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Ethnochemistry: Exploring the Potential of *Sasak* and *Java Local* Wisdom as a Teaching Materials

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ABSTRAK

Kurang tersedianya sumber belajar dalam bentuk bahan ajar menjadi salah satu permasalahan yang ditemukan dalam pembelajaran kimia, baik di sekolah menengah maupun di perguruan tinggi sehingga sangat urgen dikembangkannya bahan ajar kimia yang bersifat kontekstual sebagai implementasi pendekatan etnokimia dalam pembelajaran. Tujuan penelitian ini adalah untuk mengeksplorasi dan mengembangkan bahan ajar kimia sebagai sumber belajar dengan menggali potensi kearifan lokal Sasak dan Jawa. Pendekatan penelitian ini menggunakan pendekatan kualitatif dengan teknik pengumpulan data melalui studi pustaka, wawancara, dan dokumentasi. Data yang diperoleh dianalisis menggunakan analisis kualitatif Miles & Huberman. Subjek penelitian terdiri dari tokoh masyarakat, ahli konten kimia, dan literatur kimia yang relevan dengan kajian penelitian. Berdasarkan temuan penelitian dapat disimpulkan bahwa kearifan lokal Sasak dan Jawa dapat dijadikan sebagai sumber belajar kimia melalui pengintegrasian kearifan lokal Sasak dan Jawa dengan materi ikatan kimia serta perubahan unsur, senyawa, dan campuran. Dengan demikian, implikasi dari penelitian ini dapat menjadi sumber rujukan dalam mengembangkan bahan ajar kimia yang bersifat kontekstual sehingga menjadikan pembelajaran menjadi lebih bermakna.

ABSTRACT

The lack of availability of learning resources in the form of teaching materials is one of the problems found in chemistry learning, both in secondary schools and in tertiary institutions, so it is very urgent to develop contextual chemistry teaching materials as an implementation of the ethnochemical approach in learning. The purpose of this study was to explore and develop chemistry teaching materials as learning resources by exploring the potential of local Sasak and Javanese wisdom. This research approach uses a qualitative approach with data collection techniques through literature, interviews, and documentation. The data obtained were analyzed using Miles & Huberman's qualitative analysis. The research subjects consisted of community leaders, chemical content experts, and chemical literature relevant to the research study. Based on the research findings, it can be concluded that Sasak and Javanese local wisdom can be used as a source of chemistry learning through integrating Sasak and Javanese local wisdom with chemical bonding materials and changes in elements, compounds, and mixtures. Thus, the implications of this research can be a source of reference in developing contextual chemistry teaching materials so as to make learning more meaningful.

1. INTRODUCTION

Chemistry learning characteristics include three main aspects: macro, micro, and symbolic. Therefore, chemistry lecturers or teachers have to introduce students to those characteristics through a constructivism-based learning approach. One implementation of a constructivism-based learning approach is through the development of chemistry teaching materials relevant to students' daily lives to create an exciting learning experience (Khan et al., 2017; Wahyudiati et al., 2020). The advantages of constructivism-based teaching materials are students could involve actively in constructing knowledge and learning experiences both physically and mentally as a means of acquiring new knowledge, skills, and experiences (Fadli, 2019; Hasanah et al., 2016; Said-Ador, 2017; Sumardi et al., 2020; Wahi et al., 2019). The sensory

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experiences that stimulate students' knowledge, skills, experiences, and scientific thinking processes must be supported by the availability of constructivism-based chemistry learning resources to achieve positive learning outcomes (Raikou et al., 2017; Wahyudiati & Fitriani, 2021).

The unavailability of constructivism-based chemistry learning resources is one of the problems in chemistry learning. The development of chemistry learning resources causes this problem since it focuses on abstract concepts by providing examples that tend to be theoretical and result in monotonous materials, less factual, and difficult for students to understand (Collins et al., 2018; Sutrisno et al., 2020; Wahyudiati, 2016). To overcome these problems, presenting factual and contextual material through the availability of learning resources in the form of teaching materials and learning media relevant to students' daily lives could be the answer since it is also an ethnochemistry implementation approach in learning. The implementation of ethnochemistry in learning can be through associating chemical concepts related to the local wisdom value and the chemistry practices in everyday life (Dudung, 2020; Heliawati et al., 2022; Wahyudiati, 2022).

