Teachers' Perception on Culturally Responsive Chemistry Instruction Through Traditional Knowledge and Practices

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ABSTRACT

This study examined the integration of Indigenous Knowledge and Practices (ICKP), particularly indigenous dye extraction, in Chemistry instruction. Grounded in culturally responsive and contextualized science education, the study aimed to explore key dimensions of ICKP integration, including awareness, attitudes, self-efficacy, instructional practices, perceived relevance, and implementation barriers. A descriptive survey design with qualitative support was employed to provide a comprehensive understanding of the phenomenon. Data were collected from eight (8) Chemistry educators in selected secondary schools in the Philippines using a structured questionnaire consisting of Likert-scale items and open-ended questions. Quantitative data were analyzed using weighted mean and standard deviation, while qualitative responses were examined through thematic analysis. Findings revealed generally positive perceptions toward ICKP integration, with very high ratings in perceived relevance to both instruction and learning, as well as strongly positive attitudes. Indigenous dye extraction was viewed as an effective contextual tool for explaining abstract Chemistry concepts and enhancing learner engagement. However, awareness and self-efficacy were found to be at moderate levels, indicating limited familiarity and confidence in implementing ICKP-based instruction. Thematic analysis identified several key challenges, including lack of instructional materials, curriculum constraints, limited training, heavy instructional workload, learner perception issues, and logistical barriers. Despite these challenges, ICKP integration was perceived to significantly contribute to conceptual understanding, cultural relevance, and preservation of indigenous knowledge. The study concludes that while the integration of indigenous dye extraction in Chemistry instruction is highly valued and pedagogically beneficial, its implementation remains inconsistent due to systemic and practical constraints. The findings highlight the need for enhanced institutional support, teacher training, resource development, and curriculum alignment to facilitate effective ICKP integration. This study contributes to the advancement of culturally responsive science education and underscores the role of education in bridging scientific knowledge and cultural preservation.

Keywords: Chemistry Instruction, Chemistry Instruction Barriers, Contextualized Chemistry Instruction, Culturally Responsive Teaching, Indigenous Dye Extraction, Indigenous Chemistry Knowledge and Practices (ICKP), Science Education

INTRODUCTION

Science education has increasingly emphasized the importance of culturally responsive and contextualized instruction that connects scientific concepts to learners' lived experiences and cultural backgrounds. Contemporary studies suggest that integrating Indigenous Knowledge Systems and Practices (IKSP) into science education promotes inclusivity, improves learner engagement, and enhances conceptual understanding by recognizing diverse ways of knowing beyond dominant Western scientific paradigms (Jumarito & Nabua, 2024). This perspective supports the growing movement toward culturally responsive pedagogy, which views learners' cultural experiences and local knowledge as valuable resources in the teaching and learning process.

In Chemistry education, contextualization is particularly important because many concepts are abstract, symbolic, and difficult for learners to relate to real-life situations. Studies have shown that culturally responsive approaches in Chemistry instruction can improve students' understanding by linking scientific concepts to familiar cultural practices and everyday experiences (Rahmawati et al., 2023). Indigenous practices such as

natural dye extraction provide meaningful contexts for exploring Chemistry concepts including solubility, extraction, acid-base reactions, and organic compounds. Through these culturally grounded activities, Chemistry becomes more relevant, understandable, and accessible to learners.

The growing field of ethnochemistry further highlights the educational value of integrating indigenous practices into science instruction. Ethnochemistry refers to the study of chemical ideas embedded in cultural traditions and indigenous practices. Research suggests that ethnochemistry-based instruction can improve learner engagement, strengthen conceptual understanding, and promote appreciation of local culture while simultaneously supporting the preservation of indigenous knowledge systems (Said-Ador, 2017). In the Philippine context, Said-Ador (2017) documented the use of household chemicals among Maguindanaons and emphasized that indigenous practices may serve as meaningful foundations for culturally based Chemistry lessons. Similarly, Jumarito and Nabua (2024) explained that culturally responsive STEM pedagogy allows learners to connect scientific concepts with indigenous knowledge systems, making learning more meaningful and learner-centered.

