INTEGRATING THE POTENTIAL OF LOCAL WISDOM OF LAWANG SEWU WITH CHEMISTRY LEARNING AS AN INNOVATIVE SOURCE OF CHEMISTRY LEARNING THROUGH AN ETHNOCHEMISTRY APPROACH

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ABSTRACT

Ethnochemistry is an approach that integrates original science in society and scientific science based on local culture and wisdom. This research aims to reconstruct community knowledge into scientific knowledge of Lawang Sewu. Lawang Sewu is located in Semarang City and is a place that is quite iconic and historical and can subsequently be used as an innovative teaching material. The research method used is a qualitative approach with ethnographic studies. The research stages are divided into three, namely identification, verification and formulation. The identification stage is that the researcher directly observes the phenomenon that occurs in Lawang Sewu, the verification stage where the researcher conducts observations and interviews with experts, and the formulation stage where the researcher reconstructs community science with scientific science with expert supervision. The result of this research is that Lawang Sewu is closely related to chemical substances including thermodynamics, thermochemistry, ideal gases, elements and compounds as well as temperature and heat. It is hoped that this research can be an innovative learning resource for educators in the field of Chemistry.

Keywords: Ethnochemistry, Lawang Sewu, Chemistry Education, Local Wisdom, Innovative Learning Resources

INTRODUCTION

Today we have entered the twenty-first century. The industrial revolution 4.0 began in the 21st Century. There is a belief that this custom will open up more job opportunities and speed up and facilitate human work with satisfactory results. Thus, it becomes clear that more qualified human resources are needed to achieve satisfactory work results in this century (Mardhiyah et al., 2021). The transformation of the educational paradigm is very important to improve the quality of human resources (Ohlssen & Krempecki, 2020). This century education emphasizes communication, collaboration, creativity, problem-solving, and critical thinking skills (Septikasari & Frasandy, 2018). The goal of 21st century education is to encourage students to master skills that are relevant and useful for modern life so that they can be more responsive to the changes and developments of the times.

21st century skills are a central point in today's education, especially in science (Jufri and Gunawan, 2020). This skill is a basic need in science learning which is currently still not taught properly in schools. One of the skills that is very important to improve so that students can apply science correctly is science literacy (Suryani, A.W and Setiadi, 2017). Science literacy is the ability to use scientific knowledge to identify problems and draw conclusions based on evidence in order to understand and make decisions about nature and changes made to nature through human activities (Pratiwi et al., 2019)

According to the student science literacy report from the Program for International Student Assessment (PISA) published by the Organization for Economic Cooperation and Development (OECD) in 2019, Indonesia is ranked 62nd out of 70 countries studied. This shows that Indonesia is included in the 10 countries with the lowest literacy level (OECD, 2019). This fact shows that Indonesia students still have difficulty understanding science concepts and processes, and are also not able to apply the science knowledge they have learned in their daily lives (Sutrisna N, 2021). What's more, educators' teaching methods tend to be conventional, which encourages students to only memorize concepts and not stimulate students to build their own knowledge, which can potentially lead to misconceptions (Rokhim, Rahayu and Dasna, 2023).

Efforts that can be applied to improve science literacy are to collaborate between local culture and science learning or we can know ethnoscience. In the current context of science learning, ethnoscience approaches that focus on culture have not been widely applied. Therefore, there needs to be an adjustment in the educational curriculum by adding elements of culture and daily life so that the learning material is more relevant and contextual (Sudarmin, & Pujiastuti, 2015). The ethnoscience approach itself is divided into several types, namely, ethnobiology, ethnophysics, ethnochemistry, ethnomathematics (Nursaadah et al., 2017). In this research, the right approach for our research is ethnochemistry. According to Ajayi, ethnochemistry is the research of how certain cultural groups apply chemical principles in their activities, which reflects the ideology of the

community such as the potential for local wisdom, historical sites, culinary tourism, and others (Ajayi, Achor and Agogo, 2017).

One of the potentials of local wisdom that reflects Semarang culture is the Lawang Sewu building. Lawang Sewu, which is more than 50 years old, of course. has important value for history, culture and science Haryadi, 2019). One of the uniqueness of Lawang Sewu itself lies in its basement. During the Japan colonial period, this space was used as a dungeon, but the initial function of this basement was as a water channel, and air conditioning for the building (Darmawan, Mellina and P. Mbulu, 2018)). This underground well is related to the concept of chemistry.

