The relationship between Ethnochemistry Learning Experience and Cognitive Learning Outcomes based on Gender

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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.

Index Terms- Cognitive learning, Ethnochemistry learning, Gender

I. INTRODUCTION

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). 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 students' scientific attitudes from a gender perspective.

II. 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. Furthermore, the scientific attitude instrument and ethnochemistry-based learning experience used in this study adopted an ethnochemistry-based CAEQ questionnaire. 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 experience and the scientific attitude of students in terms of gender perspective.

III. FINDINGS & DISCUSSIONS

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
ELE	60	80.70	4.85
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

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 be involved in problem-solving activities, develop their scientific process skills, and understand concepts easier (Wahyudiati & Fitriani, 2021, Sutrisno et al., 2020). 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).

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).

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.

IV. 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. 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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