Despite these recognized benefits, the integration of Indigenous Knowledge and Practices (IKP) in science education remains limited and inconsistent. Existing literature indicates that teachers often encounter barriers such as limited training, lack of instructional materials, insufficient contextualized resources, and uncertainty in integrating indigenous knowledge into formal science instruction (Asino et al., 2024). Although educational policies encourage contextualization and culturally responsive teaching, practical implementation in classrooms remains challenging due to curriculum demands, institutional limitations, and lack of support systems. As a result, indigenous knowledge is frequently treated as supplementary content rather than as an integral component of science learning.

Another important concern is the gradual erosion of indigenous knowledge systems among younger generations. Globalization, modernization, and the continued dominance of Western-oriented educational frameworks have contributed to the marginalization of local knowledge and traditional cultural practices (Djarwo & Amsad, 2025). This decline has significant implications for cultural identity and sustainability because indigenous practices are deeply connected to community heritage, beliefs, and historical continuity. Research suggests that culturally responsive science education can contribute to the preservation of indigenous knowledge by fostering appreciation of local culture and strengthening learners' cultural identity (Rahmawati et al., 2023). Educational institutions therefore play an important role not only in scientific learning but also in sustaining and revitalizing indigenous knowledge systems.

Emerging studies further emphasize the importance of bridging indigenous knowledge with scientific pedagogy rather than treating them as separate or competing systems. Integrating indigenous knowledge into science instruction has been shown to enhance both cultural relevance and scientific understanding when implemented thoughtfully and respectfully (Borg et al., 2025). This approach is particularly relevant in Chemistry education, where culturally grounded practices such as indigenous dye extraction can serve as authentic and inquiry-based contexts for learning scientific concepts.

Although several studies have explored culturally responsive teaching and indigenous knowledge integration, there remains limited research focusing specifically on the integration of indigenous dye extraction in Chemistry instruction within the Philippine context. Furthermore, existing studies often focus on curriculum development or theoretical discussions, with limited attention given to teachers' actual perceptions, experiences, and challenges in implementing Indigenous Knowledge and Practices in classroom instruction.

Given these gaps, this study investigates Chemistry teachers' perceptions regarding the integration of indigenous dye extraction practices in Chemistry instruction as part of Indigenous Chemistry Knowledge and Practices (ICKP). Specifically, the study examines teachers' awareness, attitudes, self-efficacy, learning experiences, perceived relevance, and perceived barriers related to ICKP integration. By doing so, the study aims to contribute to the growing discourse on culturally responsive science education and provide insights into how indigenous practices may support both meaningful Chemistry learning and cultural preservation.

METHODOLOGY

This study employed a descriptive research design with qualitative support to examine the integration of Indigenous Chemistry Knowledge and Practices (ICKP), particularly indigenous dye extraction, in Chemistry instruction. The design was considered suitable because the study sought to explore teachers' perceptions, experiences, and challenges related to ICKP integration in naturally occurring educational settings.

To provide a more comprehensive understanding, the study utilized a descriptive survey approach supplemented by qualitative data. Quantitative data were gathered using structured Likert-scale items to determine teachers' levels of awareness, attitudes, self-efficacy, learning experiences, perceived relevance, and perceived barriers regarding ICKP integration. Qualitative data were collected through open-ended questions to gain deeper insights into teachers' perspectives, experiences, and implementation challenges.

Respondents and Sampling

The respondents of the study were eight (8) Chemistry teachers from selected secondary schools in the Philippines. The study employed purposive sampling in selecting the respondents. This technique was considered appropriate because the study specifically required Chemistry teachers who could provide informed perspectives regarding the integration of Indigenous Chemistry Knowledge and Practices in science instruction.

The respondents were selected based on the following criteria: (1) currently teaching Chemistry or science-related subjects in secondary schools, and (2) familiarity or experience with contextualized teaching practices or indigenous or traditional chemistry knowledge integration. Teachers were selected as the sole respondents because they are the primary implementers of instructional strategies and curriculum content, making their perspectives essential in examining the integration of Indigenous Chemistry Knowledge and Practices (ICKP) in Chemistry education.

Although the sample size was limited, the study aimed to obtain exploratory and experience-based insights rather than statistical generalization. The use of purposive sampling enabled the researchers to gather information-rich responses that contributed to a deeper understanding of teachers' perceptions, experiences, and challenges regarding ICKP integration in Chemistry instruction.

Instruments

The primary instrument used in this study was a researcher-developed structured questionnaire administered through Google Forms. The instrument was designed to gather both quantitative and qualitative data regarding teachers' perceptions of integrating Indigenous Chemistry Knowledge and Practices (ICKP) in Chemistry instruction.

