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Incorporating Local Craft in Chemical Processes to Enhance Students' Comprehension of Concepts and Interest in Chemistry

[1*]Sylvester Adebisi Olude, [2]Olajumoke Shakirat Oludipe, [3]Sakibu Olajide Saibu, [4]Ibukunolu A. Ademola, [5]Tunde Owolabi, [6]Hakeem Akintoye

[1]Natural Science Education Department, College of Science Education, Lagos State University of Education, Oto/Ijanikin, Lagos, Nigeria
[2,4,5,6]African Centre of Excellence and Transformative STEM Education, Lagos State University, Ojo, Lagos, Nigeria
[3]Natural Science Education Department, College of Science Education, Lagos State University of Education, Oto/Ijanikin, Lagos, Nigeria

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* *Corresponding author.*
E-mail: oludeas@lasued.edu.ng

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A B S T R A C T

This study investigated the integration of local craft activities involving chemical processes into chemistry teaching as a strategy to address challenges in schools, where inadequate resources and equipment often hinder effective instructional delivery. A non-equivalent pre-test and post-test quasi-experimental design was employed. Using simple random sampling, two senior secondary schools in Badagry, Lagos State (District V), were selected, with two intact classes comprising 68 for the experimental group and 74 students for the control group, making a total of 142 respondents. The research instruments included a Chemistry Achievement Test (CAT) and Chemistry Students Interest Questionnaire (CSIQ), both validated and subjected to reliability testing via a test-retest method, yielding coefficients of 0.80 and 0.78, respectively. Findings revealed that students demonstrated better comprehension when working with locally available materials [$F(1,198)=19.82$; $p<0.05$] in schools. Additionally, their interest in pursuing chemistry courses increased [$F(1,198)=13.04$; $p<0.05$]. The study concludes that integrating local craft activities into chemistry instruction showcases real-life applications of chemical processes, enhancing student comprehension and a deeper appreciation of the subject. The study recommends that workshops and conferences should be put in place to up-date teachers' knowledge and make available necessary materials for the smooth running of the programme.

1. Introduction

Chemistry, as a core science, plays a pivotal interdisciplinary role in understanding chemical processes within physical, biological, ecological, and engineered systems. These processes have far-reaching implications for human health and environmental sustainability (Wissinger et al., 2021). Capitalising on this role requires interdisciplinary exchanges among natural sciences, social sciences, humanities, and the arts. Chemistry is a central science subject required at the senior secondary school certificate level for admission into most basic and applied science courses at tertiary institutions (Zephrinus et al., 2015). It is essential for human capacity development, modernization, and personal empowerment (Ayodele, 2018). Knowledge of chemistry is vital across various fields, including health, petrochemicals, and food processing, contributing significantly to economic growth and development (Bamidele et al., 2013).

African societies are renowned for their rich heritage of local crafts, which reflect the ingenuity and creativity of their people. These crafts encompass diverse practices such as pottery, dyeing, soap-making, brewing, leather tanning, bead-making, and traditional medicine preparation. Each craft relies on generations of indigenous knowledge and incorporates a profound understanding of materials and processes, often rooted in chemistry. Many of the local crafts, like blacksmithing, soap making, and the local gin, are closely related to the scientific concepts taught in chemistry today (Adebayo & Olatunji, 2023). However, studies have continued to show that instructional approach has remained the most implicated factor for students' poor achievement in chemistry (Konyefa & Nwanze, 2020; Enekwechi, et al., 2019). Students' low performance in chemistry is a great concern to all stakeholders, especially in external examinations such as National Examination Councils and Senior Secondary School Examinations.

The West African Examinations Council (WAEC) has expressed concern over the decline in the performance of candidates in science, specifically chemistry (Kale-Derry, 2019; Sakiyo & Badau, 2015). This is attributed to the perceived abstract nature of chemistry which made students develop low or no interest in the subject while some termed chemistry as a difficult subject because of chemical processes and reactions. Researchers have attributed these to the non-provision of conducive classrooms and laboratory facilities, the inadequacy of qualified chemistry teachers, the lack of motivation for chemistry teachers, and the inadequate provision of instructional materials for learning chemistry (Abumchukwu, et al., 2021;(Okebukola, 2018).

Zephrinus et al. (2015) stressed that a high level of abstraction of chemistry concepts with no or inadequate laboratory resources for demonstration and experimentation is responsible for the decline in chemistry performance among young learners. This poor performance according to the WAEC Chief Examiners' Report is as a result of students' inability to construct an understanding of basic chemistry concepts (WAEC, 2018). Also, Ineffective teaching strategies, limited exposure to hands-on laboratory activities, and inadequate resources contribute to this trend (Njoku, 2007). Another issue is students' interest in studying chemistry. Interest is useful in predicting the success and the satisfaction that an individual is likely to obtain from engaging in certain activities now and in future. Low interest contributes to poor performance and achievement in chemistry (Igboanugo, 2013). Egolum, et al. (2021), stated that the conventional method renders the student passive while the teacher gets the monopoly of the teaching-learning activities and the students' interest in the lesson becomes very minimal.

