Available online
http://journal.um.ac.id/index.php/jptpp/
EISSN: 2502-471X
DOAJ-SHERPA/RoMEO-Google Scholar-IPI

Jurnal Pendidikan:
Teori, Penelitian, dan Pengembangan
Volume: 8 Number 1, January, 2023
Page: 57—61

The Relationship between Ethnochemistry Learning Experience and Cognitive Learning Outcomes Based on Gender

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ARTICLE INFORMATION

Article History:

Accepted: 12-12-2022
Approved: 12-01-2023

Keywords:

cognitive learning;
ethnochemistry learning;
gender

ABSTRACT

Abstract: This study analyzes the relationship between ethnochemistry learning experiences and students' cognitive learning outcomes based on gender perspective. This quantitative study adopted the survey design. The sample of 60 people (40 women and 20 men) was determined through cluster random sampling. An ethnochemistry-based learning experience questionnaire and student cognitive learning outcomes tests were utilized to collect the data. The collected data were then analyzed by multiple regression test with a significance level of .05. The conclusion drawn based on the results were; 1) the cognitive learning outcomes of chemistry students are higher than the ethnochemistry-based learning experience, and 2) there is a significant relationship between the ethnochemistry learning experience and the students' cognitive learning outcomes in terms of gender perspective.

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Chemistry learning purpose in higher education relates to the IQF curriculum: cognitive, affective, and psychomotor learning outcomes, which refer to achieving 21st-century learning objectives in the industrial revolution 5.0 era. The components of 21st-century skills include critical thinking, communication & collaboration, problem-solving, creative thinking, and scientific attitudes (Zhou et al., 2019; Wahyudiati et al., 2019; Wahyudiati, 2022a; Sutrisno et al., 2020). Installing these skills in students can be through developing problem-solving abilities relevant to their lives through the scientific method. Therefore, students' soft skills could be improved, and they would have better cognitive learning outcomes. Thus, developing students' scientific methods that can enhance their cognitive learning outcomes are expected in order to achieve the chemistry learning objectives. However, based on the previous research, the factual conditions of chemistry learning still use conventional learning models with limited learning media, which creates poor students' problem-solving skills and cognitive learning outcomes (Adawiah et al., 2022; Wahyudiati & Fitriani, 2012).

Moreover, aspects to consider are the learning environment, the use of innovative technology, and learning strategies because they significantly affect the improvement of students' scientific attitudes and student cognitive learning (Osborne et al., 2003; Sumardi et al., 2020; Zhao & Wang, 2022). Therefore, improving the quality of chemistry learning requires various innovative teaching strategies and must be balanced with improving the quality of lecturers to have a more comprehensive learning experience. In the end, those would enrich the cognitive learning outcomes.

The learning experience will determine students' learning objectives' completion. Learning success can be through encouraging students to acquire knowledge, develop skills, grow science process skills, and understand concepts independently to have significant and meaningful learning (Edelson, 2001; Wahyudiati, 2021a). However, previous research showed that classroom learning tends to take place in one direction and is dominated by lecturers, resulting in poor students' soft and hard skills (Wahyudiati, 2022b; Fadli & Irwanto, 2020; Patonah et al., 2021). Accordingly, the learning experience is one of the important factors influencing the achievement of chemistry learning objectives in universities.

The learning experience is an essential aspect of knowledge, attitudes, and skills to produce qualified and competent graduates. Through the problem-solving process and learning experience, it trains students to solve a problem through scientific procedures (Wahyudiati, 2022b; Patonah et al., 2021; Wahyudiati et al., 2019). In addition, one of the best ways to make it easier for students understanding chemical concepts is through habituation of understanding concepts relevant to everyday life or known as local wisdom. Integrating chemistry learning with students' local culture is implementing a contextual learning approach by combining chemical concepts with local wisdom called the ethnochemistry approach (Wahyudiati & Fitriani, 2021; Sutrisno et al., 2020; Wahyudiati, 2022b). The ethnochemistry approach implementation trains students to understand chemical concepts, develop problem-solving skills and prove hypotheses that the objectives of chemistry learning can be achieved (Adawiah et al.,

2022; Suardana et al., 2018; Wahyudiati et al., 2020). However, previous research confirmed that the study of experiential learning based on the ethnochemistry approach at the university level is such a scarcity (Sutrisno et al., 2020; Wahyudiati & Fitriani, 2021). Besides that, factual and contextual learning experiences could improve student learning outcomes because students are actively involved in learning activities in independently construct knowledge, experience and skills.