The questionnaire consisted of two major sections. The first section contained quantitative items measured using a 4-point Likert scale. This section assessed six major constructs: (1) awareness of indigenous practices, (2) attitudes toward ICKP integration in Chemistry instruction, (3) self-efficacy in integrating ICKP in teaching, (4) learning experiences and exposure related to ICKP-based instruction, (5) perceived relevance of ICKP to Chemistry instruction and learning, and (6) perceived barriers to ICKP integration. The use of a 4-point Likert scale allowed respondents to express varying degrees of agreement, familiarity, confidence, and perceived relevance without providing a neutral midpoint.

The second section consisted of open-ended questions intended to elicit deeper insights into teachers' experiences, perceptions, and challenges related to ICKP integration. These qualitative responses provided contextual explanations that supported and enriched the quantitative findings of the study.

The questionnaire underwent content validation by experts in Chemistry education and science instruction to ensure the clarity, relevance, and appropriateness of the items in relation to the objectives of the study. Suggestions and recommendations from the validators were incorporated to improve the overall quality of the instrument prior to its administration.

Data Gathering Procedure and Analysis

Prior to the conduct of the study, permission to administer the survey questionnaire was secured from the identified respondents. The researchers explained the purpose of the study and assured the respondents that participation was voluntary and that all information gathered would be treated with confidentiality and used solely for academic purposes.

The questionnaire was distributed online through Google Forms. Respondents were given sufficient time to answer the questionnaire at their convenience. The use of an online platform allowed efficient data collection and facilitated accessibility for the participants. After the retrieval of responses, the data were organized, checked, and prepared for statistical and thematic analysis.

Quantitative data gathered from the Likert-scale items were analyzed using weighted mean and standard deviation. The weighted mean was used to determine the average level of responses for each construct, while the standard deviation was used to determine the consistency and variability of the respondents' responses. Different descriptive scales were used depending on the construct being measured since each variable assessed a different dimension of teachers' perceptions and experiences. The use of varied response descriptors allowed the instrument to more accurately capture the nature of each construct, such as familiarity, agreement, confidence, and frequency of practice.

For Awareness of Traditional Dye Extraction, responses were interpreted using the scale: Very Familiar, Familiar, Moderately Familiar, and Not Familiar. For Attitudes Toward Indigenous Chemistry Knowledge and Practices (ICKP) Integration, Perceived Relevance to Chemistry Concepts, and Perceived Barriers, the scale ranged from Strongly Agree to Strongly Disagree. Self-Efficacy responses were interpreted using the descriptors Very Confident, Confident, Moderately Confident, and Not Confident, while Teaching Practices utilized the scale Often, Sometimes, Rarely, and Never.

The following weighted mean ranges were used in interpreting the responses:

Table 1. Scale Descriptors

Weighted Mean Range	Interpretation
3.25 – 4.00	Very High
2.50 – 3.24	High
1.75 – 2.49	Low
1.00 – 1.74	Very Low

For the qualitative data, thematic analysis was employed to analyze the open-ended responses. Significant statements relevant to the research questions were identified and coded. Similar codes were grouped into broader themes and sub-themes representing recurring patterns in the responses. The identified themes were interpreted and integrated with the quantitative findings to provide a deeper and more comprehensive understanding of teachers' perceptions and experiences regarding ICKP integration in Chemistry instruction.

RESULTS AND DISCUSSION

This section presents, analyzes, and interprets the data gathered in the study. Quantitative results are discussed using statistical measures, while qualitative findings are presented through thematic analysis to provide deeper insights. The findings are examined in relation to the research objectives and supported by relevant literature to highlight their implications for the integration of Indigenous Knowledge and Practices (ICKP) in Chemistry instruction.

Descriptive Analysis

Table 2. Interpretation of Key Constructs

Category	Mean	**Standard Deviation**	**Interpretation**
Awareness of Indigenous Dye Extraction	2.65	.864	Moderately familiar
Attitudes Towards ICKP integration in Chemistry Instruction	3.55	0.714	Strongly Positive
Self-Efficacy in learning Chemistry	2.925	0.720	Moderately Confident
Learning Experience or Exposure	3.075	0.797	Often
Perceived Relevance to Chemistry Instruction	3.6	0.496	Strongly Positive
Perceived Relevance in Learning	3.325	0.656	Strongly positive

