, M., & Sumarni, W. (2017). Developmen of Ethnoscience Approach in The Module Theme Substance Additives to Improve the Cognitive Learning Outcome and Student's Entrepreneurship. *Journal of Physics: Conference Series* 824 (1).
- Sukawi & Zulfikri. (2010). Adaptaasi Arsitektur Sasak Terhadap Kondisi Iklim. Lingkungan Tropis. *Jurnal Berkala Teknik*, 1 (6), 1-8.
- Sukmadinata, S.N. (2007). *Metode Penelitian Pendidikan*. Bandung: Rosda Karya.
- Sulistiyorini, S. (2007). *Pembelajaran IPA Sekolah Dasar, Dan Penerapan Dalam KTSP*. Yogyakarta: Unnes dan Tiara Wacana.
- Sulistiyowati, Reffiane, F. & Handayani, D. E. (2020). Pengaruh Model Project Based Learning Berbasis Etnosains Tema Ekosistem Terhadap Aktivitas Belajar Siswa. *Jurnal Pendidikan Surya Edukasi (JPSE)*, 6 (2), 120-132.
- Toharudin, U., & Kurniawan I. S. (2017). Sundanese Cultural Values of Local Wisdom: Integrated to Develop a Model of Learning Biology. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*. 32 (1), 29-49. <https://gssrr.org/index.php/JournalOfBasicAndApplied/article/view/6872>
- Wahyu, Y. (2017). Pembelajaran Berbasis Etnosains Di Sekolah Dasar. *Jurnal Inovasi Pendidikan Dasar*, 1 (2). 140-147.
- Wati, E., Yuberti, Saregar, A., Fasa, M.I., Aziz, A. (2020). Literature Research: Ethnoscience in Science Learning. *Journal of Physics: Conference Series*, 1-9. <https://doi.org/10.1088/1742-6596/1796/1/012087>
- Widianti, A.K. (2017). Preservasi Rumah Adat Desa Sade Rembitan Lombok Sebagai Upaya Konservasi. *Vitruvian: Jurnal Arsitektur, Bangunan, & Lingkungan*, 6 (3), 79-84.
- Widyasari, F., Indriyanti, N. Y. & Mulyani, S. (2018). The Effect of Chemistry Learning with PjBL and PBL Model Based on Tetrahedral Chemistry Representation in term of Student's Creativity. *JPKP (Jurnal Kimia Dan Pendidikan Kimia)*, 3 (2).
- Wir'aen, R. (2017). Nilai Edukatif pada Arsitektur Rumah Adat Bale Sasak di Dusun Limbungan Lombok Timur Nusa Tenggara Barat. Skripsi: Rogram Studi Pendidikan Seni Rupa Fakultas Bahasa Dan Seni Universitas Negeri Yogyakarta.
- Zed, M. (2008). *Metode Penelitian Kepustakaan*. Jakarta: Yayasan Obor Indonesia.