Anor et al., (2022) pointed out that if chemistry is not properly and pedagogically taught, it will interfere with students' learning by making them unable to construct an understanding and relate principles in chemistry to real life situations. In some schools, proper laboratories are often nonexistent or poorly equipped, limiting hands-on experiments that are crucial for understanding scientific concepts (Adams & Newton, 2020). These schools, often characterised by resource deficits, lack proper laboratories, equipment, and qualified teachers, making it difficult to deliver effective science education (UNESCO, 2021). The situation also leads to the development of negative attitudes towards chemistry. Ugwu and Diovu, (2016), submitted that meaningful learning occurs when there is an interaction between the learners' appropriate elements in the knowledge that already exists and the new materials to be learnt. One solution to address these challenges is incorporating local crafts and their underlying chemical processes into the chemistry curriculum. This gap can be filled by incorporating real-world experiences into chemistry instruction, giving learners a more practical and meaningful understanding of abstract concepts (Olude et al., 2024).

Understanding chemical processes in local practices, such as those involved in cooking, cleaning, or local crafts like dyeing and pottery, not only enhances scientific literacy but also enables students to apply their knowledge in practical activities, fostering problem-solving skills and innovation (Adebayo et al., 2018). Local crafts, such as soap making, fabric dyeing, fermentation, and pottery, involve chemical concepts directly aligned with the curriculum (Adebayo et al., 2018). For example, traditional fabric dyeing introduces concepts like solubility, pH, and colour chemistry, while fermentation explores biochemical reactions involving microorganisms. The interconnectivity between local craft practices and chemistry concepts might go a long way bringing chemistry home to the learners thereby making them see the relationship between indigenous knowledge and modern chemistry. This interconnectivity could be achieved using an ethnochemistry-based instructional package. Most chemistry concepts can be observed in some indigenous practices of students' culture in their environment which the teacher can organize and apply in classroom to sensitize and create curiosity in students for better achievement (Adam et al. 2024; Idah & Odume, 2019). These culturally relevant activities may help bridge the gap between students' everyday experiences and theoretical chemistry, promoting deeper understanding and engagement (Bamidele & Fashola, 2022). Such approaches are cost-effective, relying on locally available materials, and are particularly suited to resource-constrained settings (Okafor & Oluwole, 2020).

Culturally responsive teaching leverages students' cultural experiences and knowledge as tools for effective learning (Rychly & Graves, 2012). The use local craft in chemistry teaching aligns with constructivist learning theories, which emphasised building new knowledge on learners' prior experiences (Chibuye et al., 2024). Also, Akinyemi and Fagbohun (2019) emphasised the importance of incorporating cultural relevance into science teaching, particularly in Nigeria, as a strategy to enhance learning outcomes. Contextualising science education within the cultural and everyday experiences of students makes scientific concepts more relatable and accessible.

This may help students to gradually increase their learning of chemistry concepts as the teacher progresses in the scientific analysis of their ethnochemistry practices unlike the conventional instructional approaches common among chemistry teachers (Okwara & Upu, 2017). The use of locally available resources in teaching in African societies are rich with science concepts that can enhance the teaching of physics, chemistry, and biology but remain underutilised in classrooms (Owolabi, 2010). Nations such as Japan, India, and Kenya have successfully integrated Western science with indigenous practices to create unique scientific advancements (Odo, 2013).

Incorporating local crafts into chemistry teaching can foster hands-on learning, inquiry-based activities, cooperative learning, and performance assessments (Khupe, 2014). These activities are not only contextualise learning but also enhance students' scientific literacy and problem-solving skills in chemistry teaching (Amugune et al., 2019). The incorporation of reaction of chemical processes in local craft, for example, soap-making activities illustrate saponification, while dyeing fabrics demonstrate principles of solubility and pH. Studies have shown that contextualised learning approaches improve students' understanding, interest, engagement, and retention of scientific concepts (Okafor & Oluwole, 2020). By using local craft in teaching chemistry, educators can create culturally relevant and cost-effective lessons that make chemistry relatable to students' lives. Findings of Ugwu (2018), revealed that students' interest in chemistry was improved significantly with the incorporation of ethnochemistry practices into curriculum delivery.

One creative and culturally sensitive way to solve the issues facing schools with limited resources is to incorporate local crafts and chemical processes into chemistry instruction. This strategy of instruction engages the students with discussions and analysis of chemically related real life experiences in the socio-cultural practices of their immediate community (Fasasi, 2018). This will increase students' engagement, enhance comprehension, and give students skills applicable to the real world by utilising local craft with relevant chemical reactions and customs. This approach bridges the gap between community traditions and contemporary scientific understanding, improving science education quality while simultaneously promoting sustainable development.

