Ethnochemistry-Based Learning Packet on Traditional Tausug Soap-Making: Effects on Grade 9 Students' Chemistry Learning and Cultural Appreciation

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DOI: https://doi.org/10.47772/IJRISS.2026.100600797

Received: 03 June 2026; Accepted: 08 June 2026; Published: 06 July 2026

ABSTRACT

Chemistry is often perceived as difficult due to its abstract concepts and limited connection to students' everyday experiences. To address this challenge, this study developed and evaluated an ethnochemistry-based learning packet integrating traditional Tausug soap-making into chemistry instruction. The study aimed to determine the effectiveness of the learning packet in improving Grade 9 students' chemistry learning and cultural appreciation. A one-group pretest-posttest design with qualitative support was employed involving thirty-five (35) Grade 9 students in one public school in Jolo, Sulu during the School Year 2025–2026. The learning packet was developed using the ADDIE instructional design model and underwent expert validation prior to implementation. Data were collected through a 15-item for pre-test and post-test, activity scores, and a perception questionnaire. Descriptive statistics including frequency, percentage, mean, and standard deviation were utilized, while the Wilcoxon Signed-Rank Test was employed to determine significant differences between pre-test and post-test scores. Results revealed that students demonstrated high performance in the learning activity, with most obtaining Outstanding and Very Satisfactory ratings. Findings further showed a significant improvement after exposure to the learning packet with the computed W-value of 0.00 was lower than the critical value of 195, indicating a significant difference between the pre-test and post-test scores. Therefore, the null hypothesis stating that there is no significant difference between the pre-test and post-test scores of the students is rejected. Moreover, students expressed highly positive perceptions of the instructional material, obtaining a grand mean of 3.79, interpreted as Strongly Agree. The findings indicate that integrating indigenous knowledge and cultural practices through ethnochemistry-based learning packet can effectively enhance students' conceptual understanding of chemistry while promoting appreciation of local cultural heritage. The study recommends the integration of ethnochemistry and culturally responsive approaches in science instruction to foster meaningful and contextualized learning experiences.

Keywords: ethnochemistry, Tausug traditional soap-making, learning packet

INTRODUCTION

Chemistry plays a vital role in helping students understand natural phenomena and the composition of materials encountered in everyday life. Despite its importance, chemistry remains one of the most challenging subjects for many students because of its abstract concepts, symbolic representations, and complex scientific processes. According to Johnstone (1991) [8], students often struggle to understand chemistry when concepts are presented without meaningful connections to their daily experiences. Consequently, students frequently perceive chemistry as difficult, resulting in low engagement and limited conceptual understanding.

To address these challenges, educators have increasingly adopted contextualized and culturally responsive teaching approaches that connect scientific concepts with students' experiences and community practices. One emerging approach is ethnochemistry, which integrates indigenous knowledge, cultural traditions, and scientific principles into chemistry instruction. Ethnochemistry recognizes that many traditional practices embody scientific concepts that can serve as meaningful contexts for learning science.

In many indigenous communities, traditional knowledge systems contain rich scientific understandings developed through generations of observation and experience. Aikenhead and Ogawa (2007) [1], emphasized that integrating indigenous knowledge into science education enables students to connect scientific concepts with familiar cultural experiences, thereby improving understanding and engagement. Similarly, Gay (2000) [4] argued that culturally responsive instruction enhances participation by relating learning experiences to students' cultural backgrounds.

Among Tausug communities in Sulu, traditional soap-making represents a cultural practice that demonstrates important chemistry concepts. The process utilizes locally available materials such as coconut oil (lana) and alkaline substances derived from wood ash (abu), illustrating the chemical process of saponification. Although this practice has long been part of community life, its scientific significance is rarely explored in formal chemistry instruction.

Recognizing the educational potential of this indigenous practice, the present study developed an ethnochemistry-based learning packet that integrates traditional Tausug soap-making with chemistry concepts. By contextualizing scientific ideas within a familiar cultural practice, the learning packet seeks to enhance students' understanding of chemistry while promoting appreciation of local cultural heritage. Specifically, this study aimed to determine the effectiveness of the ethnochemistry-based learning packet in improving Grade 9 students' chemistry learning and cultural appreciation.