Ethnochemistry is a variety of chemically related cultural practices or community traditions that describe chemistry practice as the study of chemical concepts, practices, or ideas in any culture (Abramova & Greer, 2013; Rahmawati et al., 2017). Various ethnochemistry studies employing cultural products as learning resources increased students' conceptual understanding and trained critical thinking skills and had a positive effect on students' scientific attitude skills and human rights (Fadli, 2020; Sumardi & Wahyudiati, 2021). Therefore, the implementation of ethnochemistry using cultural products as learning resources and natural laboratories is highly suggested.

Conducting this particular research by integrating ethnochemistry learning is one of the best solutions to chemistry learning problems. Various studies showed the integration of ethnochemistry in the curriculum makes the learning process based on cultural heritage context the substance of understanding concepts and scientific investigations based on natural laboratories grounded on local wisdom values (Ajayi et al., 2017; Druker-Ibáñez & Cáceres-Jensen, 2022; Rahmawati & Ridwan, 2017). The novelty of this study was to explore the values of the *Sasak* and *Javanese* local wisdom relevant to the chemistry concept so it can be a learning resource and a natural laboratory. Hence, it is expected not only to develop students' cognitive aspects but also to develop affective and psychomotor aspects that are important to the demands of 21st-century learning.

2. METHOD

This ethnographic study adopted a qualitative approach. The research subjects involved were community leaders, chemistry content experts, and relevant chemistry literature. The research stages consisted of three stages: description, analysis, and interpretation. The description stage was employed to explore the background of the problem through initial observations and interviews involving community leaders and content experts to obtain information related to the research object. Next, the analysis stage was performed to collect data based on the problem formulation and research objectives through analysis of research findings in the form of *Sasak* and *Javanese* local wisdom cultural products and values relevant to the subject of chemical bonds and changes in elements, compounds, and mixtures. The last stage was the interpretation stage; it was conducted to get precise conclusions based on the data analysis.

Data collection techniques utilized were observation, interviews, and documentation based on the data type. Meanwhile, the research instruments used were interview guidelines, observation guidelines, and documentation guidelines. The collected data were analyzed using Spradley's technique which consisted of four analysis steps, namely; (1) domain analysis; (2) taxonomic analysis; (3) componential analysis; and (4) cultural themes analysis. Domain analysis and taxonomic analysis functions were to select and simplify the recorded rough data in observation sheets, interviews, and documentation and discard unnecessary or irrelevant data. After the data were reduced and analyzed, the next step was compiling the data to be more systematic and then looking at its relevance to theories or previous research results (componential analysis and cultural themes). The final stage was concluding the results and findings that answer the research problem formulation.

3. RESULT AND DISCUSSION

Result

The local wisdom of the *Sasak* and *Javanese* tribes in the *merariq* or *manten* (wedding) tradition has relevance to the concept of chemical bonds, the concept of stable electron configuration, and the concept of positive ions (releasing electrons) and negative ions (accepting electrons). The concept of material change and its transformation in *Sasak* and *Javanese* local wisdom is reflected in the use of chemical

elements from various metals, such as gold, silver, bronze, copper, brass, and different other metals used in the making of the traditional ceremony tools and arts of the *Sasak* and *Javanese* tribes.

1. Sorong Serah and Srah-srahan in the Merariq or Manten (Marriage) tradition

Based on the traditional marriage procession (*merariq*) of the *Sasak* or *Javanese mantenan*, it is closely related to electron stability or a stable electron configuration. Also, the concept of positive ions (releasing electrons) and negative ions (receiving electrons) is similar to the tradition of *nenarih* and *sorong serah*, known as *srah-srahan* in the *Javanese* tribe. The similarities underlie the theory, concept, meaning, and value. For instance, at the *sorong serah* or *srah-srahan* procession, an agreement is made between a woman and a man to get married, either asked by the man or through *Subandar* or *Jerumannya*. The basic concept is mutual need, giving, and acceptance to live together, with a relationship that binds it or through marriage. At the procession, the bride and groom's family meet to determine the *pisuka* (*seserahan*) agreement to be given to the bride, as shown in Figures 1, and Figures 2.