The findings indicate that respondents generally hold positive perceptions toward the integration of Indigenous Chemistry Knowledge and Practices (ICKP) in Chemistry instruction. Among the indicators, *Perceived Relevance to Chemistry Instruction* (M = 3.60, SD = 0.496), *Attitudes Toward ICKP Integration* (M = 3.55, SD = 0.714), and *Perceived Relevance in Learning* (M = 3.325, SD = 0.656) obtained the highest mean scores interpreted as "Very High", suggesting that respondents view indigenous practices as meaningful and relevant tools for improving Chemistry instruction and learning. These findings support previous studies emphasizing that culturally responsive and ethnochemistry-based instruction enhances learner engagement, contextual understanding, and conceptual relevance in science education (Rahmawati et al., 2023; Wahyudiati, 2024).

In contrast, *Awareness of Indigenous Dye Extraction* (M = 2.65, SD = 0.864) and *Self-Efficacy in Learning Chemistry* (M = 2.93, SD = 0.720) obtained comparatively lower mean scores than the other indicators, although both were still interpreted as *high*. These findings suggest that while teachers generally possess a strong awareness of Indigenous Cultural Knowledge and Practices (ICKP), including indigenous dye extraction, and perceive themselves as capable of facilitating chemistry learning, their familiarity with and confidence in implementing indigenous-based instructional approaches may not be as strong as their recognition of the educational value of such practices. The relatively higher standard deviations further indicate variations in respondents' levels of exposure and experience with indigenous knowledge integration. This finding is consistent with previous studies, which reported that the implementation of contextualized and indigenous-based instruction remains uneven across educational settings due to differences in teacher training, available resources, and instructional exposure (Latip et al., 2024).

Meanwhile, *Learning Experience or Exposure* (M = 3.075, SD = 0.797) indicates that respondents often encounter ICKP-related practices in teaching or learning contexts, although implementation may vary across classrooms. Overall, the findings suggest that respondents generally recognize the educational relevance of ICKP integration while also highlighting the need for greater instructional support, training, and exposure to strengthen teachers' familiarity and confidence in its implementation.

Qualitative Analysis

Table 3. Thematic Analysis of Challenges in Integrating ICKP

Theme	**Sub-themes**	**Description**	**Illustrative Responses (Codes)**
Lack of Resources and Instructional Materials	Limited authentic sources; lack of ready-to-use ICKP materials; scarcity of plant/raw materials; inadequate lab tools	Teachers struggle to find credible, usable, and locally relevant materials for ICKP integration in science lessons.	"Limited authentic sources"; "lack of accessible and reliable materials"; "very limited resources"; "plant material sources are very scarce"; "lack of instructional materials"

Curriculum Constraints	Time pressure; packed curriculum; rigid competencies	The structure and demands of the curriculum limit opportunities to integrate ICKP meaningfully.	"time constraints in the curriculum"; "curriculum is already packed"; "specific competencies hinders integration"
Limited Teacher Preparation and Training	Lack of ICKP training; uncertainty in correct application	Teachers feel unprepared and lack confidence in appropriately integrating ICKP.	"I was not really trained"; "lack of training on ICKP"; "unsure if I'm explaining things correctly"
Pedagogical and Instructional Load	Multiple lessons; diverse activities; workload demands	Heavy teaching load reduces time for lesson contextualization and ICKP integration.	"handle several lessons daily"; "prepare different activities for various topics"
Learner Diversity and Perception Issues	Cultural diversity; Western science preference	Students' varied backgrounds and preference for Western science reduce engagement with ICKP.	"students have varied cultural backgrounds"; "used to Western science"; "don't see value right away"
Contextual and Logistical Barriers	Geographical limitations; access to materials	Physical location and logistics hinder acquisition of materials needed for ICKP-based activities.	"have to travel outside the municipality"

The qualitative findings revealed that the integration of Indigenous Chemistry Knowledge and Practices (ICKP) in Chemistry instruction is affected by several interconnected challenges, particularly limited instructional resources, curriculum constraints, insufficient teacher preparation, instructional workload, learner perception issues, and logistical barriers. Respondents emphasized difficulties in accessing authentic indigenous materials and localized instructional resources, as well as limited time and flexibility within the curriculum to implement contextualized lessons effectively. Teachers also expressed uncertainty in integrating indigenous knowledge due to limited training and pedagogical support.

