

## A Review of the Integration of a Socio Scientific Issues Approach Based on Local Wisdom in Chemistry Education (Context of Local Wisdom in East Java)

Ifah Silfianah\*, Hendar Dio Adyana, Tutik Sri Wahyuni

Islamic University State Sayyid Ali Rahmatullah, 46 Mayor Sujadi Street, Plosokandang, Tulungagung, 66221, Indonesia

\*Corresponding author: [ifah.silfianah@uinsatu.ac.id](mailto:ifah.silfianah@uinsatu.ac.id)

**Abstract:** In learning, the SSI approach involves utilising social science-related topics that engage students in dialogue, discussion, and debate. This SSI approach is pertinent to chemistry education, which connects to real-life situations. Local wisdom-based learning is understood as the process that draws from students' cultural and social environment and is linked to educational materials. This study aims to explore the topic of SSI through the lens of local wisdom in chemistry education. This study comprises a literature review employing a qualitative descriptive analysis method. The findings indicate that integrating SSI and local wisdom merges scientific understanding with the context of social issues pertinent to the environment and local culture. This approach emphasises mastery of scientific concepts regarding social issues and fosters an appreciation of the local wisdom surrounding them. In addition to enhancing critical thinking skills and scientific literacy through SSI, this approach's integration can also heighten awareness and concern for local wisdom. In the context of local wisdom in East Java, three topics may serve as references for promoting SSI-local wisdom in chemistry education, including issues related to sound water quality in Gamping village, a hub for the Tulungagung marble handicraft industry, Malang dairy farms that potentially contribute to greenhouse gas emissions, and culinary shellfish sourced from microplastic-polluted waters in Sidoarjo and Surabaya. These SSI-local wisdom topics in chemistry education can be further developed as contexts in learning resources or incorporated into various chemistry teaching models.

**Keywords:** Socioscientific Issues Approach Based on Local Wisdom, Chemistry Learning

### INTRODUCTION

The current 21st century is characterised by the rapid development of science, which has brought many changes to various aspects of life. One of these changes gave birth to the Sustainable Development Goals (SDGs) initiated by the United Nations in 2015. The SDGs carry a mission to improve the world through their 17 pillars (Paoli & Addeo, 2019). As one of the countries that endorsed the SDGs, Indonesia has taken various steps to realise this mission, mainly through education. Education is a crucial element in advancing the nation and serves

On the other hand, the quality of education in Indonesia is still relatively low, especially in the field of science. Based on the PISA study, through working on questions consisting of 2 categories, category 1 is called low-level thinking skills (LOTS), and category 2 is called high-level thinking skills (HOTS). Based on the PISA results, it is known that students in Indonesia are only able to work on questions in the LOTS category (Erman & Wakhidah, 2024). This shows that the critical thinking skills of students in Indonesia are still relatively low. Critical thinking itself is one of the essential skills in the 21st century, according to the Partnership for 21st Century Learning. In addition, Indonesian students also have low science literacy skills. This is evidenced by research conducted by PISA from 2000 to 2018; Indonesia is consistently ranked in the last 10 out of 77 participating countries (Yusmar & Fadilah, 2023). Science literacy itself is a key skill that is important for students' needs in the 21st century (Kirana et al., 2022). Factors contributing to this low science literacy are students' insufficient understanding of science and its relevance to their

everyday lives. Enhancing critical thinking skills and science literacy is interconnected in developing the competencies required today, ultimately aiming to achieve quality education.

In fostering an understanding of science and its relation to everyday life, there is an approach known as the Socioscientific Issues (SSI) approach. The SSI approach is essential to teach because it is relevant to students' lives and makes learning enjoyable and meaningful (Rohmaya, 2022). The SSI approach involves the deliberate use of social topics related to science that require students to engage in dialogue, discussion, and debate (Zeidler & Nichols, 2009). The SSI approach, in addition to learning science concepts, develops critical thinking and ethical decision-making skills. The SSI approach allows students to be active in learning. Students are invited to explore and analyse science-related social issues requiring scientific understanding and moral and social considerations. In addition, this approach also supports the development of broader science literacy skills. This includes the experience of basic science concepts and the ability to apply that knowledge in real life.

