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Integration of local wisdom of natural color sasirangan in project-based learning with steam approach to train science literacy

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ABSTRACT

Science learning should provide meaningful experiences for students to understand various scientific phenomena in life. Integrating local wisdom in learning can improve scientific literacy because the various concepts learned are witnessed directly by students in life. This research aim of developing science LKPD integrated with local wisdom of sasirangan natural colors to improve project-based science literacy with the STEAM approach. The research approach used is qualitative research. Based on the research results and discussion, it can be concluded that the project-based learning model is very appropriate to be applied with the STEAM approach so that learning activities are student-centered, create meaningful learning, and train science literacy. Based on these findings, teachers should design media and lesson plans that are integrated with local wisdom and apply them in classroom learning.

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Introduction

Education is a necessity for humans in living life. This is because through education humans can develop potential through the learning process(Kuzminov et al., 2019a). In Law Number 20 of 2003 it is stated that through education human potential needs to be developed in order to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed for oneself, society, nation and state. In line with the objectives mandated by the law, education is organized to provide meaningful learning(Kuzminov et al., 2019b). Understanding of learning material is achieved by the process of knowledge formation by the learners themselves. That knowledge is within one who knows (Schunk, 1986). Because the formation of knowledge is by students themselves, the learning process in the world of education must involve students to actively think, compile concepts, and give meaning to the things learned.

Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 22 of 2006 describes the purpose of learning science in schools must foster the interest of students to learn various objects or events in the surrounding environment(Widyawan et al., 2020). The National Education Standards Agency (2010) states that in an effort to meet the needs in the era of globalization, education must be able to maintain the culture and identity of the nation in the midst of the onslaught of various cultures and civilizations of other

nations. From this description, the educational process must start from phenomena that originate from things close to the lives of students so that the science learned is real.

Constructivist learning theory considers that learners basically have initial knowledge gained from various phenomena in life(Bada & Olusegun, 2015a). Such initial knowledge can be developed to build more complex knowledge. This theory recognizes that the learner will be able to interpret information into his mind only in the context of his own experiences and knowledge of needs, backgrounds, and interests. Lev Vygotsky revealed that human intelligence comes from society, its environment and culture. Therefore, it can be said that meaningful learning comes from everything in the surrounding environment as initial knowledge that is strengthened by new knowledge built by the students themselves. Natural science subjects study concepts, laws, formulas, real and abstract phenomena (Gagese, Wahyono and Kendek, 2018). There are many learning materials that must be understood by students, thus making students feel difficult and the level of enthusiasm for learning is relatively low (Dwitiyanti, 2020). For environmental education to be successful, students must actively interact with objects, and the activities must be in the form of observing and then conceptualizing (Retnowati, 2018). Therefore, it is necessary to develop teaching modules that make scientific social phenomena as a trigger and source of learning. The scientific social phenomenon in question is in the form of local wisdom in the process of making natural dye sasirangan cloth with ironwood dust.

Local wisdom can be defined as the local idea of a particular community that is wise, wise, virtuous, and established in the community and is used as a guide by community members(Bada & Olusegun, 2015b). Local wisdom is the way people behave and act in response to changes in the physical and cultural environment (Pornpimon et al., 2014). Local wisdom is a characteristic that comes from regions or regions that have cultural values that develop in the local community for generations (Priyambodo & Wulaningrum, 2017). Local wisdom that surrounds students can help students understand the relationship of their living world to what they learn in science (Meliono, 2011). Through local wisdom, students can learn cultural values and a sense of nationalism that can affect learning outcomes (attitudes, behaviors, and thinking skills) (Laurent, 2016). Knowledge of local wisdom needs to be integrated in the science learning process to increase students' understanding of learning materials related to the surrounding environment (Abah et al., 2015).