In addition, respondents noted that heavy teaching responsibilities and varying student perceptions toward indigenous knowledge further complicate implementation. Some teachers observed that students tend to be more familiar with Western scientific perspectives, which may reduce immediate appreciation of indigenous practices in science learning. Logistical difficulties, particularly limited access to indigenous materials in certain localities, also hindered the consistent conduct of ICKP-based activities.

These findings are consistent with previous studies highlighting that although contextualized and culturally responsive science instruction is widely recognized as valuable, implementation remains constrained by insufficient resources, limited teacher preparation, curriculum demands, and structural limitations within educational settings (Orbe et al., 2018; Pawilen, 2021; Mavuru & Ramnarain, 2024). Overall, the findings suggest that stronger institutional support, localized instructional materials, and teacher training programs are necessary to support meaningful and sustainable ICKP integration in Chemistry instruction.

Table 4. Analysis of Relevance of Cultural Practices in Chemistry Learning

Theme	**Sub-themes**	**Description**	**Illustrative Responses (Codes)**
Contextualization of Abstract Concepts	Making abstract ideas concrete; real-life connection	Cultural practices help simplify and ground abstract	"make abstract concepts concrete"; "connect abstract ideas to real-life experiences";

		chemistry concepts in everyday experiences.	"make abstract ideas more meaningful"
Enhanced Student Understanding and Engagement	Better comprehension; improved engagement; meaningful learning	Students understand chemistry better when linked to familiar cultural practices.	"better grasp concepts"; "more engaging"; "makes learning more meaningful and engaging"
Connection to Daily Life	Everyday experiences (cooking, fermentation)	Cultural practices serve as relatable entry points for scientific understanding.	"cooking or fermentation"; "everyday experiences"; "chemistry exists in their daily lives"
Localization and Contextual Learning	Culturally responsive teaching; contextualization	Teaching becomes more relevant when rooted in learners' cultural context.	"contextualization"; "important in helping learners understand"
Preservation and Value of Culture	Cultural preservation; respect for tradition	Integrating cultural practices helps preserve and validate indigenous knowledge systems.	"preserves it"; "appreciate local wisdom"; "cultural heritage"
Deepened Scientific Curiosity and Application	Inquiry; real-world application; innovation	Cultural integration stimulates curiosity and application of scientific concepts.	"increase curiosity"; "deepened chemistry understanding"; "real-world setting"

The thematic analysis revealed that respondents perceive cultural practices as highly relevant in helping students understand Chemistry concepts. The findings suggest that integrating cultural practices into instruction makes scientific concepts more concrete, relatable, and meaningful by connecting them to learners' daily experiences and cultural backgrounds. Respondents emphasized that practices such as cooking, fermentation, and indigenous dye extraction help simplify abstract Chemistry concepts and improve student engagement and comprehension.

The themes of contextualization, connection to daily life, and enhanced understanding collectively highlight the importance of culturally responsive and contextualized teaching in Chemistry education. These findings support constructivist learning perspectives, which emphasize that learners understand concepts more effectively when new knowledge is connected to prior experiences and familiar contexts (Piaget, 1952; Vygotsky, 1978). Similar studies have also shown that contextualized and ethnochemistry-based instruction improves learner engagement, conceptual understanding, and relevance of science learning (Suryawati & Osman, 2018; Seballos et al., 2025).

Respondents likewise emphasized that integrating cultural practices in Chemistry instruction contributes to the preservation and appreciation of local knowledge and traditions. This suggests that cultural integration functions not only as an instructional strategy but also as a means of validating and sustaining cultural heritage within formal education. Furthermore, respondents noted that connecting cultural practices to scientific explanations stimulates curiosity and encourages learners to apply Chemistry concepts in real-world contexts, supporting inquiry and meaningful learning experiences.

Overall, the findings indicate that cultural practices play a significant role in enhancing Chemistry learning by making concepts more engaging, contextualized, and culturally relevant. The qualitative findings also support

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the quantitative results of the study, particularly the high ratings in perceived relevance to both instruction and learning, highlighting the educational potential of integrating Indigenous Chemistry Knowledge and Practices in Chemistry education.