Many of the social issues used in the SSI approach are related to local wisdom in society. In science learning, there is a local wisdom-based approach, or it can also be called ethnoscience (Sumarni, 2018). For instance, in the context of local wisdom associated with the local potential that produces a product, waste is generated from the processing of that product. This waste has the potential to pollute the environment. From this perspective, it can be integrated into the SSI approach. In practice, the local wisdom-based SSI approach merges scientific understanding with the context of social issues linked to local wisdom and culture. This approach emphasises mastering scientific concepts while developing critical thinking skills, a sense of local wisdom, and social and environmental impacts. By connecting issues with the context of local wisdom, students are encouraged to be more concerned and directly involved in matters pertinent to their daily lives. Many of these issues are directly related to chemistry.

In this context, the local wisdom-based SSI approach, which was reviewed through chemistry learning, is a practical step. This cannot be separated from the fact that every aspect of life is closely related to chemistry. Understanding chemistry is a critical aspect of the 21st century. Essential thinking and science literacy skills that impact the quality of education can be improved through an approach that involves science issues based on local wisdom related to the lives of surrounding communities. Chemistry significantly enhances the quality of life in various sectors, such as food, health, energy, industry, and the environment.

In the study of chemistry education, numerous researchers have investigated the SSI approach, particularly regarding its impact on learning competencies, the creation of teaching materials and learning media that incorporate SSI, and its integration with various learning models such as PjBL (Project-Based Learning), PBL (Problem-Based Learning), discovery learning, inquiry models, and STEAM approaches (Science, Technology, Engineering, Art, and Mathematics). Additionally, research has been conducted on local wisdom-based learning, including the development of teaching materials and learning media rooted in local wisdom, the influence of local wisdom-based learning on learning competencies, and its integration with problem-based learning (PBL), project-based learning (PjBL), and inquiry models.

However, no article specifically examines the integration of the SSI approach based on local wisdom in chemistry learning. Therefore, the author will write an article to investigate the SSI approach more deeply based on local wisdom in chemistry learning. This article will examine the integration of the SSI approach based on local wisdom in chemistry learning and the topic of SSI based on local wisdom in chemistry learning in the context of local wisdom in East Java.

## METHOD

This article studies integrating the local wisdom-based SSI approach in chemistry learning. The research conducted is classified as a literature study. A literature study is research conducted by collecting data and information through various sources such as reference books, previous research results, articles, notes, and multiple journals relevant to the topic discussed (Sari, 2020). The literature study research in this article aims to analyse, combine, and interpret concepts from previous research related to the discussion in this article.

This literature study research uses a qualitative descriptive method that aims to describe and explain various existing activities, focusing on the characteristics, qualities, and relationships between these activities (Sukmadinata, 2013). This method uses data from writings, images, or events described in a narrative (Asmara, 2016). The data analysis technique used in this study is the content analysis method. This analysis aims to conclude by identifying specific characteristics in writing objectively, generally, and systematically (Ulfah et al., 2022). In this analysis, the process of comparing and combining various explanations is carried out to obtain relevant conclusions.

## RESULTS AND DISCUSSION

### Socioscientific Issues Approach in Learning Chemistry

Socioscientific issues (SSI) is one of the approaches that can be incorporated into learning science such as chemistry. The SSI approach uses social topics related to science to trigger students into dialogue, discussion, and debate related to these topics (Zeidler & Nichols, 2009). SSI emerged from a reflection on the role of science, which, in practice, can bring both positive and negative impacts. The existence of these two opposing sides can stimulate in-depth discussions and debates that enable students to explore various perspectives and develop their abilities.

Many of the SSI approaches that start from social issues are related to chemistry. Chemistry itself is the study of matter and its changes (Chang, 2003). Matter in chemistry includes everything that has mass and occupies space, so everything in this universe is matter. This is what makes the SSI approach very relevant to be applied in learning chemistry. The SSI approach integrates complex and contemporary social issues into chemistry learning. For example, pollution, health, environment, and natural resources directly relate to chemistry. By using this approach, students not only learn chemistry concepts but also learn to understand how to connect chemistry concepts with social problems related to science so that they can find solutions. The SSI approach has 9 dimensions: ethical, environmental, social, religious, health, economic, science, technology, and political (Wiyarsi & Çalik, 2019).