Theoretical Framework

Vygotsky's sociocultural learning theory, which offers a thorough framework for comprehending how social and cultural interactions impact learning, is adopted in this study. Vygotsky believed that learning was a dynamic interaction between people and their surroundings rather than an isolated process. The approach emphasises how crucial social cooperation is and how culture shapes the educational process. The Zone of Proximal Development (ZPD) and the More Knowledgeable Other (MKO) are two essential ideas at the heart of Vygotsky's theory: A person who is more knowledgeable, skilled, or experienced in a certain field than the learner is referred to as the MKO. This person who helps the learner acquire new information or develop a skill could be a teacher, a peer, or even a member of the community. By offering clarifications, examples, or resources that enable the learner to participate in activities that might otherwise be beyond their grasp. The range of tasks that a student can do with an MKO's help but is still unable to complete on their own is known as the ZPD. It stands for the "sweet spot" of learning, where the learning is challenging enough to foster growth without becoming demoralising. This zone, where help progressively diminishes as the student gains proficiency, is where effective teaching and learning take place, because local crafts are so integrated in cultural customs in which students may relate to and find value in them. Teaching saponification, for instance, through the traditional soap-making process where local soap called Ose Dudu offers a framework that is known to the culture and promotes meaningful learning. Students are better able to relate chemistry to their daily lives and the local economy. Craft-based projects encourage collaboration and information sharing.

Chemistry lessons that incorporate local crafts help students connect scientific ideas with their prior knowledge. For instance, students are exposed to the chemical reactions that take place when caustic soda is added to boiling oil through the process of creating soap locally.

Vygotsky's theory posited that when students' collaborative knowledge is gained through interactions with others in the community. During the production of black soap (*Ose dudu*), students engage in collaborative learning by working together, sharing ideas, and solving problems. For instance, they might discuss the choice of local materials and their role in the saponification process. This gives a culturally relevant context for understanding the chemical process of saponification. This connection bridges the gap between abstract chemical concepts of soap reactions and real-life applications. When the students are guided by the teacher, scaffolding learning process is applied which enable students to master the concept of saponification. The locally available materials are termed as learning aids and they learnt scientifically and culturally.

Research Questions

i. How does the integration of local crafts and chemical processes affect students' comprehension of chemistry concepts?
ii. Does the integration of local crafts and chemical processes impact gender differences in students' comprehension of chemistry concepts?
iii. To what extent do activities involving local crafts and chemical processes enhance students' interest in chemistry?

Hypotheses

The following null hypotheses were formulated to guide the study.

1. Integrating local craft and chemical processes has no significant effect on students' comprehension of chemistry concepts.
2. Integrating local craft and chemical processes has no significant effect on gender differences in students' comprehension of chemistry concepts.
3. Using local crafts and chemical process activities does not significantly enhance students' interest in chemistry.

2. Methodology

Research Design

This research adopted a quasi-experimental pretest, and posttest nonequivalent groups using two intact classes because randomisation would disrupt normal classroom activities. This design was used to identify the effect of new strategies adopted in teaching and learning chemistry using local crafts processes and resources. Therefore, a 2x2 factorial matrix consisting of an instructional strategy was employed.

Population and Sample

The population of this study comprised all senior secondary school chemistry students in co-educational public secondary schools in Lagos state. A total of one hundred and forty-two students were selected from two intact classes. Two senior secondary schools with relatively similar characteristics in terms of teachers' qualifications, locality and student population were purposefully selected out of all senior secondary schools on the outskirts of Lagos state where practical materials are not fully available. One of the schools was assigned an experimental group and the other as a control group. The chemistry students in the two nonequivalent intact classes of SS3 schools formed the samples for the study because fat and oil were part of the scheme of work in the first term. Both classes comprised male and female students. Thus, the sample size comprised 68 in the experimental group taught using local craft processes and 74 in the control group.

Research Instruments

The research instruments used by the researcher were a Chemistry Achievement Test (CAT) and a self-designed Chemistry students' Interest Questionnaire (CSIQ). The instruments were face and content validated by three specialists. The specialists were chemistry teachers who are still teaching chemistry in government secondary schools with 15 years teaching experience. The instrument, Chemistry Achievement Test (CAT) items were drawn from past West African Examination Council (WAEC) and

National Examination Council (NECO) past questions based on the content of the saponification chemistry Curriculum and a questionnaire on students' interest in chemistry. The chemistry achievement test was divided into two parts: Section A comprised the Bio-data of respondents while Section B consisted of 20 multiple choice questions with four options lettered A-D, the options for each question had one key and three distractors on the topic taught by the researchers. Also, the questionnaire contained two sections. Section A contained demography information of the respondent and section B had twenty statements on students' interest in chemistry using local craft in teaching chemistry concepts. Four Likert scales of strongly agreed, agreed, strongly disagreed and disagreed were employed.

The respondents were required to answer all questions. To establish the content validity of the instruments, the instruments were given to experienced chemistry teachers from a senior secondary school in Lagos State. A test-retest method was conducted using twenty students to determine the reliability of the instruments. Test scores of the two administered tests were determined with the Spearman-Brown formula which yielded a high-reliability index of 0.80 and 0.78 respectively. This warranted the usage of the instruments for the study.