The students' learning activities could enrich the learning experience, especially the contextual learning experience that refers to students' local wisdom (ethnochemistry-based learning); it is one solution to improve students' conceptual understanding. However, the implementation of the ethnochemistry learning approach in universities is limited, and its practice tends to be memorization (Tan & Gilbert, 2014; Dewi et al., 2017; Osborne et al., 2003; Wahyudiati & Fitriani, 2021). Ethnochemistry is a variety of cultural practices that describe the chemical practices of cultural groups that are chemically related and can be identified and analyzed as the study of chemical ideas that can be found in any culture (Singh & Chibuye, 2016). An example of ethnochemistry (combining chemical concepts with local Sasak wisdom) is that the interaction between two or more atoms is always accompanied by the expenditure of energy, where the concept of energy expenditure in the chemical bond theory has a strong connection with the ajikrama tradition (amount of customary payments) krama gubuk (Fadli, 2018). The surrender of all customary fees is carried out in a ceremony called sorong serah (handover from the woman to the man). The forces that hold the atoms together in the molecule are called chemical bonds. Chemical bonds are forces or interactions that cause atoms to bond together as molecules or cause atoms, ions, and molecules to bond together as more complex groups (Achamad, 2001). In addition to the approach and learning environment factors, previous research results found a relevance between the learning experience and cognitive learning outcomes based on gender and between the learning experience and critical thinking skills based on grade level (Xu et al., 2013; Zhao & Wang, 2013). 2022). However, no studies focus on the relevance of ethnochemistry-based learning experiences with cognitive learning outcomes from a gender perspective. Therefore, it is important to find the relationship between the ethnochemistry learning experience and cognitive learning outcomes from a gender perspective. Ethnochemistry is a variety of cultural practices that describe the chemical practices of cultural groups that are chemically related and can be identified and analyzed as the study of chemical ideas that can be found in any culture. In this study, the topic of chemistry was integrated with Sasak local wisdom (the tradition of merarik or marrying) with chemical bonding material in terms of cognitive learning outcomes between male and female students (gender perspective).

METHOD

This quantitative study employed a survey approach. A cross-sectional survey design was used to obtain quantitative data, and a focus group interview technique was used to confirm quantitative data. The cross-sectional survey design was performed to measure the relationship or influence between two or more research variables in describing the factual conditions of the research object (Creswell & Creswell, 2017). The research sample was determined through cluster random sampling at the department of chemistry education at Mataram State Islamic University with 60 students consisting of 40 females and 20 males. For cognitive learning outcomes tests, namely on the topic of chemical bonds (ionic bonds, metallic bonds, and covalent bonds) which are integrated with Sasak local wisdom in the number of 8 Essay questions. The concept of forming ionic bonds is closely related to the interesting tradition of the Sasak people. The concept of attracting the Sasak tribe is based on the principle of mutual need and complementarity to achieve a goal that not only unites two individuals but essentially unites two families in a bond known as besan which is relevant to the concept of forming metallic bonds, ionic bonds, and bonds. covalent, where in theory chemical bonds are formed due to the attractive attraction that occurs between the positive charge of metal ions and the negative charge of free-moving electrons. Furthermore, ethnochemistry-based learning experience used in this study adopted an ethnochemistry-based CAEQ (chemistry attitudes and experiences questionnaire) (Coll et al., 2002) which was transformed into an ethnochemistry-based CAEQ instrument. The instrument was first tested for expert and empirical validation to measure the level of instrument reliability, and Cronbach's alpha coefficient value was obtained at = .88 > .70 to meet the reliability requirements (Hair et al., 2010). Finally, the data were analyzed using multiple regression tests to determine the relationship between ethnochemistry-based learning experiences and students' cognitive learning outcomes.

RESULTS

The average value of students' cognitive learning outcomes (CLO) and ethnochemistry-based learning experience (ELE) based on gender was determined based on the average score and standard deviation, as shown in Table 1. The mean value of cognitive learning outcomes was 81.70, while the mean value of students' cognitive learning outcomes was 84.50.

Table 1. The mean of ELE & CLO of Chemistry student

Measured aspect	N	Mean	SD
Ethnochemistry-based learning experience (ELE)	60	80.70	4.85
Cognitive learning outcomes (CLO)	60	84.50	4.52

Before testing the hypothesis, the prerequisite test was done through the normality and homogeneity tests. The data analysis showed that the research data was homogeneous and normally distributed since the significance value was higher than 0.05. After performing the prerequisite test, it was continued with multiple regression tests. The hypothesis test showed a significant relationship between students' ELE and CLO based on gender because the p-value is higher than 0.05, which means the null hypothesis was rejected. The alternative hypothesis was accepted (Table 2).

Table 2. Regression analysis on students' ELE dan CLO based on gender perspective

