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Study of the Ethnoscience Learning Approach About the Keris Yogyakarta for Chemistry Learning in High School

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Abstract

This research aims to determine chemistry teachers' perceptions of ethnoscience-based learning approaches and the characteristics of the Keris Yogyakarta, as well as to examine its potential for high school chemistry education. This qualitative study involves ten high school chemistry teachers in Yogyakarta. Data collection techniques included questionnaires, interviews, and analysis of the high school chemistry curriculum. The research instruments used were survey sheets and interview guidelines. The data were analyzed using qualitative methods of Miles and Huberman. The results show that chemistry teachers have a positive perception of the ethnoscience approach. The Keris can serve as a thematic element to introduce Yogyakarta culture in chemistry learning. Relevant chemical topics include elemental chemistry and redox reactions. The chemical elements or compounds involved in making the Keris include iron, steel, nickel, arsenic, citric acid, and ascorbic acid. Ethnoscience learning about the Keris provides students with knowledge about applying chemical concepts in its manufacture, integrating local knowledge and culture, and helping students understand chemical concepts more easily and engagingly. Additionally, ethnoscience learning about the Keris can increase students' appreciation and concern for Indonesia's cultural heritage.

Keywords: chemistry learning; ethnoscience; keris

Abstrak

Penelitian ini bertujuan untuk mengetahui persepsi guru kimia terhadap pendekatan pembelajaran berbasis etnosains dan karakteristik Keris Yogyakarta, serta mengkaji potensinya dalam pendidikan kimia SMA. Penelitian kualitatif ini melibatkan sepuluh guru kimia SMA di Yogyakarta. Teknik pengumpulan data meliputi angket, wawancara, dan analisis kurikulum kimia SMA. Instrumen penelitian yang digunakan adalah lembar survei dan pedoman wawancara. Data dianalisis dengan menggunakan metode kualitatif Miles dan Huberman. Hasilnya menunjukkan bahwa guru kimia mempunyai persepsi positif terhadap pendekatan etnosains. Keris dapat dijadikan sebagai unsur tematik untuk memperkenalkan budaya Yogyakarta dalam pembelajaran kimia. Topik kimia yang relevan meliputi kimia unsur dan reaksi redoks. Unsur atau senyawa kimia yang terlibat dalam pembuatan Keris antara lain besi, baja, nikel, arsenik, asam sitrat, dan asam askorbat. Pembelajaran etnosains tentang Keris membekali siswa dengan pengetahuan tentang penerapan konsep kimia dalam pembuatannya, mengintegrasikan pengetahuan dan budaya lokal, serta membantu siswa memahami konsep kimia dengan lebih mudah dan menarik. Selain itu, pembelajaran etnosains tentang Keris dapat meningkatkan apresiasi dan kepedulian siswa terhadap warisan budaya Indonesia.

Keywords: etnosians; keris; pembelajaran kimia

Introduction

The increasingly rapid development of science and technology in the 21st century has caused the erosion of cultural values and local wisdom (Puspasari et al., 2019). This phenomenon is due to the younger generation now being more familiar with foreign culture than their own (Asna et al., 2024). It is crucial to maintain and instill local culture in students, the future generation of the nation. Culture encompasses the values, social norms, language, religion, arts, and customs held by specific groups. These cultural characteristics, including values, attitudes, and knowledge, are essential in developing student character (Andayani et al., 2021). Education serves as a platform to shape and develop students' character, producing an intellectual future generation (Novarlia, 2023). One way to maintain local culture among students is by integrating local wisdom into the learning process. A learning approach that links regional culture, national character, and local customs with scientific knowledge is called ethnoscience learning (Sudarmin & Pujiastuti, 2015)

Ethnoscience is a branch of cultural studies that seeks to understand how people comprehend culture or nature. Ethnoscience-based learning involves creating a learning environment and designing experiences that integrate culture into the school curriculum (Wahyu, 2017). This approach is vital in the independent curriculum, enabling students to master high-level concepts about the social and natural world (Lightner et al., 2021). Ethnoscience-based learning introduces students to the potential of a region's local culture, making them more familiar with it and encouraging participation in preserving its sustainability (Rikizaputra et al., 2022). Cultural integration in learning positively impacts students' academics performance, improving cognitive learning outcomes and scientific communication skills (Asih et al., 2018; Yasir et al., 2020). Research by Rikizaputra et al. (2021) indicates that many teachers have not yet integrated local culture into the science learning process.