(H. R. Setiawan & Masitah, 2017) in the research The Development of Local Wisdom-Based Natural Science Module to Improve Science Literation of Students found that teaching modules containing local wisdom are suitable for science learning because they are related to natural events and the environment where students live. The modules developed are able to improve students' science literacy. (Rilia & Indah, 2019) prove that students who use teaching materials with PBL assisted by ethnoscience sasirangan have the ability to think critically with high categories. (Lubis et al., 2022) concluded that the use of problem-based learning models with local wisdom oriented towards scientific social issues is more effective in increasing environmental literacy and conceptual understanding. The same thing was also found by (Hartini et al., 2018) who developed physics learning tools based on local wisdom to train saraba kawa characters found that learning based on local wisdom can grow student character(HL et al., 2020). The use of local wisdom can help teachers educate character. The effectiveness of learning tools based on local wisdom not only makes students understand the learning material, but also able to develop students' values and character.

The difference between this study and previous studies lies in the approach used to train science literacy, namely the STEAM approach applied in project-based learning. Based on the analysis of problems it is necessary to have a science teaching integrated local wisdom sasirangan natural dye(Amrita et al., 2020). The study of learning theory and previous research supports this idea, so researchers are interested in conducting research with the aim of developing science LKPD integrated with local wisdom of sasirangan natural colors to improve project-based science literacy with the STEAM approach.

Method

The research approach used is qualitative research, which is systematic research used to study or examine an object in a natural setting without any manipulation in it and without any hypothesis test. Data were collected through literature review, interviews, and observation. Literature review is conducted to explore various concepts and principles of temperature, expansion, and heat. Literature review uses library data in the form of books as data sources (M. Sari & Asmendri, 2020) This research was conducted by reviewing various existing literature related to ethnoscience learning, sasirangan fabric, project-based learning, STEAM approach, and integrating local wisdom in learning. Interviews and observations were used to explore information about the process of making sasirangan fabrics, natural dyes, and ethnoscience contained in them. Interviews and observations were conducted at the Sasirangan ecomel craftsman group on Jalan Veteran Telaga Sari Village number 05 RT 03, South Amuntai District, North Hulu Sungai Regency, South Kalimantan Province. The

interview guideline was conducted by going to the respondent, asking for the identity of the respondent and providing pre-prepared questions related to the research topic.

Results and Discussions

The following are STEAM approaches that can be applied in learning.

Table 1. STEAM content in learning temperature and heat material

Science	Factual: Natural coloring ingredients cooked in a full pot will overflow when cooked due to expansion. Conceptual: the greater the heat given to an object, the higher the temperature of the object. Procedural: how to take temperature measurements using a thermometer. Metacognitive: the surrounding materials have great potential to be used wisely to meet the needs of human life.
Technology	1. Mesin untuk pencelupan kain sasirangan. 2. Internet untuk mencari informasi seputar suhu, kalor, dan pemuaian.
Engineering	1. Mendesain motif kain sasirangan. 2. Designing experiments to prove the effect of heat on the temperature of substances.
Art	Produce artwork in the form of sasirangan cloth by utilizing ironwood dust waste as a dye.
Matematics	1. Reading thermometer scales 2. Calculating solid expansion 3. Calculating the heat needed to raise the temperature of objects

The process of making natural dye sasirangan cloth displays various scientific phenomena that can be a topic of learning (M. Sari & Asmendri, 2020) In summary, here are scientific phenomena and science concepts on temperature and heat matter.

Table 2. Scientific Phenomena and The Concept of IPA in The Manufacture of The Sasirangan

No	Scientific phenomena	The concept of temperature and heat
1	The ironwood dust to be used as a dye is cooked first. A mixture of water with slowly cooked ironwood dust will gradually get hotter.	The degree of heat or coldness of a substance is referred to as temperature or temperature. The human sense of touch can only sense but cannot measure temperature. To measure the temperature before and after cooking water can use a measuring instrument called a thermometer. There are four temperature scales, namely celsius, reamur, fahrenheit, and kelvin. The relationship of the four temperature scales is: $\frac{t_C}{5} = \frac{t_R}{4} = \frac{t_F-32}{9} = \frac{t_K-273}{5}$
2	A pot filled to the brim with coloring water when heated can spill over	The spillage of water from the pot because the heated water has increased in temperature, causing the water to experience a larger volume expansion (size) when compared to the expansion of the pot volume. Solids can undergo three expansions, namely long expansion, wide expansion, and volume expansion. While liquids and gases only experience volume expansion. Volume expansion in sasirangan dye water is formulated as follows. $V_2 = V_1\{1 + \gamma(T_2 - T_1)\}$
3	When cooking water in a small pot (eg water mass 5 kg) and a large pot (eg water mass 8 kg), so that both boil simultaneously (reaching a temperature of 100oC), then the large pot must be given greater heat energy.	The heat energy given from the fire to a pot of dye water is referred to as heat. The heat needed to raise the temperature of a substance is very dependent on the mass of the substance, the heat of the type of substance, and the desired temperature increase, so it is formulated as follows