Figure 1. The Prosession of *Sorong Serah* in the *Merariq* Tradition *(Sasak)*

Figure 2. The Procession of *srah-Srahan* in the *Manten* Tradition *(Javanese)*

(Source: https://jejakmedan.com/adat-istiadat-suku-jawa)

The tendency of an atom to achieve stability is to have a noble gas configuration (stable), either by accepting or donating electrons in its outer shell so that positive ions and negative ions are formed by transferring electrons from one atom to another. For example, the unstable Sodium atom loses one valence electron to become an ion (Na^+) with an electron configuration like neon; The $_{11}Na$ (2. 8. 1) atom (2. 8.1) → Ion $_{11}Na^+$ (2. 8), while the unstable Cl atom gains one electron, resulting in a Cl^- ion with an electron configuration similar to argon. Atom $_{17}Cl$ (2. 8. 7) → Ion $_{17}Cl^-$(2. 8. 8). These two ions with opposite charges attract each other electrostatically in the ion lattice. The bond formation that occurs through the transfer of electron pairs between Na and Cl atoms is called an ionic bond. This concept is closely related to the *merariq or manten* because they are also based on mutual need and complementarity to achieve a goal that unites two individuals and unites two families in a strong bond.

2. Banjar Tradition

The term *banjar* in the *Sasak* language dictionary means a village council. The term banjar is also defined as a customary group or association of indigenous people whose members consist of residents in a village (*dasan*) or come from several *dasan*, whose membership is based on and has the same goal. *Krama banjar* works more in the *banjar* related to the people's living activities and death procession. *The types include krama banjar subak, krama banjar merariq, krama banjar mate, and krama banjar haji.*

Banjar is a social forum used in various traditional ceremonies of community activities that have the characteristics of togetherness and build social solidarity. Specifically, the problems faced by a member of a *banjar* become the problem for all members of the banjar. *Banjar* activities in the *Sasak* community are focused more on activities involving the life cycle as an alliance of social solidarity and togetherness in the *Besiru* event, as shown in Figure 3.

Figure 3. Banjar Tradition of *Sasak* Tribe

The concept of local wisdom in the *banjar* tradition is the concept of social solidarity and togetherness, which is closely related to Gilbert Lewis' theory that atoms combine to achieve a more stable electron configuration. Maximum stability is achieved when the atom has the same electron configuration (isoelectronic) as the noble gas electron configuration. So, the theory that underlies the formation of a stable electron configuration by handing over electron pairs to achieve stability has a strong meaning in social concepts such as cooperation, mutual need, promoting unity, and social solidarity to achieve the desired goals.

3. The material Concept and its Changes Integrated with *Sasak* and Javanese Local Wisdom

The concept of material and its changes integrated with local *Sasak* and *Javanese* wisdom is reflected in the use of chemical elements from various types of metals such as gold, silver, bronze, copper, brass, and various other metals for the manufacture of traditional ceremonial tools and traditional arts. For example, *Sasak* and *Javanese* brides' jewelry is made of gold, silver, and bronze. Compounds and mixtures are widely used in the *Sasak* and *Javanese* people's life; traditional art manufacturing tools such as *gong*, *terumpang*, *kenceng*, and *Javanese gamelan* are made from a combination of two or more metals. The examples of physical changes found in *Sasak* and *Javanese* local wisdom include the coloring of *Sesek* cloth, dyeing *batik* cloth, making *sia* or salt, and the tradition of *belulut* (floor coating of a traditional *Sasak* house with cow dung). Examples of chemical changes are also found in the manufacture of *gule beaq*, *poteng reket* (fermented sticky rice), *poteng ambon* (fermented cassava), *oncom, peuyeum,* and *Sesek* and *batik* fabrics coloring.

Figure 4. *Batik* and *Sesek* Fabrics Coloring with Natural Coloring
(Source: Krjogja.com and Mongabay environment news site)