Chemistry is a branch of science that studies the composition, properties, changes, and energy involved in substances. Students often find chemistry challenging due to its complex, abstract, and hazardous nature (Sutrisno et al., 2020). However, chemistry is essential for understanding phenomena in the surrounding environment. Applying ethnoscience-based chemistry learning can provide students with new experiences by integrating chemical concepts with local culture (Rahmawati et al., 2017). This approach can also explain cultural knowledge from a scientific perspective (Dorsah & Okyer, 2020), making the material more contextual and easier for students to understand. Nevertheless, research shows that cultural integration in chemistry learning is still rarely practiced by teachers (Wahyudiati, 2021).

Yogyakarta is a region rich in local cultural potential, which can serve as a valuable resource for chemistry education (Anggraini et al., 2021). One such cultural element is the Keris, which has distinctive characteristics that differentiate it from those of other regions. Knowledge about the materials used, the manufacturing process, and the treatment of the Keris can be incorporated into chemistry lessons. It is hoped that ethnoscience-based chemistry learning about the Keris will make the material more accessible, as it relates directly to everyday life. Additionally, teaching chemistry through the context of the Keris can help preserve Indonesian culture. Previous studies have discussed the integration and interconnection of the Keris (Resmiyanto, 2022), the Keris Madura in science learning (Yasir & Hartiningsih, 2023), and how to preserve iconic Keris from Indonesia (Wibawa et al., 2024). However, existing research has not explored the potential of the Keris Yogyakarta in chemistry education. This study aims to investigate the potential of the Keris Yogyakarta in enhancing chemistry learning.

Method

This research is a qualitative study that examines chemistry teachers'

perceptions of ethnoscience-based learning and explores the potential of the Keris in high school chemistry learning. This study was conducted in Yogyakarta with ten high school chemistry teachers participating. Data collection techniques included questionnaires, interviews, and an analysis of the high school chemistry curriculum. The research instruments consisted of a questionnaire and an interview guide. The data were analyzed using qualitative methods described by Miles and Huberman (2005), including data collection, data reduction, data presentation, and conclusion drawing.

Results and discussion

This research focused on chemistry teachers in Yogyakarta to determine their perceptions of ethnoscience-based learning approaches and the use of the Keris in chemistry education. The high school chemistry curriculum was analyzed to assess the potential of the Keris in chemistry instruction.

Chemistry teachers' perceptions of ethnoscience-based learning approaches

Every human activity is related to scientific phenomena. A chemistry teacher must understand chemical concepts and their application in everyday life. Local culture can serve as a learning resource, helping students better understand the subject matter (Ilhami et al., 2021). Ethnoscience-based learning, being closely related to daily life, can enhance students' comprehension of chemistry. Therefore, chemistry teachers can adopt ethnoscience as an alternative teaching approach in the classroom. Ethnoscience is deeply intertwined with Indonesian societal culture, and chemistry instruction developed from a cultural perspective can stimulate students' interest in science (Wijaya et al., 2020).

Chemistry teachers' perceptions of the ethnoscience-based learning approach were identified through interviews and questionnaires. This identification involved ten high school chemistry teachers in Yogyakarta. The data regarding their perceptions of ethnoscience-based learning approaches are presented in Table 1.

Table 1
Data on Chemistry Teachers' Perceptions of the Ethnoscience Approach

No	Statement	Percentage
1.	In teaching chemistry in class, a learning approach based on local wisdom or potential has been used	80%
2.	Using an ethnoscience-based learning approach can make chemistry material more contextual	100%
3.	An ethnoscience-based learning approach can make learning chemistry more interesting	90%
4.	An ethnoscience approach can increase students' love and knowledge of Indonesian culture	100%
5.	Knowledge about ethnoscience can increase student literacy	80%

Table 1 shows that chemistry teachers in Yogyakarta have utilized an ethnoscience-based approach to teaching chemistry. This approach makes the chemical material studied more contextually interesting and increases knowledge and appreciation of native Indonesian culture. Additionally, knowledge of ethnoscience can enhance student literacy.