Procedures for Data Collection

The researchers sought approval from Education District V via the Ministry of Education, Lagos state, to have access to the selected senior secondary schools selected for the study. Lagos state is structured into six education districts based on geographical location. Education district V has Amuwo Odofin and Badagry areas. Thereafter, the Researchers went to each school to brief the chemistry teachers about the purpose of the study and get familiar with the students to enhance smooth participation in the research study. One chemistry teacher in the first school tagged a (Experimental Group), and the school tagged B (Control Group).

The reason for engaging their regular chemistry teachers was to teach the students and help eliminate any form of bias that would have occurred if the researcher had been directly involved in teaching the students. A visit was also paid to the community where local soap production is a basic job to get familiar with them and the environment. The researchers interacted with the owner of the craft where the practical was chosen for demonstration, describing the purpose of the study and why it needed to be carried out.

The experimental group's chemistry teacher was trained on how to incorporate local craft resources to teach chemistry concepts on saponification, with students' involvement. The teacher in the control group was also briefed on how to handle students using the lecture method to teach every process involved. The briefing lasted for one week. Using available local materials in teaching saponification to the experimental group by chemistry teacher using Teacher Instructional Guide on Local Craft Strategy (TIGOLCS).

Phase 1: Pre-Intervention Phase

This phase involved the administration of a pre-test of the CAT to all the sampled SS3 students to determine their achievement before the treatment. This was done to ensure the similarity/homogeneity of the two groups before starting the intervention. This lasted for one week in each of the selected schools.

Phase 2: Intervention Phase

The second phase involved treatment administration in the groups.

Experimental Group (Local craft strategy mode of instruction)

The experimental group adopted a student-centred teaching strategy that involved feedback: After the lesson, teachers review feedback for improvements for the next lesson. This lasted for three weeks and included. This included

i. Interactive Lessons: Concepts were introduced through a practical activity about the use of local crafts and chemical processes in teaching saponification.
ii. Practical Sessions: Students actively participated in the experiment.

Soap production (black soap, known as *Ose dudu*) was chosen based on their curriculum, relevance and availability of raw material in the community and its connectivity to the chemistry topic Saponification.

Preparation of Soap (Saponification, known as Ose sise): Demonstrating the reaction between fats & oils and alkalis. The research emphasizes hands-on experiments using everyday materials. Soap Making: Students produced soap from oil (extracted from palm kernel) and sodium hydroxide (formed from local materials).

Production materials

1. Cocoa pods (dried)
2. Palm kernel oil (or palm oil)
3. Water
4. Large metal pot
5. Stirring stick

Procedure

Step 1: Preparation of cocoa husks into ashes by burning.

Students collected dried cocoa husks and burned them in an open area until they were completely reduced to ash. They collected burnt ashes and sieved the ash to remove large particles. See figure: 1-2

Step 2: Extraction of Alkali.

Students added the sieved ash to distilled water in a large pot and boiled the mixture for about 1–2 hours. This allowed the soluble potassium carbonate (K_2CO_3) to dissolve in the water. They filter the solution through a sieve to remove any solid residue. See figure. 3

Step 3: Mixing with Oil

Students heat palm kernel oil in a large metal pot and slowly add the alkali solution (from Step 2) to the heated oil while stirring continuously. They continue stirring until the mixture thickens and starts to trace (forms soap). See figure: 4

Step 4: Pouring the Soap.

Students pour the mixture into moulds. They allowed the soap to cool and solidify for 24–48 hours. Cut the soap into desired shapes and allow it to cure for 2–4 weeks in a well-ventilated area. See figure: 5-8

While the students were carrying out the practical activity, safety rules and regulations were observed. The Students wore gloves and protective eyewear when handling ash and boiling mixtures to avoid chemical burns. The practical was carried out in a well-ventilated area to avoid inhaling fumes. They ensured that all equipment and material used for soap-making were cleaned and non-reactive (avoid aluminum pots). They handled the alkali solution carefully as it is caustic.

Figure 1. Burning of Cocoa Husks

The dried cocoa husks were placed in a clay pot or metal container, and burned at a high temperature until they turned to fine ash, with controlled burning ensured to prevent incomplete combustion

Figure 2. Burnt Cocoa Husk

Figure 3. Boiling Oil

Figure 4. Extracted Caustic Soda

The ash was mixed with water and soaked for several hours or overnight, then filtered using a fine cloth or sieve to extract the potash solution, which served as the saponification agent in soap production. Palm kernel oil was heated in a large pot, and the potash solution was gradually added while stirring continuously. Gentle heat was maintained to allow the oil and potash to react, forming a soap mixture through saponification.

Figure 5. The Mixture of Boiling Oil and Soda Ash

Figure 6. Solid Soap

The soap mixture was poured into molds and left to cool and solidify, a process that may take several hours.

Figure 7**.** Pounding of the Solid-State Soap

Phase 3: Post-Intervention Phase

After three weeks of teaching, the reshuffled version of the same instrument used as pre-tests (CAT) and questionnaire were administered by the researchers to the students in experimental and control groups as post-tests. The test scripts were collected by the researchers for marking and were recorded their scores for further processing. Rules and regulation as regard conduction of test was observed.