Discussion

Integrating Basic Chemistry 1 material with *Sasak* and *Javanese* local wisdom as a learning resource can be prepared by implementing a visualization approach called the chemical triangle concept. Implementation of a visualization approach in chemistry learning through integrating the subject matter and its changes with *Sasak* and *Javanese* local wisdom can be found in the use of chemical elements from various types of metals such as gold, silver, bronze, and copper as the basic ingredients for making traditional ceremonial tools and arts traditional *Sasak* and *Javanese* tribes. The current research findings

align with the previous research, which proved that *Sasak* and *Javanese* local wisdom has the potential to be integrated with chemistry materials (Aminudin et al., 2019; Ida Ayu & Ni Made, 2019; Sutrisno et al., 2020; Wahyudiati & Fitriani, 2021). The advantage of the integration is that the learning experience could be more significant and increase students' motivation to learn because it is related to their everyday life experiences. Learning activities that refer to the context of students' lives are the implementation of constructivism learning theory which combines students' initial experiences with new knowledge. Various previous research also showed that students' constructs of knowledge, attitudes, skills, and new experiences would be more significant when associated with prior knowledge in order to increase students' cognitive, affective, and psychomotor abilities (Fadli, 2020; Galloway et al., 2016; Gupte et al., 2021; Sumardi et al., 2020).

Another interesting finding also revealed that the relevance of chemistry material to *Sasak* and *Javanese* local wisdom could be viewed from an analogous approach between domains. An analogy approach is an approach that is based on a close relationship between two different concepts but has a relevant meaning (Aligica & Tarko, 2012; Soetanto & Jack, 2016). The application of an analogous approach between domains in chemistry learning can be seen through integrating everyday life situations experienced by students, which are closely related to the chemistry concept (Rahmawati, 2018; Sutrisno et al., 2020; Wahyudiati & Fitriani, 2021). It can be found in the chemical bonds concept. The *Sasak* and *Javanese* cultures that have similarities to chemical bonding materials are the *merariq* (*Sasak* wedding) and *manten* (*Javanese* wedding) traditions, which consist of the *nenarih* and *sorong serah* processes to the *Sasak* tribe and the *srah-srahan* procession to the *Javanese* tribe. The values of local wisdom that underlie the concept of *merariq* or *manten* are based on mutual needs between men and women who are legalized through marriage bonds to achieve stability which has the same meaning as chemical bonds. The concept of needing each other through the transfer of electron pairs to achieve stability is the concept that underlies the formation of chemical bonds. The formation of ionic bonds through the transfer of electron pairs between positive and negative ions is to achieve a stable electron configuration or resemble the electron configuration of noble gases (Miao et al., 2015). Approaching chemistry learning using analogy has the advantage that it stimulates learning and is significant for students who become more motivated to be involved actively in the learning process. Likewise, other research results proved that implementing an analogous approach to chemistry learning can improve the outcomes (Sutrisno et al., 2020; Xue et al., 2022). In addition, ethnochemistry-based learning makes students more interested in learning chemical concepts since it used to be less exciting and dominated by abstract concepts.

The novelty of the current research is that implementing the ethnochemistry approach is infrequently done. Moreover, combining *Sasak* and *Javanese* local wisdom with chemistry concepts has never been conducted, so the findings of this study are expected to contribute to chemistry learning innovation. In addition, these results are similar to previous related research, that learning chemistry through the provision of concrete examples often experienced in students' daily lives transformed learning to be more fun, engaging, and meaningful. Moreover, they become more motivated to learn and increase their representational abilities in chemistry learning in universities (Osman & Lee, 2014; Santos & Arroio, 2016; Wahyudiati, 2016). In addition, chemistry learning resources integrated with *Sasak* local wisdom significantly affect scientific attitudes and student cognitive achievements (Hikmawati et al., 2021; Wahyudiati et al., 2020). In the end, the implementation of ethnochemistry in learning, either in the form of integration with learning models, as a resource of learning for scientific investigations, or as a natural laboratory, could develop students' critical thinking skills, science process skills, and improve students' cognitive learning outcomes (Said-Ador, 2017; Wahyudiati et al., 2020; Wahyudiati & Fitriani, 2021; Zidny et al., 2020). Thus, exploring the potential of *Sasak* and *Javanese* local wisdom as a resource for learning chemistry can be one of the innovations in chemistry learning and play a role in younger generations appreciating more of their cultures.

4. CONCLUSION

Based on the research findings, it can be concluded that *Sasak* and *Javanese* local wisdom can be used as a resource for learning chemistry by integrating *Sasak* and *Javanese* local wisdom on the subject of chemical bonds and the subject of changes in elements, compounds, and mixtures. The relevance of Basic Chemistry 1 material with *Sasak* and *Javanese* local wisdom was analyzed based on the perspective of analogy, representation, and visualization. All in all, the implications of this research can be a reference in developing contextual chemistry teaching materials to create a more significant learning experience.

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