Based on the description above, this research aims to explore and integrate local wisdom or indigenous science of the community with scientific science with the topic of Lawang Sewu which is one of the historical places in Semarang City. The process of exploration and reconstruction of Lawang Sewu local wisdom has not been carried out much, so exploration and reconstruction are needed so that it can become a scientific science. The results of the research can be used as a source of contextual learning for Chemistry educators in schools so that they can foster science literacy, especially chemistry, and can develop knowledge for students.

METHOD

This research is an ethnographic study that involves in-depth investigation and recording the results. Meanwhile, formal experience can only be understood scientifically and based on academic work, so that scientific knowledge is considered an objective, universal, and value-free process, and can be held accountable for its truth. chiapetta and Koballa, 2010 state that science is a systematic effort to create, build, and organize knowledge about natural phenomena, driven by human curiosity. Investigations into these phenomena are being carried out, and various natural phenomena can be tested and studied through science (Ogunniyi, 2011). This research process results in accurate reconstructions of specific groups (Cohen, Manion, & Morrison, 2007).

The research we conducted described the condition of Lawang Sewu and found its relationship with the chemical concept in it. This research was conducted in Lawang Sewu, Semarang city, Central Java, Indonesia. This location was chosen because it is one of the potential local wisdom that is quite famous in the city of Semarang. The method used is a qualitative approach by reconstructing the uniqueness of both the building and its ornaments.to be scientifically transformed and transform the actual knowledge from the tour guide into scientific concepts, which are used as formal science taught in schools. The tour guide as our informant is two people and both have a tour guide license. Data collection techniques include primary data collection by means of observation and interviews as well as secondary data in the form of literature studies and documents both regarding chemistry learning materials and Lawang Sewu.

The research instruments we used in this research were in the form of field notes to record various important knowledge, video and audio recordings, and cellphone cameras to capture interesting and important objects. Observations were made by observing various parts of Lawang Sewu and the researcher also listened to the informant's explanation, namely the tour guide. When going around Lawang Sewu, we also actively asked if there were some interesting things that we didn't understand, and the informant gave us quite satisfactory answers. The research stage in this study is a literature study to find out the research from previous researchers, then observation in Lawang Sewu to find out its uniqueness and get some documentation, and the last is a wawancaara with a tour guide or informant.

There are 3 stages in science reconstruction (Sarini, P. & Selamet, K., 2019). The first stage is identification, in this stage the researcher visited Lawang Sewu. We observe every corner. The second stage is verification, in this stage we conduct an interview with a tour guide. The last stage is Formulation. In this stage, we integrate the original science in Lawang Sewu with scientific science.

Data collection and data analysis techniques can be seen from the following table:

Table 1

It	Research Data	Instrument	Data Collection Techniques	Data Analysis
1.	Identification	Documentation	Documentation, observation	Analysis of observation results
2.	Verification	Voice recordings, field notes	Interviews, observations	Analysis of interview results, observations
3.	Formulation	Notes on the results of the discussion	Expert discussion	Kategorikan

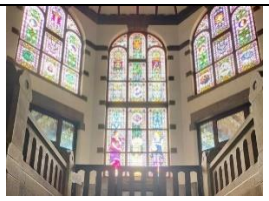
RESULTS AND DISCUSSION

The results of the research are the result of the reconstruction of the community's original science to scientific science in Lawang Sewu. The results are presented in three stages of research. Here are the results presented:

Identify the original science of society to scientific science

The identification stage that we carried out was in the form of identifying, documenting and observing several interesting angles of Lawang Sewu. The data are presented in Table 2.

Table 2

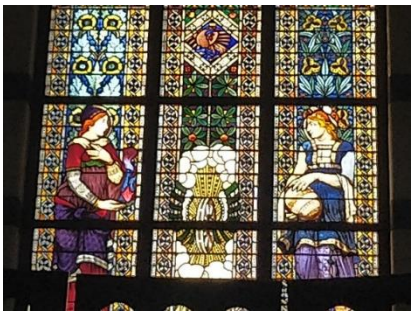
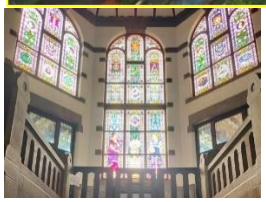
It	Picture	Information
1		Stained glass
2		Door in Lawang Sewu
3/		The bathroom is located in the back corner of each Building
4		Basement containing aqueducts
5		A fairly spacious ceiling is on the roof of Building B

Verification

In the verification stage, we conducted interviews and observations with tour guides who became informants. We verified the results of the data identification that we produced in the previous stage. Our tour guides are freelancers available in Lawang Sewu and already have a license. The data we produced at this stage is in the form of the disclosure of the community's original science about Lawang Sewu. We present the data in code which in the next stage we transform into scientific science table 3 as follows.