In chemistry learning, the SSI approach acts as a context or bridge to connect chemistry with the surrounding life through social issues. Social issues sourced from daily life and media such as news, articles, and so on can be used as the basis of SSI. This approach can be included in context-based chemistry learning. Because chemistry is closely related to life, the learning process must start from the surrounding environment so that students are familiar with the context being studied (Aini & Wiyarsi, 2021). This approach can also be included in teaching materials (Sofiana & Wibowo, 2019), learning media (Jacinda et al., 2024), integrated in learning models (Azizah et al., 2021), and included in assessment instruments (Suparman et al., 2022). By integrating SSI into various aspects of chemistry learning, students can more easily relate chemistry concepts to social issues around them. This not only improves their understanding of chemistry but also develops critical thinking skills and social awareness. This approach also encourages students to be more active and involved in the learning process, increasing their sense of responsibility for social and environmental issues.

In addition, according to previous research, the SSI approach can improve students' critical thinking (Sirmayeni, 2023) and science literacy skills (Purwandari et al., 2024; Hanifha et al., 2023; Saija et al., 2022). Learning through SSI can train students abilities to provide opinions on the issues presented and use scientific methods to solve problems (Talens, 2016).

### **Chemistry Learning Based on Local Wisdom**

Local wisdom is knowledge that arises from experience and develops with the community and its environment in a local system experienced collectively. Local wisdom can also be called environmental wisdom, which is obtained from the abstraction of active adaptation experiences to a unique environment (Sudarmin, 2014). In the context of learning, local wisdom is integrated into learning carefully to be well connected. Local wisdom-based learning is understood as learning that comes from students' social and cultural environment by connecting learning materials with the surrounding life (Suastra, 2010). This local wisdom has 6 dimensions, namely the dimensions of local knowledge, local resources, local skills, local values, local decision-making mechanisms, and local group solidarity (Sedyawati, 2007).

Local wisdom-based learning in chemistry, also known as ethnoscience or ethnochemistry, integrates local wisdom and the social and cultural environment linked to chemical concepts. Local wisdom in chemistry learning can be an approach that makes learning more contextual and relevant to the student's environment (Violeta et al., 2018). Through local wisdom-based chemistry learning, students can more easily understand and relate the subject to their daily lives, thereby enhancing engagement and comprehension of the material being studied. Furthermore, this approach also fosters students' appreciation for and preservation of local wisdom, highlighting the significance of chemistry within the local context. Examples of local wisdom in chemistry education include the process of making batik, the culture of menginang, and the preparation of various traditional foods, such as takwa tofu and ampo.

Based on previous studies, many have used this local wisdom-based learning, especially in chemistry learning. Chemistry learning based on local wisdom has been included in modules (Riza et al., 2020) and educational comic learning media (Pelawati Agustina, 2021) teaching materials and integrated into learning models (Sanova et al., 2021). From these studies, it can be seen that chemistry learning based on local wisdom not only improves students' understanding of chemical concepts but also enriches their learning experience by linking chemistry and local contexts. Implementing this approach can encourage students to be more active in learning and foster a sense of love and concern for the environment and local culture.

### **Integration of Socioscientific Issues Approach Based on Local Wisdom in Chemistry Learning**

In learning, many have integrated models or approaches with other approaches. Based on the explanation discussed earlier, Socioscientific Issues (SSI) uses science-related social issues. Many of these social issues are related to local wisdom. SSI is used to develop knowledge, improve critical thinking skills, strengthen problem-solving skills, and even develop innovations in the context of local wisdom. The ability to think critically, solve problems, and be creative will be formed better if there is a close relationship between science concepts such as chemistry and social and cultural issues related to local wisdom (Erman & Wakhidah, 2024). Because of this aspect, SSI can be integrated with local wisdom. Local wisdom is used as the basis for raising issues or social problems discussed through SSI. Conceptually, the principle of connecting SSI with local wisdom is using

the IDEA principle (Erman & Wakhidah, 2024). The following table is related to the IDEA principle in learning.