Objectives of the Study

The main objective of this study is to determine the effectiveness of ethnochemistry-based learning packet in improving the students' understanding of ethnochemistry concepts related to traditional Tausug soap-making among Grade 9 students. Specifically, this study aimed to:

1. develop an ethnochemistry-based learning packet on traditional Tausug soap-making;
2. determine the students' activity scores using the ethnochemistry-based learning packet;
3. determine the influence of the ethnochemistry-based learning packet in terms of pre-test and post-test scores; and
4. determine the students' perception regarding the ethnochemistry-based learning packet.

METHODOLOGY

The study employed a one-group pretest-posttest design with qualitative support to determine the effectiveness of the ethnochemistry-based learning packet. The ADDIE instructional design model consisting of Analysis, Design, Development, Implementation, and Evaluation served as the framework for the development and implementation of the learning packet.

During the analysis phase, a pre-test was administered to Grade 9 students to determine their prior knowledge and learning difficulties regarding chemistry concepts. The results identified the least mastered competencies and served as the basis for selecting the content, learning objectives, and activities to be included in the ethnochemistry-based learning packet. The analysis also considered the integration of traditional Tausug soap-making practices as a culturally relevant context for teaching chemistry.

Based on the results of the pre-test, the learning packet was designed to address the identified learning gaps in chemistry concepts while integrating indigenous knowledge related to traditional Tausug soap-making. Learning objectives, lesson contents, assessment activities, and instructional materials were carefully planned. The packet included lesson discussions, guided activities, reflection questions, formative assessments, and visual illustrations of the soap-making process linked to chemistry concepts. Learning tasks were designed to promote active participation, critical thinking, and the application of chemistry concepts in real-life cultural practices.

During the development phase, the ethnochemistry-based learning packet was produced and subjected to expert validation. The packet consisted of lesson discussions, visual illustrations, activity sheets, guide questions, practice exercises, and assessment tasks designed to enhance students' understanding of chemistry concepts through the context of traditional Tausug soap-making. The learning activities encouraged students to analyze observations, relate indigenous cultural practices to scientific explanations, and reflect on the connection between chemistry and local knowledge systems. Furthermore, feedback and recommendations from the validators were incorporated to improve the content accuracy, organization, language suitability, and overall instructional design of the learning packet, ensuring its effectiveness and appropriateness for Grade 9 learners.

During the implementation phase, the validated ethnochemistry-based learning packet was administered to the Grade 9 students. The learners completed the lessons, activities, and assessment tasks contained in the packet within the designated implementation period. Through the traditional Tausug soap-making context, students were guided to explore chemistry concepts, answer activity sheets, analyze learning tasks, and participate in reflective exercises. The researcher facilitated the implementation process, monitored students' progress, and provided necessary guidance to ensure the proper utilization of the learning packet.

During the evaluation phase, the effectiveness of the ethnochemistry-based learning packet was assessed through the administration of a post-test and a students' perception survey. The post-test measured the students' achievement in chemistry concepts after using the learning packet, while the perception survey gathered feedback regarding the content, organization, usefulness, and cultural relevance of the material. The collected data were analyzed using appropriate statistical tools to determine the effectiveness of the learning packet in improving students' understanding of chemistry concepts and promoting appreciation of the relationship between culture and science.

The respondents consisted of thirty-five (35) Grade 9 students enrolled in one public school in Jolo, Sulu during the School Year 2025–2026. Participants were selected through purposive sampling.

Three instruments were utilized in this study. First, a 15-item for pre-test and post-test questionnaire was administered to determine the students' academic performance before and after the implementation of the ethnochemistry-based learning packet. Second, a researcher-developed ethnochemistry-based learning packet on traditional Tausug soap-making was used as the primary instructional material for teaching ethnochemistry concepts. Lastly, a 15-item perception questionnaire using a four-point Likert scale was administered to determine the students' perceptions regarding the effectiveness of the learning packet.

The learning packet underwent expert validation by science teachers and science education specialists and was found valid and appropriate for Grade 9 students. Reliability testing revealed a Cronbach's alpha coefficient of 0.73 for the pre-test and post-test questionnaire and 0.86 for the perception questionnaire, indicating acceptable to high reliability.

Frequency, percentage, mean, and standard deviation were used to describe students' performance and perceptions. Since normality testing indicated non-normal distribution of scores, the Wilcoxon Signed-Rank Test was employed to determine significant differences between pre-test and post-test results.