Figure 8. Local Soap is Allowed to Dry

Figure 9. Washing Hands with Local Soap Produced

iii. Reflection : Students document observations, analyse results, and discuss real-world applications.

Control Group *(Lecture method)*

In this group, the teacher adopted a lecture method of teaching, which also lasted for three weeks. The teacher explained every step involved in the teaching of saponification on the board without any practical activity. He also stated further steps involved in producing soap.

3. Results and Discussion

The demographic data of the respondents involved in the study were analysed using pie charts, the research questions were answered with mean and standard deviation, while the null hypotheses were tested with analysis of covariance (ANCOVA) at 0.05 significance level using SPSS 23.0 package.

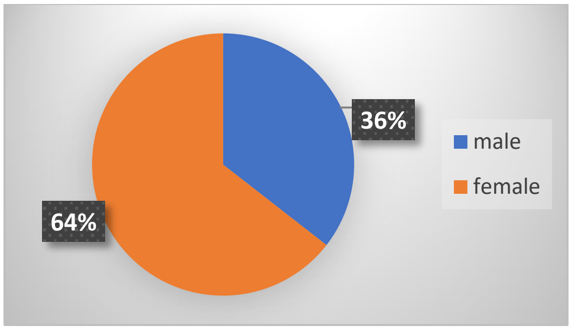

Figure 10. Demographic Data of Male and Female Participants

Figure 10 shows that 64% of the respondents are female while 36% of the students are male.

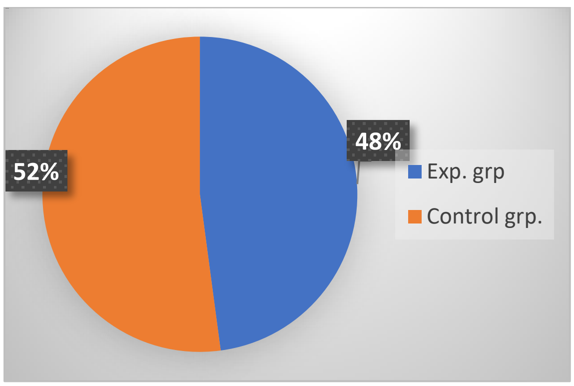

Figure 11. Participants in The Experimental and Control Group

Figure 11 shows that 48% of the students are in the experimental group while 52% are in the control group.

Research Question One: How does the integration of local crafts and chemical processes affect students' comprehension of chemistry concepts?

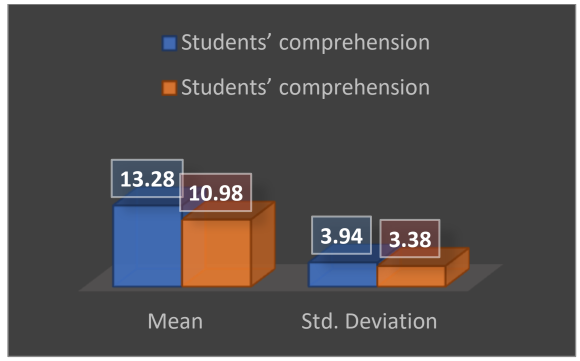

Figure 12. Mean and SD Showing the Difference in the Students’ Comprehension of Chemistry Concepts when Taught using Local Craft and Chemical Processes

Figure 12 shows the difference in the students’ comprehension of chemistry concepts when taught using local craft and chemical processes. Experimental group had the mean score of 13.28 and standard deviation of 3.94; while the control group taught using lecture method had mean score of 10.98 and S.D of 3.38 in the post test. Therefore, the students in the experimental group achieved higher than the lecture or control group.

Hypothesis one: Integrating local craft and chemical processes has no significant effect on students’ comprehension of chemistry concepts.

Table 1. ANCOVA Showing the Difference in the Students’ Comprehension of Chemistry Concepts when Taught using Local Craft and Chemical Processes

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	np^2
Intercept	426.30	1	426.30	77.69	.00	.55
Pretest	1468.61	1	1468.61	239.98	.00	.42
Groups	15.21	140	15.21	19.82	.00	.36

Table 1 shows statistically significant difference in the students’ comprehension of chemistry concepts when taught using local craft and chemical processes [$F(1,140)=19.82$; $p<0.05$]. The partial eta squared estimate reveals that the treatment was responsible for 35.9% of the students’ comprehension of chemistry concepts. This implies that students who are taught chemistry concepts using local craft and chemical performed better in chemistry concepts than those taught with lecture method.

Research Question Two: Does the integration of local crafts and chemical processes impact gender differences in students' comprehension of chemistry concepts?

Figure 13 shows that male students taught using local craft and chemical processes had a mean score of 16.08 and standard deviation of 4.00, while the while the female students had a mean of 15.57 and SD of 4.91 in comprehension test.