**Table 1.** Linking Chemistry Aspects of SSI-Local Wisdom

Sosioscientific Issues (SSI)	Linking to Chemistry Aspects	Local Wisdom
Identify concepts, principles, and theories related to SSI	Identify	Identify concepts, principles, and theories related to local wisdom
Define concepts, principles, and theories related to SSI	Define	Define concepts, principles, and theories related to local wisdom
Describe concepts, principles, and theories related to SSI	Describe	Describe concepts, principles, and theories related to local wisdom
Explain concepts, principles, and theories related to SSI	Explain	Explain concepts, principles, and theories related to local wisdom
Apply concepts, principles, and theories related to SSI	Apply	Apply concepts, principles, and theories related to local wisdom

The IDEA principles are essential to help students learn through SSI and local wisdom. The identify stage aims to recognise all aspects of chemistry as a whole and aspects of chemistry related to the context of SSI and local wisdom. Then, learning resources are needed to identify these aspects of chemistry, as well as the existence of SSI contexts and local wisdom that students recognise. The define stage and describe stage are carried out using other learning resources that allow students to understand these aspects of chemistry. Meaningful knowledge construction will occur when students relate these chemical aspects in the context of SSI-local wisdom. At the explained stage, the chemical knowledge that has been constructed will be used to describe the context of SSI-local wisdom. Finally, at the apply stage, problem-solving in the context of local wisdom through SSI, including developing innovations in the context of SSI-local wisdom through chemical aspects.

### **Topic Socioscientific Issues Approach Based on Local Wisdom in Chemistry Learning (East Java Local Wisdom Context)**

In this article, the author also collects several topics that can be used as contexts in SSI-local wisdom integrated chemistry learning, but they are limited to local wisdom in East Java. The topics reviewed in this article include the quality of shallow well groundwater in Gamping Village, which is the Tulungagung Marble Handicraft Industry Centre Village, Dairy farming in Malang Regency, which has the potential to contribute to greenhouse gas emissions, and culinary Kupang shells from microplastic-polluted waters in Sidoarjo and Surabaya. These topics were analysed by collecting local wisdom connected with social science issues from various sources, such as news websites, scientific articles, and previous research. Example of ssi-local wisdom text in chemistry learning are given the followings.

### **Groundwater Quality of Shallow Wells in Gamping Village, Tulungagung Regency (Tulungagung Marble Handicraft Industry Centre Village)**

Gamping Village, located in the Campurdarat sub-district of Tulungagung Regency, is the center of Tulungagung's marble craft industry. Marble craft has become a potential and is included in the local wisdom of Tulungagung. This area which is in direct contact with the marble industry, has risks to the quality of its groundwater. In rural communities, many people utilize groundwater wells in their daily lives, ranging from washing, and bathing, to drinking water needs. However, based on research conducted by (Yuliani & Pradana, 2019), shows that groundwater in Gamping Village has risk factors for health and is dominated by the content of bicarbonate anions and calcium cations.

#### *Questions for arguments to SSI-local wisdom*

The quality of groundwater from shallow wells in Gamping Village contains bicarbonate anions and calcium cations, which are potentially harmful to health: in your opinion, is it appropriate to prohibit the use of groundwater from shallow wells in Gamping Village for drinking even if it is cooked first?

### **Dairy Cattle Farming Potentially a Contributor to Greenhouse Gas Emissions**

Malang Regency is one of the most populous dairy cattle farming centers in East Java. The dairy cattle population in Malang Regency continues to grow every year. By 2023, the dairy cattle population in Malang District will reach more than 90,000 heads. Dairy cattle farming is considered to contribute to the improvement of the community's economy.

Cattle (cows) are ruminants that release methane, nitrous oxide, and carbon dioxide through belching and farting during digestion. These gases can cause greenhouse emissions. Based on research conducted by (Rochman & Humaidah, 2023), the total greenhouse gas emissions generated from the dairy farming sector in Pujon District, Malang Regency continue to increase every year, which can hurt the climate and environment directly or indirectly. The increasing greenhouse gas emissions are directly proportional to the number of dairy cattle population which also increases every year.

#### *Questions for arguments to SSI-local wisdom*

Cattle (cows) contribute greenhouse gas emissions through their digestive processes in the form of belching and farting. As the cattle population grows, so do the greenhouse gases produced. Growing greenhouse gas emissions can adversely affect the climate and environment: In your opinion, should the government make regulations that reduce the dairy cattle population to reduce greenhouse gas emissions that affect the environment, while the community's economic sector may be affected by this regulation, or are there other ways to reduce greenhouse gas emissions generated from the dairy farming sector?