No	Scientific phenomena	The concept of temperature and heat
		$Q = m \times c \times \Delta T$
4	After the sasirangan is finished coloring and washing, the cloth will be dried in the sun. Spreading the fabric all over can help the fabric dry faster than drying cloth in a folded state.	Drying cloth in the hot sun is an example of radiant heat transfer. The wide surface of the fabric causes the fabric to receive more heat. It is based on the formula $W = e \times \sigma \times A \times T^4$

OCEO (2004) defines science literacy as the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence in order to relate to nature and changes made to nature through human activities (Pertiwi et al., 2018). PISA (2000) divides science literacy into three major dimensions in its measurement, namely science content/knowledge, science competencies/processes, and the context of science applications (OECD, 2001). While starting in 2006, PISA developed the domain of science literacy into four major domains, namely science content, science competencies/processes, context of science applications, and attitudes. (OECD, 2007). Science literacy is the ability of students to use science concepts to apply them in everyday life, explain scientific phenomena, and describe these phenomena based on scientific evidence (Fuadi et al., 2020) Important aspects in science literacy are 1) the concept of science and its application in everyday life, 2) the process of science inquiry, 3) understanding the nature of science, and 4) understanding the relationship between science, technology, and society (Rusilowati, 2018).

The project-based learning model is a constructive learning model that positions learners as builders of their knowledge based on existing knowledge. Through a project-based learning model students will be actively involved through projects that are interesting, challenging, and related to the phenomena of daily life and relevant to the surrounding environment (Santyasa, 2006). This learning model can improve science process skills (Badriyah et al., 2020) increase students' self-confidence, motivation to learn, creative ability, and self-admiration (Santyasa, 2006), improve creative thinking skills and scientific performance (Marlinda, 2012), improve the ability to write scientific papers (Amirudin, 2015), increase understanding (Santi, 2011) and of course improve learning outcomes (D. K. Sari & SUSILOWATI, 2011). This learning model is based on three principles, namely 1) learning is context-specific; 2) students are actively involved in the learning process; and 3) students achieve learning objectives through a process of social exchange and sharing of knowledge and understanding (Torres et al., 2021). According to Sani (2014) the project-based learning stage consists of 6 steps, namely 1) questioning; 2) planning; 3) scheduling; 4) monitoring; 5) assessment; 6) evaluating.

In the study, (Kızkapan & Bektaş, 2017) found that there was no significant difference in experimental classes using project-based learning models and control classes. This is because students have difficulty in adapting to the learning model applied. In addition, it is also mentioned that project-based learning is not effective learning used for students who have low reading and writing skills. Another reason that causes the learning results of experimental classes is still weak is the lack of attention and the material is less interesting in the structure and properties of the material. The findings of (Kristanti & Subiki, 2017) found no difference in the learning outcomes of experimental class students who used a project-based learning model with the learning outcomes of control class students who used a direct learning model. This is because students are not familiar with project activities and tend to depend on friends so they cannot answer post test questions independently.

Meanwhile, in research conducted by (Santyasa, 2006), although it has been able to prove significant differences in aspects of academic achievement between students taught through project-based learning models and direct learning, the majority of students in experimental classes who use project-based learning models have not reached KKM. There are several causes of this happening such as slow student adaptation, difficulty in dividing tasks, low knowledge and skills in writing reports, uneven reasoning ability, to limited time in learning (Suparsawan & SD, 2020). This is the strong basis for researchers interested in following up on the limitations in the research by using a project-based learning model with a STEAM approach to improve science literacy by integrating local wisdom as a component that is expected to attract the interest and attention of students. Time constraints can be anticipated by compiling modules that are able to assist students in working on projects independently at home and utilizing meeting time in class to strengthen concepts and evaluate project progress every week (Mulyasa, 2021).