Table 3

It	Picture	Science native to society
A1		The ceiling on the roof is useful so that the walls of the wall do not get too hot
A2		If the door does not have water absorption, the building will dry out and crack
A3		The walls of Lawang Sewu feel a bit cold because the basement has water
A4		In the Lawang Sewu room there are 4 doors, 2 doors must not be opened because it is for air circulation.

A5		One of the paintings contained in stained glass is depicting the goddess Fortuna carrying fire and the goddess Venus carrying water, both of which are heated and produce steam which then becomes the icon of the steam train.
A6		The bathroom in Lawang Sewu is located at the back of each building so that the unpleasant smell from the bathroom does not spread to the room in the building
A7		Stained glass is not painted but is stained. One of the dyes in stained glass is made from tulips.
A8		When granite stones are touched, they stay cool even though the air around them is hot

Formulation

The formulation stage is the final stage in this study. This stage is in the form of reconstruction between science in society and scientific science. Before obtaining this data, the researcher first discussed with experts and the results of the discussion were developed into a validated textbook. Our data is presented in table 4 below.

Table 4

Code	Science native to society	Scientific science	Chemical Materials
A1	The ceiling on the roof is useful so that the walls of the wall do not get too hot	The heat energy from the sun moves through the tiles and then is absorbed by the ceiling. The ceiling is made of cement which has low thermal conductivity so that it can absorb heat. So that the heat energy has been absorbed in the ceiling making the walls of the building not too hot.	Law of Thermodynamics 1
A2	If the door does not have water absorption, the building will dry out and crack	One of the reasons for the building to crack is due to the temperature factor. The temperature in the city of Semarang is indeed quite hot so good humidity is needed to maintain temperature stability so that the building does not crack. The high temperature from the walls of Lawang Sewu flows to a lower water infiltration temperature, which is needed to maintain temperature stability so that the building is more durable.	Law of Thermodynamics 2
A3	The walls of Lawang Sewu feel a bit cold because the basement has water	There is a decrease in the temperature of the system (wall) so that the wall absorbs heat from the environment (room) or it can be called an endothermic reaction	Thermochemical Energy
A4	In the Lawang Sewu room there are 4	The Lawang Sewu room has an open system.	Thermochemical Energy

	doors, 2 doors must not be opened because it is for air circulation.	Where the heat (system) in the room (environment) can move out so that the room temperature is not too hot and other particles (wind) can enter the room.	
A5	One of the paintings contained in stained glass is depicting the goddess Fortuna carrying fire and the goddess Venus carrying water, both of which are heated and produce steam which then becomes the icon of the steam train.	The evaporation reaction that occurs from the water is then heated by fire and produces steam. The heat generated from the fire then causes a water compound to evaporate at its boiling point. There is energy produced by fire at a certain pressure to the boiling point, this causes a phase change from water to steam. The amount of energy produced by fire to evaporate water is called evaporation enthalpy.	Entalpi Termokimia
A6	The bathroom in Lawang Sewu is located at the back of each building so that the unpleasant smell from the bathroom does not spread to the room in the building	One of the odors caused by the bathroom is the smell of ammonia in the urine. The odor caused by the highly concentrated substance that ends up in the bathroom can then spread out of the room because the particles that cause the odor are lower in concentration because they collide with other particles. This is called diffusion, which is the transfer of a substance from high to low concentration. So the bathroom is placed in the back corner so that the diffusion process occurs	Diffusion

		so that the concentration of substances that make the odor is low and the smell is not smelled too sharply in the room.	
A7	Stained glass is not painted but is stained. One of the dyes in stained glass is made from tulips.	Tulip leaves contain flavonoids and tannins that can be chemical dyes for a compound	Elements and Compounds
A8	When granite stones are touched, they stay cool even though the air around them is hot	Granite from Germany does have high thermal conductivity so it easily absorbs heat. So that the stone feels dining, at hot temperatures	Temperature and Heat

Lawang Sewu has several buildings, including Buildings A, B, C, D, and E. One of the uniqueness of Building B is that it has a ceiling. The ceiling of Building B functions to absorb heat. The heat energy coming from the sun moves to the ceiling. This is in accordance with the law of thermodynamics 1 which states that energy can transfer or change shape but cannot be destroyed (Mailaff, 2023). There is also another uniqueness is an underground well or basement. This room contains rain catchment water that will flow into the river. In addition to being a drainage or water catchment area, this room also has a function to cool the room. The hot temperature that comes from the sun or the ceiling flows into the water/soil that has a lower temperature. It is written in the law of thermodynamics II that the temperature moves from high to lower temperature (Hamid, 2007).