### **Kupang Mussels: Sidoarjo-Surabaya Favorite Culinary from the Sea Polluted by Microplastics**

Kupang is a small mussel that can also be called a white mussel. Kupang mussels are commonly found in the waters of East Java, especially in Sidoarjo and Surabaya. Kupang is one of East Java's favourite culinary, usually served with lontong, also known as kupang lontong. In addition, there are several processed foods made from kupang such as kupang crackers, kupang meatballs, and petis kupang. These types of mussels are known to have a high nutritional content.

However, based on its habitat, kupang in East Java lives in polluted waters. Waters in East Java are indicated to be polluted with microplastics and heavy metals. Even the microplastic content is included in its biota as research conducted by (Husna, 2022) that analyzed the microplastic content in Kupang mussels in Sidoarjo waters. The microplastic content found in shellfish is polymers such as Nylon, LDPE, Polyamide, Polystyrene, Polycarbonate, PMMA, and Kaolin filler. Mussels that have been contaminated with microplastics are considered very dangerous if consumed and can cause health problems.

### *Questions for arguments to SSI-local wisdom*

The Kupang mussel is an animal that lives in the waters of East Java, especially Sidoarjo and Surabaya. Kupang is known for its rich nutritional content. However, if traced from its habitat, kupang has a habitat that is polluted by microplastics in the waters of Sidoarjo and Surabaya: In your opinion, is it right to ban the consumption of kupang from the waters of Sidoarjo and Surabaya?

**Table 2.** Analysis of SSI-Local Wisdom Topics in Chemistry Learning (East Java Local Wisdom Context)

SSI-Local Wisdom Dimensions	Chemistry Materials	IDEA Principle
<b>Text 1.1</b> - SSI Dimensions: health, environment - Local Wisdom Dimensions: local resources, local knowledge	<ul style="list-style-type: none"> <li>Alkali and Alkaline Earth of Metal</li> <li>Acid base</li> </ul>	<ul style="list-style-type: none"> <li>Identify</li> <li>Define</li> <li>Describe</li> <li>Explain</li> </ul>
<b>Text 1.2</b> - SSI Dimensions: health, environment, social, economic - Local Wisdom Dimensions: local resources, local decision-making mechanisms	<ul style="list-style-type: none"> <li>Hydrocarbons</li> <li>Thermochemistry</li> </ul>	<ul style="list-style-type: none"> <li>Identify</li> <li>Define</li> <li>Describe</li> <li>Explain</li> <li>Apply</li> </ul>
<b>Text 1.3</b> - SSI Dimensions: health, environment, economy - Local Wisdom Dimensions: local resources, local decision-making mechanisms	<ul style="list-style-type: none"> <li>Macromolecules and Polymers</li> </ul>	<ul style="list-style-type: none"> <li>Identify</li> <li>Define</li> <li>Explain</li> <li>Apply</li> </ul>

The SSI-local wisdom topics can be used as a context in chemistry learning. The educational context of SSI-local wisdom topics can be developed through learning resources such as textbooks, modules, booklets, LKPD, and other similar materials. Furthermore, SSI-local wisdom topics can also be integrated into various chemistry learning models, including discovery learning, problem-based learning (PBL), project-based learning (PjBL), and numerous other chemistry teaching methodologies.

## CONCLUSIONS

The SSI approach employs social topics related to science in education. Integrating SSI with local wisdom combines scientific understanding with the context of social issues connected to local traditions. This integration not only aims at mastering scientific concepts concerning social issues but also at comprehending the local wisdom surrounding them. The incorporation of SSI with local wisdom is particularly suitable for teaching chemistry related to various aspects of life. In the context of local wisdom in East Java, three topics can serve as a basis for introducing SSI-local wisdom in chemistry education. These include issues related to the quality of well water in Gamping Village, the Tulungagung Marble Handicraft Industry Centre, Malang Dairy Farms, which have the potential to contribute to greenhouse gas emissions, and the culinary use of Kupang shells, which are sourced from microplastic-polluted waters in Sidoarjo and Surabaya.

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