Table 2. ANCOVA Showing Gender Difference in Students' Comprehension of Chemistry Concepts s when Taught using Local Craft and Chemical Processes

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	np^2
Intercept	426.30	1	426.30	77.69	.000	.133
Pretest	1468.61	1	1468.61	239.98	.000	.112
Gender	11.39	66	11.39	14.56	.304	.000

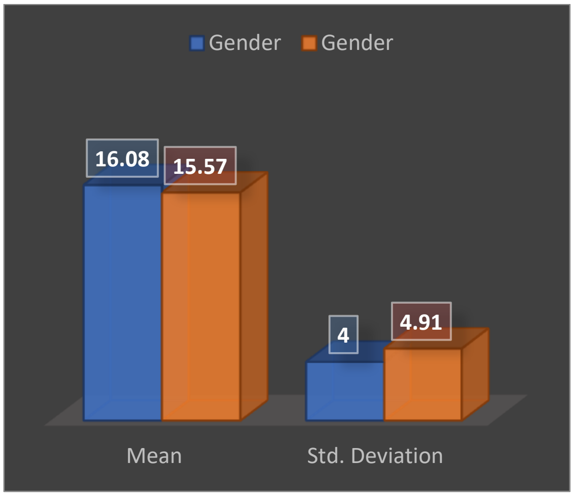

Figure 13. Mean and SD of Effect using Local Craft in Chemistry Teaching on Gender Difference in Students' Comprehension of Chemistry Concepts

Hypothesis two: Integrating local craft and chemical processes has no significant effect on gender difference in students' comprehension of chemistry concepts.

To determine if the difference is statistical significant, Table 2 reveals that male and female students do not statistically differ in their comprehension of chemistry concepts when taught using local craft and chemical processes [F(I,66)=14.56; p<0.05]. The partial eta squared estimate of .00 shows no gender differences in students' comprehension of chemistry concepts. This implies that gender of the students doesn't determine students' comprehension when they are both exposed to treatment

Research Question Three: To what extent do activities involving local crafts and chemical processes enhance students' interest in chemistry?

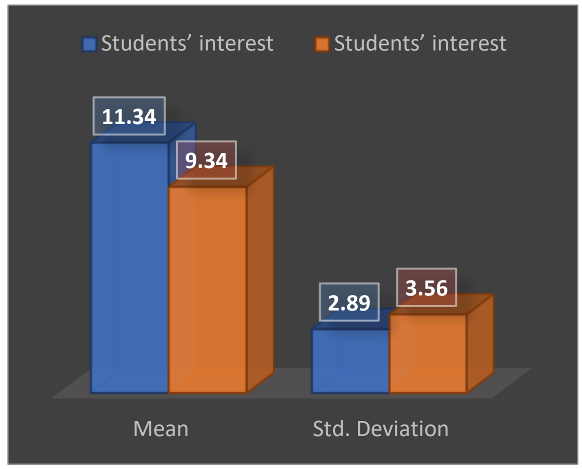

Figure 14. Mean and SD of the Effect of using Local Craft in Chemistry Teaching on Students' Interest

Data analysis in figure 14 shows that students in the experimental group taught using local craft and chemical processes had a mean interest score of 11.34 and standard deviation of 2.89, while the control group taught using the lecture method had a mean interest score of 9.35 and SD of 3.56 in chemistry. To determine the significant effect.

Hypothesis Three: Using local craft and chemical processes activities does not significantly enhance students' interest in chemistry.

Table 3. ANCOVA Showing the Effect of using Local Craft and Chemical Processes Activities on Students' Interest in Chemistry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	np^2
Intercept	426.30	1	426.30	77.69	.000	.324
Pretest	1468.61	1	1468.61	239.98	.000	.211
Interest	10.23	140	10.23	13.04	.021	.170

Table 3 reveals that using local craft and chemical processes activities on students' interest in chemistry [F(1,140)=13.04; p<0.05]. The partial eta squared estimate reveals that the treatment was responsible for 17.0% of the students' interest in chemistry. This result depicts that teaching students using local crafts and chemical processes activities enhance their interest in chemistry.

The study findings from hypothesis one revealed that students who were taught chemistry concepts using local craft in chemical processes performed better in chemistry concepts than those taught with lecture methods. This indicates that the use of local crafts and chemical processes-based approaches is more effective in enhancing chemistry students' academic achievement than the conventional lecture method. This result aligns with the study conducted by Abumchukwu, et al., (2021) who found and reported that; students taught chemistry concepts through the Ethnochemistry-based approach have higher academic achievement than those taught the same chemistry concepts through the conventional method.

Also, the study findings lend credence to the finding of Oluwatosin et al. (2017) that students taught chemistry using an ethno-chemistry instructional approach achieved significantly higher than the students in the control group. Conventional chemistry teaching approaches sometimes fall short of making a connection with students' real-world experiences, which causes detachment in learning science (Olude et al., 2024). The finding of the study also goes along with the finding of Okwara and Upu (2017) that the experimental group taught using a locally enriched instructional approach had a significantly higher mean achievement score than their counterparts in the control group.