STEAM is a development of the STEM approach. STEM is used to emphasize the understanding of disciplines integrated in science, technology, engineering, and mathematics (Nugroho et al., 2019) developed in the United States. STEM is a learning approach that integrates four components into a holistic whole, namely science (the study of natural phenomena involving observation and measurement), technology (technological innovation in modifying to meet needs), engineering (technology design skills developed through the

engineering process), mathematics (analyzing arguing, formulating, solving, interpreting mathematical solutions, related to science, technology, and engineering) (Allanta & Puspita, 2021). The STEM approach serves to build a connection between scientific inquiry activities and the ability to formulate research questions that are sought answers through scientific investigations that involve students in the engineering design process for problem solving (UNESCO et al., 2017).

STEM education with the PjBL learning model makes students active in learning, they are able to communicate, and share findings with their friends. STEM-based learning will shape the character of students who are able to recognize a concept or knowledge (science) and apply that knowledge with the skills (technology) they master to create or design a way (engineering) with analysis and based on mathematical data calculations (math) in order to obtain solutions to solving a problem so that human work becomes easier (Marzelly et al., 2018; Utami & Wijaya, 2018). Learning with a STEM approach is considered by the Federation of Creative Industries to be insufficient, because learning also requires the development and maintenance of innovation through the integration of elements of art (Badriyah et al., 2020). STEAM adds one aspect, namely art and developed in South Korea (Utomo, 2020). This approach encourages students to be able to become problem solvers through integrated thinking so that they can compete in the new knowledge-based economy.

Local wisdom is a characteristic that comes from regions or regions that have cultural values that develop in local communities for generations (Priyambodo & Wulaningrum, 2017). The local wisdom that surrounds students can help students understand the relationships of their living world and what they learn in science (Meliono, 2011). Through local wisdom, students can learn cultural values and a sense of nationalism that can affect learning outcomes (attitudes, behaviors, and thinking skills) (Laurent, 2016). Knowledge of local wisdom needs to be integrated in the science learning process to increase students' understanding of learning materials related to the surrounding environment (Abah et al., 2015). Local wisdom is a set of plans and arrangements regarding learning goals and materials prepared by educational units in accordance with diversity, regional potential, regional characteristics, regional advantages, regional needs, and their respective environments as well as ways that are used as guidelines for the implementation of learning activities to achieve certain educational goals (UNESCO et al., 2017).

Local wisdom currently receives special attention from various stakeholders ranging from policies issued by provinces and sub-districts which are then implemented through schools such as the authority of the provincial government, in accordance with PP 25 of 2000 concerning curriculum development that aims to explore the potential of certain regions optimally (Sofyan, et al., 2019). Local wisdom according to (Suastra, 2013) is a norm that applies in a society that is believed to be true and becomes a reference in daily actions and behavior. According to (Parmin, 2015), learning tools such as teaching materials that only contain concepts, are feared to produce a generation that does not preserve local culture as a pillar of national identity. Local wisdom that develops in communities that have clearly been tested to be able to maintain environmental balance should be used as material in the development of learning tools (Hetarion et al., 2020) According to (Nadlir, 2016) when viewed from his understanding, local wisdom has a relationship with the local advantages of an area such as produce, art creations, traditions, culture, services, services, natural resources, human resources or others. Local wisdom which is a human policy in developing local excellence that relies on the philosophy of values, ethics, ways, and behaviors that are traditionally institutionalized.

Local wisdom according to (Damayanti, 2022) is a characteristic of a certain region or region that has cultural value, developing in the local scope one generation to the next. Local wisdom according to (Khusniati, 2014)is a human effort by using akato act and behave towards an object or event that occurs. Sibarani (2013) defines local wisdom as the wisdom or original knowledge of the community within the scope of a certain area derived from the noble value of cultural traditions to regulate the order of life in order to create progress, peace, and community welfare. Local wisdom according to Fajarini (2014) is a view of life and science as well as various life strategies in the form of activities carried out by local communities in answering various problems in meeting the needs of life. (Wagiran, 2012) revealed that there are three concepts related to local wisdom, namely (a) local wisdom is a long experience that is used as a guide for a community in behaving, (b) local wisdom cannot be separated from the environment where a community lives, (c) local wisdom is dynamic, flexible, open, and always adapts to the times.