RESULTS AND DISCUSSION

The students' performance was evaluated based on their scores in the ethnochemistry-based learning packet implemented during the study. The activity focused on chemistry concepts related to traditional Tausug soap-making, particularly saponification, chemical reactions, and the use of indigenous materials. The students' scores served as the basis in determining their performance and understanding of the lesson after the implementation of the learning packet.

The following tables present the results and corresponding discussion of the study on the effectiveness of the ethnochemistry-based learning packet in improving students' understanding of ethnochemistry concepts related to traditional Tausug soap-making.

Table 1 Performance of Students in the Learning Activity

SCORE RANGE IN ACTIVITY	FREQUENCY	EQUIVALENT PERCENTAGE OF SCORE	DESCRIPTION
41–45	20	90–100	Outstanding
36–40	10	85–89	Very Satisfactory
31–35	5	80–84	Satisfactory
26–30	0	75–79	Fairly Satisfactory
25 and below	0	74 and below	Did Not Meet Expectations

The table 1 presents the students demonstrated high levels of performance during the learning activity. The results revealed that 20 out of 35 students (90-100) obtained scores ranging from 41–45, which is described as Outstanding. Meanwhile, 10 students (85-89) obtained scores ranging from 36–40 and were described as Very Satisfactory, while 5 students (80-84) obtained scores ranging from 31–35 and were described as Satisfactory. No students were classified under Fairly Satisfactory or Did Not Meet Expectations.

Table 2 Pre-Test and Post-Test Scores of the Grade 9 Students

PRE-TEST				POST-TEST		
SCORE	F	%	DESCRIPTION	F	%	DESCRIPTION
15	0	0	Outstanding	14	40.00	Outstanding
14-13	0	0	Very Satisfactory	13	37.14	Very Satisfactory
12-11	0	0	Satisfactory	8	22.86	Satisfactory
10-9	2	5.71	Fairly Satisfactory	0	0	Fairly Satisfactory
8 and below	33	94.29	Did Not Meet Expectations	0	0	Did Not Meet Expectations

Legend: Outstanding=90-100, Very Satisfactory=85-89, Satisfactory=80-84, Fairly Satisfactory=75-79, Did Not Meet Expectations= Below 75

Table 2 presents the pre-test and post-test scores of the Grade 9 students. The results revealed that before the implementation of the ethnochemistry-based learning packet, 33 learners (94.29%) were classified under Did Not Meet Expectations, while 2 learners (5.71%) were under Fairly Satisfactory. No learners achieved the Satisfactory, Very Satisfactory, or Outstanding levels during the pre-test. These findings indicate that the students had limited prior knowledge and understanding of the chemistry concepts presented in the learning packet before the intervention. In contrast, the post-test results showed a substantial improvement in students' performance. Fourteen students (40.00%) achieved the Outstanding level, 13 students (37.14%) attained the Very Satisfactory level, and 8 students (22.86%) reached the Satisfactory level. Notably, no students were classified under Fairly Satisfactory or Did Not Meet Expectations after the implementation of the learning packet. The shift from predominantly low pre-test scores to satisfactory and outstanding post-test scores suggests that the ethnochemistry-based learning packet positively influenced the students' understanding of chemistry concepts.

Table 3 Normality Test of Pre-Test and Post-Test

Parameter	Value		Interpretation
	Pre-Test	Post-Test	
p-value	0.004	0.001	Since p-value<0.05, we reject the Ho. It is assumed that the data is not normally distributed.
W-value	0.901	0.785	W-value is not close to 1, suggests the data is not normally distributed

The table 3 showed the normality of the pre-test and post-test scores was assessed using the Shapiro-Wilk test. The p-values obtained were 0.004 for the pre-test and 0.001 for the post-test. Since both p-values are less than the significance level of 0.05, the null hypothesis (H_0), which assumes that the data are normally distributed, is

rejected. This indicates that both the pre-test and post-test scores do not follow a normal distribution. Furthermore, the W-values were 0.901 for the pre-test and 0.785 for the post-test. Since these W-values are not close to 1, the results further suggest that the data deviate from a normal distribution. The lower W-value obtained in the post-test also indicates a greater departure from normality compared to the pre-test scores. Therefore, it is concluded that both the pre-test and post-test scores are not normally distributed. Consequently, a non-parametric statistical test, specifically the Wilcoxon Signed-Rank Test, was considered appropriate for determining the significant difference between the pre-test and post-test scores of the students.