The findings of Oladejo et al., (2021) showed that there was a significant difference between the Culturo-Techno-Contextual Approach and the traditional method in students' academic achievement in favour of the former. This finding aligns with Anor et al. (2022) that relevance of concepts taught to students is also likely to encourage students' engagement in lessons thereby helping them to construct knowledge and understanding as well as to develop skills and competences building up personal scientific literacy. When students are engaged with concept they are aware of using locally available resources, they tend to appreciate and learn better than interacting with materials they are not familiar with.

Result of the hypothesis revealed that, there is no difference descriptively between the academic achievement of male and female chemistry students taught chemistry concepts using local craft in a chemical processes-based approach. However, the difference was not statistically significant. This finding also indicates that because all students are carried along during the lesson right from their background knowledge up to the interaction with instructional materials (local craft materials) irrespective of their gender differences, both male and female performed adequately. This discovery is line with the findings of Ugwu and Diovu (2016), that the integration of indigenous knowledge and practices into chemistry teaching has no significant effect on male and female students' achievement.

Also, this goes in line with the contribution of Onyewuchi and Owolabi (2022), clearly stated it that with the same indigenous knowledge system, it is expected that when the teacher draws from it and relates to the class work no gender will be endangered or disadvantaged. This is in conformity with Ahmad and Halliru (2022), who stated that most of the ethno-chemistry practices employed during the treatment session to teach relevant chemistry concepts that are new to the students soundly familiar to both male and female students right from home and this makes learning of those concepts taught meaningfully retained irrespective of gender difference.

It also agreed with Abumchukwu, et al. (2021), who discovered that the results of the students regardless of gender were carried along during the instruction and actively participated. Mukuka (2019) contradicted the finding of this study in terms of gender; the study revealed the existence of significant difference in academic achievement of male and female students taught Ecology concepts using Ethnobiology-Discussion method in favour of male students. Incorporating local craft in chemical processes engages the students with discussions and analysis of chemically related real-life experiences in their locality, increasing their learning of chemistry concepts and gaining an understanding of the concept thereby giving leverage opportunity for achievement.

Results of the findings revealed that using local craft and chemical processes activities on students' interest in chemistry. This statement agreed with Bamidele and Fashola (2022), that the introduction of indigenous and local crafts in teaching chemistry aids cognitive development and enables students to see the relevance of chemistry in their lives, increasing their motivation to learn. Also, in line with Ugwu and Diovu (2016), local activity in teaching chemistry improved interest in ethnoscience which is also Indigenous science could be due to the wealth of knowledge and experiences of both male and female students from cultural practices. This is not in line with the study conducted by Ugwu (2017), revealed that male students had a higher mean interest score in the experimental group than their female counterparts in CIS although the difference was not significant

4. Conclusion

Integrating readily available materials and culturally relevant practices, this study demonstrates that incorporating local crafts into chemical processes offers a viable and innovative approach to teaching chemistry in underprivileged secondary schools in Lagos State. By showcasing real-life applications of chemistry, this method enhances student engagement and fosters a deeper understanding of the subject. Furthermore, it addresses the challenges posed by inadequate laboratory facilities by promoting resourcefulness among teachers and students, thereby creating a more accessible and meaningful chemistry education experience.

Recommendations

1. The chemistry curriculum should be updated by educational authorities to incorporate activities that enhance indigenous knowledge and local crafts, making sure that these are in line with the curriculum's goals.
2. Adequate information should be made available through workshops and conferences for educators needed to incorporate local crafts into their lesson plans, and regular professional development programs should be organised.
3. Schools should work with local communities and artists regional craft ideas that may be modified to teach chemical topics.
4. The government should assist by setting aside money for the creation of educational resources and rewarding educators who use cutting-edge teaching strategies.
5. Non-governmental organisations should be involved to promote collaborations between educational institutions, nearby businesses in enhancing the quality of education.

Implications of the Study

The integration of local craft into chemical processes would improve students' interest and engagement in chemistry, thereby increasing academic performance. Chemistry teachers in secondary schools should adopt innovative, low-cost methods to deliver quality education despite limited resources improving practical skills that could lead to entrepreneurship opportunities, and fostering economic empowerment. By using locally available and environmentally friendly materials, the study supports sustainable educational practices that would enhance learning and also promote the preservation and appreciation of indigenous knowledge and culture.

References

Abumchukwu, A. A., Eke, J. A., & Achugbu, C. N. J. (2021). Effects of Ethnochemistry Instructional Strategy on Secondary School Students' Achievement in Chemistry in Onitsha Education Zone. *African Journal of Science, Technology & Mathematics Education*, *6*(1)pg 121-128.

Adam, U. A., Lameed, S. N., Owolabi, T., Onowugbeda, F. U., Oladejo, A. I., Okebukola, P. A., & Mustapha, G. A. (2024). The Potency of Culture, Technology, and Context in a Biology Classroom: Culturo-Techno-Contextual Approach in Action. *International Journal of Science Education, 1-26.*https://doi.org/10.1080/09500693.2024.2405667

Adebayo, T., & Olatunji, K. (2023). Integrating Traditional Knowledge Into STEM Education: A Case for Disadvantaged Schools. J*ournal of Science Education and Innovation, 15(3)*, 45–58.