Based on the interview results, it was found that an ethnoscience-based learning approach is one of the essential approaches in the independent curriculum. This approach integrates the material students learn with local culture. Several chemistry teachers in Yogyakarta have applied an ethnoscience-based approach in their classroom instruction. Some themes used include the process of making pottery in Kasongan village, the process of making batik, joss coffee, and others. Ethnoscience-based chemistry learning is crucial for

helping students better understand Indonesian culture. However, teachers have not yet conducted ethnoscience-based chemistry lessons about the Keris Yogyakarta. According to the chemistry teachers, the Keris Yogyakarta represents an outstanding theme for discussion within the framework of ethnoscience. Additionally, the Keris Yogyakarta has distinctive characteristics that set it apart from those in other regions of Indonesia. The Keris Yogyakarta can be utilized as a theme to integrate into chemistry education in Yogyakarta. The Yogyakarta Keris is traditionally used in sacred and spiritual ceremonies. Many teachers and students even wear Keris every Thursday. Thursday Pahing is celebrated as the founding day of the Yogyakarta Palace, marking the relocation from the Ambarketawang residence to the current site of the Palace. Consequently, the Keris Yogyakarta holds significant potential as a context for ethnoscience-based chemistry learning. The use of the Keris in commemorating Thursday Pahing in Yogyakarta is an effort to preserve the Keris Yogyakarta as an iconic element of Indonesian cultural heritage (Wibawa et al., 2024).

Study of the potential of keris in chemistry learning

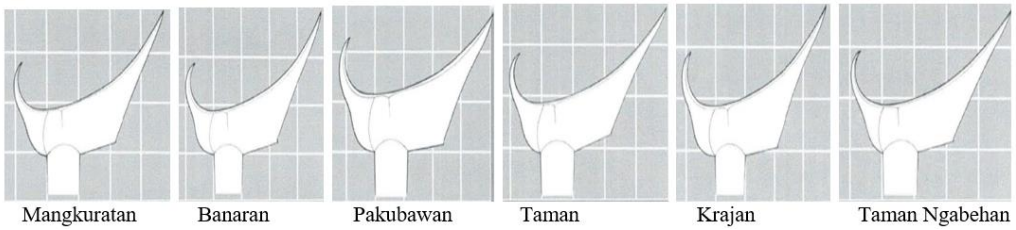
The Keris is one of the local cultural elements that needs to be preserved. The study of the potential of the Keris in chemistry education was conducted through document analysis and review of the high school chemistry curriculum. The Keris is one of Indonesia's cultural heritages, recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO) on November 25, 2005. The components of a Keris generally include: 1) Keris Blade, 2) Mendhak, 3) Selut, 4) Ukiran/ Deder/Hulu, 5) Warangka, 6) Pendok, and 7) Gandar.

The distinctive aesthetic characteristics of the Keris Yogyakarta that differentiate them from those of other regions are detailed in the following sections:

a. Warangka

Warangka is a Keris sheath made of wood. The Keris Yogyakarta warangkas have shapes including sandhang walikat, calendar, ladrang or branggah, and styleman. Each warangka has several shapes. The Yogyakarta branggah warangka shape model can be seen in Figure 1.

Figure 1
The Shape of the Braggah Warangka



b. Pendok

The pendok is an axle protector made of metal. Typically, pendoks are made of brass, bronze, silver, gold, or plated iron. The Keris Yogyakarta pendok is characterized by a convex curved line towards the warangka. Its body shape is thick with a small round tip. The shape of the Yogyakarta pendok can be seen in Figure 2.

c. Deder

Deder is the handle for the Keris Yogyakarta. The Keris Yogyakarta deder is shaped like the base of a tree stick that springs again. The primary material of deder is Tayuman wood. The shape of the Keris Yogyakarta deder can be seen in Figure 3.

Figure 2
The Shape of the Keris Yogyakarta Pendok

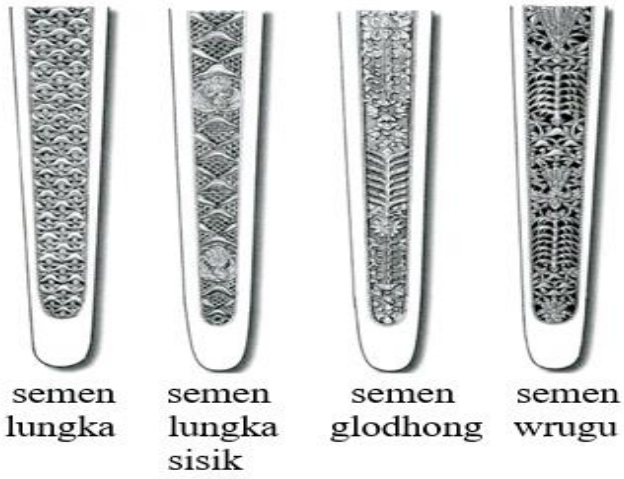
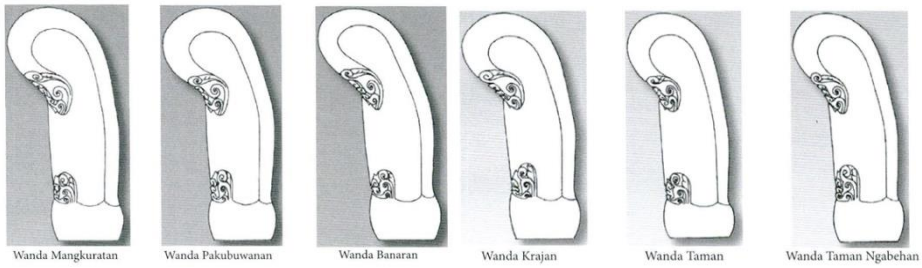