Table 4 Wilcoxon Test of Pre-Test and Post-Test

Variable	N	Median	Difference	W-value	W-critical value	Remark
Pre-Test	35	7.03	6.74	0.00	195	Significant
Post-Test	35	13.77				

To determine whether there was a significant difference between the pre-test and post-test scores of the students before and after the implementation of the ethnochemistry-based learning packet, the Wilcoxon Signed-Rank Test was employed. As shown in Table 4, the median pre-test score was 7.03, while the median post-test score increased to 13.77, resulting in a difference of 6.74 points. The computed W-value of 0.00 was lower than the critical value of 195, indicating a significant difference between the pre-test and post-test scores. Therefore, the null hypothesis stating that there is no significant difference between the pre-test and post-test scores of the students is rejected. The findings suggest that the ethnochemistry-based learning packet significantly improved the students' understanding of the chemistry concepts presented in the lesson. The increase in scores demonstrates that the students gained substantial knowledge and understanding after participating in the ethnochemistry-based learning activities. The integration of traditional Tausug soap-making as a learning context may have helped students connect scientific concepts with familiar cultural practices, making learning more meaningful and engaging. The results support the findings of Hofstein and Lunetta (2004) [6], who reported that activity-based science activities enhance students' participation and understanding because students become actively involved in the learning process. The significant improvement in students' scores may be attributed to the activity-based nature of the learning packet, which encouraged active participation and experiential learning. The findings are also consistent with the studies of Ferreira et al. (2022) [3] and Gecolea and Amon (2022) [5], who found that contextualized and localized chemistry instruction improves students' academic performance and conceptual understanding. Their studies emphasized that students learn chemistry more effectively when scientific concepts are linked to real-life experiences and community practices. In the present study, the traditional soap-making activity provided a contextualized learning experience that helped students relate chemistry concepts to everyday life. Furthermore, the results agree with the studies of Picardal and Sanchez (2022) [9] and Aikenhead and Ogawa (2007) [1], who emphasized the effectiveness of culturally contextualized and ethnochemistry-based instruction in improving students' engagement and academic achievement. These studies highlighted that integrating indigenous knowledge and cultural practices into science instruction makes learning more relevant and meaningful to students. Thus, the significant improvement in the students' post-test scores indicates that the ethnochemistry-based learning packet was effective in enhancing their understanding of chemistry concepts.

Table 5 Learners' Perception of the Ethnochemistry-Based Learning Packet

No. of Items	I believe…	Mean Ratings	Description
1	the learning packet was easy to understand.	3.71	Strongly Agree
2	the instructions provided in the learning packet were clear and easy to follow.	3.66	Strongly Agree
3	the learning activity helped me understand chemistry concepts better.	3.80	Strongly Agree
4	the examples and explanations in the learning packet were relevant to the lesson.	3.74	Strongly Agree
5	the learning packet increased my interest in learning chemistry.	3.69	Strongly Agree

6	the traditional soap-making activity helped me relate chemistry concepts to real-life situations.	3.83	Strongly Agree
7	the learning packet helped me appreciate the connection between culture and chemistry.	3.86	Strongly Agree
8	the activity encouraged me to participate actively in the learning process.	3.77	Strongly Agree
9	the learning packet made the lesson more enjoyable and meaningful.	3.80	Strongly Agree
10	the content of the learning packet was organized and easy to follow.	3.74	Strongly Agree
11	the illustrations and learning tasks helped me understand the lesson.	3.71	Strongly Agree
12	the learning packet enhanced my understanding of ethnochemistry.	3.89	Strongly Agree
13	the activities helped me develop a better understanding of scientific concepts found in cultural practices.	3.83	Strongly Agree
14	I am satisfied with the learning experiences provided by the learning packet.	3.86	Strongly Agree
15	I would recommend the use of this learning packet in future chemistry lessons.	3.91	Strongly Agree
Grand Mean		**3.79**	**Strongly Agree**

Legend: 3.26–4.00 (Strongly Agree), 2.51–3.25 (Agree), 1.76–2.50 (Disagree), 1.00–1.75 (Strongly Disagree)

Table 5 presents the students' perception of the ethnochemistry-based learning packet. The results revealed a grand mean of 3.79, interpreted as Strongly Agree, indicating that the students had a highly positive perception of the learning packet. The highest-rated item 15 was “I would recommend the use of this learning packet in future chemistry lessons” with a mean rating of 3.91, while all other items also received ratings within the Strongly Agree range. These findings suggest that the learning packet was effective in helping students understand chemistry concepts, appreciate the connection between culture and science, and engage actively in the learning process.