One of the things that makes Lawang Sewu famous is its mystical story. It is said that the basement of Lawang Sewu during the Japan colonial era was used as a prison. People who are imprisoned when they are sentenced to be beheaded, their heads will be swept into the basement which will then be carried away by the water and towards the river. However, it is just a myth without any valid evidence. Its actual function is as drainage or water catchment. The walls around Lawang Sewu feel cold because there is a temperature transfer from water to wall. This reaction in chemistry we often call it endotherm. An endothermic reaction is when the system absorbs heat and there is a decrease in temperature (Karina, 2022) The walls become cold because they are hollow and absorb the water in the room. Another interesting thing about Lawang Sewu is stained glass. This stained glass is stained, in the coloring process using tulips because it contains flavonoid compounds (Nurrahmah et al., 2023). Flavonoid compounds can provide color (Deveoglu and Karadag, 2019). In addition to the unique material, there is a painting motif depicting a goddess carrying a jug filled with water and another goddess carrying fire. When these two elements are put together it will become

vapor. The evaporation reaction is one of the sub-chapters of matter in thermochemical enthalpy.

In a building, of course, the thing that is the attraction is the building material. There is a quite unique material in Lawang Sewu, namely black granite. The black granite stone in Building A will feel cool when touched, even though the surrounding temperature is quite hot. This happens because it has a high thermal conductivity (Fandom n.d) Thermal conductivity is the ability of an object to absorb heat. This concept will be studied in temperature and heat material.

Lawang Sewu is in Javanese which means a thousand doors. A thousand is just a metaphor in Javanese which means many. The door functions as air circulation. So this is the reason why Lawang Sewu feels cool in the middle of Semarang which is quite hot and without air conditioning because it has quite a lot of air circulation. This is related to an open system. Lawang Sewu gets heat from the sun however, it has air circulation. So it can be categorized in an open system. An open system is a system that allows the exchange of energy and particles (Karina, 2022). The sewu door allows the exchange of heat energy and particles such as air can enter the system.

Lawang Sewu was built during the Netherlands colonial period. The Netherlands people are known to be quite disciplined and neat. So that it also affects how they will make the building. One of them is the bathroom. The bathroom, according to the colonizers, is a dirty room and causes odors. Therefore, the bathroom in Lawang Sewu is placed in the back corner of each building, so that the other rooms are not too smelly. This can be scientifically explained as the process of diffusion. Diffusion is the transfer of substances with high concentrations to low concentrations (Kuntari, F.R., Pranoto, S. and Sutresno, A. 2019). Likewise in the bathroom, unpleasant odors and high concentrations are in the middle of the room so that they can collide with other particles so that when they arrive in the room the concentration becomes low.

Based on the data from science reconstruction, Lawang Sewu can be one of the sources of Chemistry learning. The reconstructed chemical material can be grouped into several classes that we present in the table 5.

Code	Chemical Materials	Class
A1 ,A2	TermRotamic	11
A3,A4,A5	Thermochemistry	11
A6	Ideal Gas Diffuse	11
A7	Elements and Compounds	10
A8	Temperature and Heat	11

The use of natural and cultural resources in the learning process allows teachers to use ethnoscience learning models, media, instruments, and teaching materials for materials that are appropriate to the surrounding context. This can help improve students' science literacy (Sumarni & Kadarwati, 2020). Students'

involvement with natural and cultural resources not only helps them understand the material better, but it also allows them to relate it to everyday life. As students' literacy and understanding of science concepts or principles increases, it has a positive impact on the way they think and live science in their daily lives.

CONCLUSION

Lawang sewu is a local wisdom in Semarang that is quite famous. In addition to storing the old history of this city, he also stored various knowledge in the field of Chemistry. Among them, thermochemistry, thermodynamics, and others that can be used as innovative sources of chemistry learning so that learning in the classroom is creative and not conventional or monotonous.

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AUTHOR CONTRIBUTIONS

Author one fully contributes to the preparation of scientific articles, authors two and three contribute when conducting research. Author four as a supervisor contributes to guiding and providing direction during research and preparation of scientific articles.

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