Figure 3
The Shape of the Keris Yogyakarta Deder



d. Mendhak

Mendhak is a ring between the blade and the tip of the Keris. Initially, it was plain iron, then it evolved to iron plated with gold, copper plated with gold, silver plated with gold, and eventually, the most luxurious version is made of pure gold decorated with precious stones. The Keris Yogyakarta mendhak has a characteristic Bejen shape. The shape of the Bejen on the Keris Yogyakarta mendhak can be seen in Figure 4.

Figure 4
The Shape of the Keris Yogyakarta Bejen

As a local culture artifact, the Keris Yogyakarta can be studied as a learning resource in chemistry lessons. The ethnoscience study of the Keris in chemistry learning can be seen in Table 2.

Table 2
Ethnoscientific Study of Keris in Chemistry Learning

No	Traditions/Activities	Indigenous Knowledge	Scientific knowledge
1.	Material for making Keris blades	The material used to make Keris blades consists of three alloys: steel, pamor, and iron.	Steel forms the basic framework of a Keris, which is strong and sharp. Pamor makes the Keris blade ductile, light, and provides a prestige pattern through repeated forging. Iron acts as an adhesive between steel and pamor (Harsakya, 2023). This concept is related to elemental chemistry.
2.	Warning process	The coloring process uses arsenic to produce a shiny appearance	Arsenic is used to coat Keris blades to prevent rust. When the Keris blade, which contains iron and steel, reacts with arsenic, the nickel element becomes bright white or gray, known as pamor (Sudrajat & Wibowo, 2014). This concept is related to elemental chemistry.
3.	The process of sharpening the Keris	Masquerading (bathing the Keris) is performed on the night of 1 Suro (1 Muharram) using coconut water, lime, and water from seven flowers.	▪Soaking in coconut water removes dirt, crust, and rust from the Keris. The reaction of the iron blade with coconut water (ascorbic acid, $C_6H_8O_6$): $2\ Fe(s) + C_6H_8O_6\ (aq) \rightarrow [Fe(C_6H_6O_6)_2]^{2-} + 2\ H^+$ (Sharma et al., 2019) This concept is related to redox reactions. ▪The function of rubbing the Keris blade with lime is to remove rust from the iron blade. The reaction of rust with lime (citric acid, $C_6H_8O_7$): $Fe^{3+} + C_6H_8O_7 \rightarrow [Fe(C_6H_5O_7)] + 3H^+$ (Sya'diyah et al., 2023) This concept is related to redox reactions. ▪Soaking in water with seven kinds of flowers makes the Keris smell pleasant.

Table 2 shows that the results of the Keris ethnoscience study correlate with high school chemistry material. Chemical topics related to ethnoscience regarding Keris include elemental chemistry and redox reactions. Ethnoscience makes it easier for students to understand facts and phenomena present in society, integrating them with scientific knowledge (Melyasari et al., 2018). Integrating Keris ethnoscience studies into chemistry learning can help students recognize their surrounding environment. This approach can facilitate students' understanding of chemistry material, helping them achieve learning objectives. Additionally, this integration can motivate students to construct their knowledge by utilizing local culture in learning. Therefore, ethnoscience-based learning about Keris

Yogyakarta can be effectively applied in the classroom learning process.

Conclusion

An ethnoscience-based learning approach is a learning approach that integrates local wisdom or culture with the subject matter students learn in class. This approach is one of the essential approaches in the independent curriculum that teachers can use in the learning process. Teachers responded positively to the ethnoscience-based learning approach. Chemistry teachers in Yogyakarta have used an ethnoscience-based chemistry learning approach to the themes of making pottery in Kasongan, batik, joss coffee, and others. Teachers have never used ethnoscience about Keris Yogyakarta in chemistry lessons in class. The Keris Yogyakarta has its characteristics compared to Keris from other regions, especially in the warangka, pendok, deder, and mendhak sections. Keris has the potential to be integrated into chemistry learning in the classroom. Ethnoscience about Keris can be taught in chemistry lessons at school, especially in chemical elements and redox reactions.

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