To further examine the cultural appreciation component of the learning packet, the culture-related indicators were analyzed separately. Item 6, “The traditional soap-making activity helped me relate chemistry concepts to real-life situations,” obtained a mean rating of 3.83, interpreted as Strongly Agree. Item 7, “The learning packet helped me appreciate the connection between culture and chemistry,” obtained a mean rating of 3.86, interpreted as Strongly Agree. Item 12, “The learning packet enhanced my understanding of ethnochemistry,” received a mean rating of 3.89, interpreted as Strongly Agree.

Likewise, Item 13, “The activities helped me develop a better understanding of scientific concepts found in cultural practices,” obtained a mean rating of 3.83, interpreted as Strongly Agree. This finding indicates that students particularly valued the cultural dimensions of the learning packet, providing quantitative evidence that the integration of traditional Tausug soap-making promoted cultural appreciation alongside chemistry learning.

The positive perception of the students supports the findings of Hofstein and Lunetta (2004) [6], who emphasized that hands-on and activity-based approaches enhance conceptual understanding and academic performance by allowing students to directly experience scientific concepts. The results are also consistent with the study of Ferreira et al. (2022) [3], which found that contextualized and activity-based chemistry instruction increases students’ motivation and helps them connect abstract chemistry concepts to real-life situations.

CONCLUSION

Based on the findings of the study, it can be concluded that the ethnochemistry-based learning packet is an effective instructional material for teaching chemistry concepts among Grade 9 students. The integration of traditional Tausug soap-making into the learning activity provided students with meaningful and culturally relevant learning experiences that enhanced their understanding of chemistry concepts.

The results demonstrated that students actively participated in the learning activity and achieved satisfactory to outstanding performance. Furthermore, the significant improvement observed between the pre-test and post-test scores confirmed the positive influence of the learning packet on students' academic performance. The positive perceptions expressed by the students further indicate that the learning packet was engaging, understandable, and beneficial to their learning.

Therefore, the study concludes that ethnochemistry-based instruction can serve as an effective approach in chemistry education by promoting understanding, improving academic performance, and fostering appreciation of local culture and indigenous knowledge. Hence, the researcher do not have enough evidence to accept the null hypothesis. In conclusion, the ethnochemistry-based learning packet, offers a promising approach to making science education more meaningful and effective.

RECOMMENDATION

Based on the findings of this study, it is recommended that Science teachers are encouraged to utilize ethnochemistry-based learning packet and integrate local cultural practices, indigenous knowledge, and community-based activities into chemistry instruction to provide students with meaningful, culturally relevant, and engaging learning experiences while enhancing their understanding and appreciation of cultural heritage.

School administrators and curriculum planners may support the development and implementation of localized and culturally responsive instructional materials in science education.

Learning packet developers may create additional ethnochemistry-based learning packet covering other chemistry topics and indigenous practices to further enrich science instruction.

Moreover, future researchers are encouraged to conduct similar studies involving larger populations, different grade levels, and other science topics to further validate the effectiveness of ethnochemistry-based learning packet and examine their long-term effects on students' academic performance, motivation, cultural awareness, and retention of scientific concepts.

ACKNOWLEDGEMENT

The researcher sincerely acknowledges the invaluable contributions, support, and assistance of the individuals and institutions who made the successful completion of this study possible.

Special appreciation is extended to the Grade 9 students who participated in this study. Their willingness to share their time, effort, and responses provided the necessary data and valuable insights that significantly contributed to the accomplishment of this research.

Above all, the researcher offers heartfelt gratitude to Almighty God for His endless guidance, wisdom, strength, and blessings throughout the conduct of this study. His divine providence sustained the researcher through every challenge and made the successful completion of this work possible. To Him be all the glory, honor, and praise.

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