Test	Df	F	Sig
Regression	2	.875	.000

DISCUSSION

Based on the study results, the average value of students' ethnochemistry-based learning experience (80.70) was lower than their cognitive learning outcomes (84.50). The average value of cognitive learning outcomes, which is considered high in a category, indicates that contextual learning experience with the ethnochemistry approach has a positive impact on improving students' cognitive learning outcomes. This impact is because the ethnochemistry approach allows students to more easily understand chemical concepts because of the integration of chemical concepts that are relevant or related to Sasak local wisdom so that it influences student cognitive learning outcomes (Wahyudiati & Fitriani, 2021, Sutrisno et al., 2020). In various cultures of the Sasak tribe there is local wisdom which is related to the theory of chemical bonds (analogy between domains) in terms of the concept of electron stability/stable electronic configuration, the concept of positive ions and negative ions, the theory of chemical bond formation which is analogous to having the concept is the same as the tradition of nenarih (applying) and sorong serah (handing over the dowry to the woman's family). As for the linkages, namely the existence of similarities in the theories or concepts that underlie them, the meanings, and values contained therein. At nenarih events, especially when there is an agreement between the girl and the young man to get married, either the young man asks himself or through his subandar (family representative) or jerumannya (Wahyudiati & Fitriani, 2021), where the underlying concept is the concept of mutual need. giving and receiving each other to live together, with the existence of a relationship that binds it, namely a marriage relationship, namely through the marriage contract process. This concept is analogous to the concept underlying the formation of chemical bonds, namely the concept of giving and receiving of an atom to achieve a stable electron configuration (Prasetiawan, 2009: 161).This condition is supported by the previous findings that showed learning activities need to be taught through a contextual approach, which affects the achievement of learning objectives and psychomotor aspect (Adawiah et al., 2022; Villafañe & Lewis, 2016; Wahyudiati, 2021b, 2022a).

Achieving chemistry learning objectives is not only influenced by the development of 21st-century skills but is by the ethnochemistry-based learning experience. The advantages of implementing an ethnochemistry approach relevant to everyday experience and local wisdom make students involved in independently constructing experiences, skills, and knowledge. (Rahmawati, 2018; Wahyudiati, 2022b). In addition, previous studies supported that the ability of female cognitive learning outcomes tends to be higher than that of male students because female students have more positive motivation, curiosity, and chemical attitude than their counterparts (Villafañe et al., 2014). The relationship with learning chemistry is that female students have higher learning motivation than male students which has an impact on student cognitive learning outcomes, where the cognitive learning outcomes of female students tend to be higher than male students so that an ethnochemical approach is needed in learning through integration chemistry concepts with Sasak local wisdom so as to increase learning motivation which has an impact on increasing the cognitive learning outcomes of male students (Wahyudiati, 2022c).

Another research finding also found a significant relationship between ethnochemistry-based learning experiences and students' cognitive learning outcomes based on gender. The implementation of the ethnochemistry approach is reflected in the integration of chemical concepts with the students' daily experiences that contain local wisdom values reflected as concepts, ideas, and cultural products. Likewise, previous research conducted by Wahyudiati & Fitriani (2021), Rahmawati (2018) and Singh (2016) revealed that integrating culture into chemistry learning helped students in linking chemical concepts with local wisdom. In addition, applying ethnochemistry through integrating relevant chemical concepts into local wisdom could increase the motivation of male and female students (Sutrisno et al., 2020; Villafañe & Lewis, 2016; Wahyudiati, 2022b) and their sense of nationalism (Sumardi & Wahyudiati, 2021). The concept of forming ionic bonds is closely related to the interesting tradition of the Sasak people. The concept of attracting the Sasak tribe is based on the principle of mutual need and complementarity to achieve a goal that not only unites two individuals but essentially unites two families in a bond known as besan which is relevant to the concept of forming metallic bonds, ionic bonds, and bonds. covalent, where in theory chemical bonds are formed due to the attractive attraction that occurs between the positive charge of metal ions and the negative charge of free-moving electrons (Fadli, 2018; Wahyudiati & Fitriani, 2021). In addition, the concept of ionic bond formation also has a close relationship with the tradition of merik and begibung in the Sasak tribe. The concept of attracting and begibung in the Sasak tribe is also based on the principle of mutual need and complementarity to achieve one goal so that stability is achieved as is the case with the concept of ionic bonding, namely the handover of electron pairs (Fadli, 2018).

Other findings also showed that ethnochemistry-based learning experiences positively correlate with learning outcomes. It is supported by previous studies that confirmed ethnochemistry-based learning experiences could increase their experiences, skills, and knowledge to improve problem-solving abilities and cognitive learning outcomes(Wahyudiati, 2022a; Villafañe et al., 2014; Wahyudiati, 2021b; Zhao & Wang, 2022). One of the main factors affecting student cognitive learning outcomes is implementing an ethnochemistry approach that prioritizes problem-solving activities based on local wisdom to create a more meaningful learning experience.

CONCLUSION

Based on the study results, it can be concluded that the cognitive learning outcomes of chemistry teacher candidates are higher than the ethnochemistry-based learning experience. There is a significant relationship between the ethnochemistry learning experience and the students' cognitive learning outcomes in terms of gender perspective. Ethnochemistry is a variety of cultural practices that describe the chemical practices of cultural groups that are chemically related and can be identified and analyzed as the study of chemical ideas that can be found in any culture. In this study, the topic of chemistry was integrated with Sasak local wisdom (the tradition of merarik or marrying) with chemical bonding material in terms of cognitive learning outcomes between male and female students (gender perspective). Based on the findings, discussion, and research conclusions, chemistry lecturers are encouraged to implement an ethnochemistry approach to improve students' learning outcomes and ethnochemistry-based learning experiences.

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