One effective way is to make local wisdom a subject in schools (Sagala, 2017) so that local subjects can later be developed and become a characteristic of local potential and local excellence. Local wisdom is a curricular activity to acquire competencies in accordance with local characteristics, local potential, and local development prospects including local excellence whose material can be grouped into existing subjects (Jamaris, 2013). Cultural values on local wisdom can influence how students express emotions and interact with others (Uge et al., 2019). The learning process that brings local wisdom into science learning content (in

this case integrated science subjects) is also called ethnoscience. (Rahayu & Sudarmin, 2015) define ethnoscience as an activity to transform between original science and scientific science. Native science knowledge consists of various knowledge that offends real events that occur in society, while scientific science is in the form of concepts, principles, theories, or laws that have been tested for truth through experiments in laboratories and have been recognized by the scientific community. Through the ethnoscience-based learning process, students will be introduced to various facts or phenomena that develop in people's lives and are associated with science (Fuadah, 2021) According to (LUBIS, 2022) integrating local wisdom as a learning resource can preserve local cultural knowledge and help students understand learning through the real world. This will make it easier for students to learn because the learning content is associated with the surrounding culture.

South Kalimantan has a unique culture that still exists today is sasirangan (Rilia & Indah, 2019). Sasirangan comes from the word sirang or sirang which is taken from the manufacturing process by attacking or sewing jalujur using a barrier (thread) (Ihdal, 2021). Sasirangan is a typical cloth craft of the South Kalimantan region and is produced by the Banjar community on a household industrial scale. Since 2007, the sasirangan industry has been designated as one of the ten leading commodities/products/business types of South Kalimantan (Putra, 2011). Sasirangan cloth is a handicraft with ikat and dye techniques that are characteristic of South Kalimantan (Ministry of Home Affairs, 2016).

The people of South Kalimantan have a belief that this cloth can be a medium of traditional medicine and drive away evil spirits. So that at first only certain people could make it (Pratomo et al., 2019). Sasirangan cloth used to be a traditional clothing commonly used at traditional ceremonies. Even this cloth was originally used for healing for people who were stricken by a disease (pamintaan). This cloth is used in traditional ceremonies of Banjar tribes. On July 24, 1982, Ida Fitriah Kusuma had dared to teach her newly mastered knowledge to interested Banjarmasin City residents. After the training, on August 10, 1982 they formed the Banawati Cloth Making Working Group. Their Sasirangan cloth was introduced to the public on December 27, 1982. At that time they held a sasirangan cloth fashion show at Febiola Hotel Banjarmasin. Since then the sasirangan cloth began to be known directly by all members of the community and the place of the group is now referred to as Sasirangan village (Jumriani, 2018).

Along with the times, the motif of sasirangan cloth has also developed. Various motifs that often appear on sasirangan fabrics are Sari Gading, Kangkung Kaokamban, Gigi Haruan, Jeruju Leaves, Traditional Peanut Flower, Mangosteen Tampuk, Hiris Pudak, Kembang Sakaki, King Spinach, Coral Sinapur Waves, Balimbur Dragon, Bintang, Jajumputan, Katu Leaf, Gradasi, Langsat, Naga, Spider, Dara Mengnang, Bakantan, Floating Market and Ketupat (Almas, 2018). The motif on the sasirangan cloth can be a medium for character education, this is because the sasirangan cloth motif has a deep moral and philosophical message. Revealed by (Leha, 2018) aspects of character education contained in the sasirangan cloth motif, namely, 1) religus on the star and kangkung kaumbakan motifs, 2) nationalism on the pace of bakayuh motifs, 3) independence on the motifs of coral sinampur waves and karikit fungi, 4) mutual assistance on kambang kacang and ridge shoots, and 5) integrity on the motifs of haruan teeth and snakes. Sasirangan was chosen as the right content of local wisdom in learning because this cloth is used by students as school uniforms every week (Rilia & Indah, 2019), which is precisely on Wednesday and Thursday. This is the strong basis for the use of sasirangan as an ethnoscience of science learning in this article. In addition, based on the theory of social constructivism proposed by Lev Vygostsky, learning containing local wisdom is the most appropriate choice to create a meaningful learning process (Fadli, 2020).