Table 5. Analysis of Views on ICKP Integration in Classroom Instruction

Theme	**Sub-themes**	**Description**	**Illustrative Responses (Codes)**
ICKP as a Valuable Educational Approach	Meaningful learning; inclusivity; relevance	ICKP is seen as enriching and making learning more meaningful and inclusive.	"very important"; "makes learning more meaningful"; "inclusive"; "connected to real-life experiences"
Need for Authentic and Respectful Integration	Avoid tokenism; accuracy; ethical use	ICKP should not be superficial but integrated properly and respectfully.	"integrated authentically"; "not treated as add-on"; "carefully and with respect"
Cultural Preservation and Appreciation	Heritage preservation; valuing indigenous wisdom	ICKP supports cultural continuity and appreciation of local knowledge systems.	"preserve cultural heritage"; "appreciate local wisdom"
Teacher Capacity and Support Needs	Training; resources; guidance	Teachers emphasize the need for institutional support to implement ICKP effectively.	"need more support"; "training, resources, guidance"; "proper support systems"
Curriculum and Instructional Planning Requirements	Time; alignment; proper planning	Effective integration requires structured planning and alignment with competencies.	"careful planning"; "enough instructional materials and time"
Willingness and Openness to Implement ICKP	Teacher motivation; advocacy	Teachers express willingness to adopt ICKP if conditions are met.	"I can be a volunteer"; "I would like to be an implementor"
Use of Local Materials in Science Learning	Community resources; applied science	ICKP can be integrated through local materials in experiments and activities.	"utilization of raw materials available in the community"

The thematic analysis revealed generally positive perspectives toward the integration of Indigenous Chemistry Knowledge and Practices (ICKP) in classroom instruction. Respondents viewed ICKP as a meaningful and culturally relevant educational approach that enhances inclusivity, contextualization, and learner engagement. Teachers emphasized that integrating indigenous practices helps make learning more connected to students' lived experiences while also promoting appreciation and preservation of local knowledge and cultural heritage.

At the same time, respondents highlighted that effective ICKP integration requires authentic and respectful implementation rather than superficial inclusion. Teachers emphasized the importance of proper planning, curriculum alignment, adequate instructional materials, and institutional support to ensure meaningful integration in classroom practice. The findings also revealed that while respondents generally expressed

openness and willingness to implement ICKP, they recognized the need for additional training, resources, and guidance to strengthen their capacity and confidence in applying culturally responsive teaching approaches.

Another important finding was the perceived value of using locally available materials in science activities and experiments. Respondents noted that community resources and traditional practices can make Chemistry instruction more accessible, practical, and relevant to learners' everyday experiences. These findings support previous studies emphasizing that contextualized and culturally responsive science instruction enhances learner engagement, cultural appreciation, and conceptual understanding when supported by appropriate resources and teacher preparation (Gay, 2010; Pawilen, 2021).

Overall, the findings suggest that teachers generally recognize the educational value and potential of ICKP integration in Chemistry instruction. However, successful implementation depends on the availability of institutional support, teacher preparation, curriculum flexibility, and authentic approaches to integrating indigenous knowledge within science education.

CONCLUSION

The findings of the study indicate that teachers generally hold positive perceptions toward the integration of Indigenous Chemistry Knowledge and Practices (ICKP) in Chemistry instruction. Respondents recognized the relevance and educational value of integrating cultural practices, particularly in making Chemistry concepts more meaningful, contextualized, and relatable to learners. High levels of positive attitudes and perceived relevance suggest that teachers view ICKP as a valuable approach in improving both instruction and learning experiences in Chemistry education.

The study also revealed that cultural practices contribute significantly to students' understanding and engagement by connecting abstract scientific concepts to familiar real-life experiences. Themes such as contextualization, connection to daily life, and enhanced engagement highlight the importance of culturally responsive and contextualized instruction in promoting meaningful learning. Additionally, respondents acknowledged the role of ICKP integration in preserving and appreciating local knowledge and cultural heritage within formal science education.

Despite these positive perceptions, the findings further revealed several challenges affecting the implementation of ICKP in Chemistry instruction. These include lack of instructional materials and resources, curriculum constraints, limited teacher preparation and training, instructional workload, learner perception issues, and logistical barriers. Such findings suggest that while teachers are generally willing and open to integrating ICKP, practical and institutional limitations continue to hinder its consistent implementation in classrooms.

Overall, the study concludes that ICKP integration has strong potential to enhance Chemistry instruction by making learning more culturally relevant, engaging, and meaningful. However, successful implementation requires adequate institutional support, localized instructional materials, teacher training, curriculum flexibility, and authentic integration practices to ensure that ICKP is meaningfully and sustainably incorporated into Chemistry education.

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