According to Disporabudpar (2011), the process of making sasirangan cloth begins by drawing the desired pattern or motif on white cloth. The pattern that has been made is then sewn (jalulong) following the shape of the pattern using hand needles that are given strong threads. After all the patterns are sewn, the ends of the thread are pulled until they are wrinkled (sized). The next step is to heat the dyeed water using a pan. After the dye is well mixed and the water is not too hot, the cloth is dipped in the dye liquid while flipping until the color absorbs evenly. The dyeed-treated fabric is then drained first, if the fabric starts to dry then the next step is to release the binding thread. When removed, you will see a pattern of white spots which are parts of the fabric that are not exposed to dye liquid because they are bound by thread. The next step is immersion into the color preservation solution so that the color of the sasirangan does not fade quickly. Next, the cloth is washed thoroughly and then dried in the sun (chested). When the cloth has dried, the next step is to iron the sasirangan cloth so that the fabric looks neat and slippery, and the results will be obtained cloth with white spots motif which is referred to as sasirangan cloth as a typical fabric of South Kalimantan.

The advantage in this study, the dyes used come from natural materials and are classified as waste, namely ironwood dust (Eusideroxylon zwageri). The selection of ironwood dust is based on the availability of materials that are very abundant and close to the lives of students. Ironwood dust extraction is very easy,

namely by mixing one kilogram of ironwood powder with 10 liters of water and then cooking for two hours (Indrawati et al., 2013) The cooled solution is then filtered and can be used as a coloring agent for fabrics. Natural dyes have beautiful and distinctive colors that are difficult to imitate with synthetic dyes(Y. D. Y. Sari & Damayanti, 2020) Natural dyes have been recommended as dyes that are friendly to the environment and health because the content of natural components has a relatively low pollution load, is easily biodegraded, and is non-toxic (Nintasari & Amaliyah, 2016).

Figure 1. The Stage of Making Sasirangan a) Envelop; b) Immersion

The parts of plants that can be used as natural coloring materials are bark, twigs, stems, leaves, roots, seeds, flowers, and sap. Any plant can be a source of natural dyes because it contains natural pigments. The potential source of natural dyes is determined by the intensity of the color produced and depends on the type of dye present in the plant (A. P. Setiawan, 2003). Plants that can produce color include guava leaves (Psidiumguajava) (Susanto & Sewan, 1973), secang wood (Caesalpinia sappan), crimson (Bixa orellana), putri malu (Mimoca poudica) (Husodo, 1999). In addition, there are also rambutan (Nephelium lappaceum L), mango leaves (Mangifera indica L), jengkol (Pithecelobium jiringa), avocado (Persea americana), noni (Morinda citrifolia), angsana (pterocarpus indicus), ketapang (Terminaliacatappa), tingi (Ceriops tagal) (Darmastuti, 2012). The local plant that has the potential as a source of natural dyes is ironwood dust (Eusideroxylon zwageri) which contains tannins and produces brown color on fabrics (Nintasari & Amaliyah, 2016).

Figure 2. Natural dye Siangan from Ironwood Sawdust

Conclusions

The process of making natural dye sasirangan fabric displays various scientific phenomena of temperature and heat material ranging from temperature measurement, expansion, to heat transfer. Based on the research results and discussion, it can be concluded that the project-based learning model is very appropriate to be applied with the STEAM approach so that learning activities are student-centered, create meaningful learning, and train science literacy. Based on these findings, teachers should design media and lesson plans that are integrated with local wisdom and apply them in classroom learning. This finding is still limited to a literature review, so it is hoped that there are researchers who can follow up on integrating the local wisdom of natural color sasirangan through the development of learning tools to test the validity, practicality, and effectiveness of science literacy.

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