Adebayo, T., Ogunleye, A., & Oke, O. (2018). Using Everyday Materials to Teach Chemistry: A Nigerian Perspective. *Science Education International*, *29(4)*, 243–252.

Adams, P., & Newton, D. P. (2020). Science Education in Resource-Constrained Environments: Addressing the Challenges. *Journal of Educational Development, 45(3),* 15–25.

Ajagun, G.A. (2006). Towards Good Performance in Science Education. *Journal of Teacher Education and Teaching, 2*(1), 117-125.

Ahmad, S. S., & Halliru, A. (2022). Effects of Ethnochemistry-Based Approach on Chemistry Students' Academic Achievement and Retention in Malumfashi Educational Zone, Katsina State, Nigeria. *African Journal of Science, Technology, Mathematics, and Education (AJSTME), 8(8),* 658–670. https://www.ajstme.com.ng

Akinyemi, K. & Fagbohun, A. (2019). Enhancing Science Teaching Through Cultural Relevance: Lessons from Nigeria. *African Journal of Educational Research, 15(2),* 121–134.

Anor, C.E., Lundell, J., Hanson, R., & Oppong, E. (2022). Students' Engagement in Learning by Indigenous Knowledge-Chemistry

Lesson. *LUMAT: International Journal on Math, Science and Technology Education*, *10(1)*, 388–414.

Ayodele, O. D. (2018). Re-Structuring Secondary School Chemistry Education for Sustainable Development In Nigerian Developing Economy. *Chemistry Education in Nigeria.*

Chibuye, B., & Singh, I. S. (2024). Integration of Local Knowledge in the Secondary School Chemistry Curriculum: A Few Examples of Ethno-Chemistry from Zambia. *Heliyon*, *10*(7), e29174.

Egolum, E. O., Samuel, N. N. C., & Okonkwo, I. G. A. (2021). Enhancing Students' Interest in Chemistry Through Inculcation of Problem-Solving Skills. *South Eastern Journal of Research and Sustainable Development*, *4*(2), 116–130.

Garuba, M.A., Agweda, F. E., & Abumere, D. I. (2012). The Contribution of Science and Technology Education to National Development: The Nigerian Experience. *Journal of Education and Practice*, *3(1)*, 16–21.

Idah, N. N and Odume, C. O (2020). Ethno-Chemistry Teaching Strategy – A Means of Bridging the Gender Gap in Secondary School Chemistry Achievement for National Development. *Enugu State College of Education Technical (ESCET) Journal of Education*, *1(1).*

Igwe, I.O. (2015). Secondary Education Chemistry Curriculum Implementation in Nigeria:Contending Issues and Innovative Approaches for the Future. *Journal of Life and Applied Sciences*, 24-33.

Kale-Derry, S. (2019). Drop in WASSCE performance worrying. Daily Graphic, p. 26

Konyela, B.I., & Okigbo, E.O. (2021). Effect of Ethno-Chemistry Instructional Approach on Secondary School Students Interest in Chemistry in Bayelsa State. ISR *Journal of Research and Method in Education* (ISOR – JRME), 11(5), 12–19.

Konyefa, B. I., & Nwanze, A. C. (2020). Integrating WhatsApp Application into the Learning Process: Effects on Pre-Service Teachers' Interest in Chemistry in Colleges of Education. *International Journal of Innovative Research and Advanced Studies (IJIRAS)*, *7*(9), 121–125.

Khupe, C. (2014). Indigenous Knowledge and School Science: Possibility for Integration. A Ph.D Thesis, University of the Witwatersrand, Johannesburglearning of chemistry in Enugu education zone. *In 57th annual conference proceedings of STAN (pp. 433–446).* Abuja: The STAN Place Ltd.

Mukuka, E.M. (2019). Does Ethno-Biology Improve Pupil's Understanding in Ecology? A Case of Lubuto Secondary School in Ndola District. *Global Scientific Journals*, 7(9): 972-1065.

Njoku, Z.C. (2007). Comparison of Students' Achievement in Three Categories of Questions inSSCE Practical Chemistry Examination. *Journal of the Science Teachers Association of Nigeria.* 42(1 & 2), 1-2.

Nwaka, N.I., Egbo, J.J., & Okechineke, C.I. (2016). Utilization of ICT Social Media Networking Sites by Senior Secondary School Students in the Learning of Chemistry in Enugu Education Zone. *In 57th annual conference proceedings of STAN (pp. 433–446).* Abuja: The STAN Place Ltd.

Obomanu, B. J., & Adeleye, A. S. (2021). Innovative Strategies for Science Education in Resource-Constrained schools. *International Journal of Science Education, 39(2),* 123–138

Odo, E.E. (2013). Integration of Ethno-Chemistry into Chemistry Curriculum in Nigeria: Option for sustainable development. *In S.O. Abonyi (Ed.), 54th annual conference proceedings of STAN (pp. 260–267).* Ibadan HEBN Publishers Plc

Okafor, C., & Oluwole, B. (2020). Addressing Resource Constraints in Nigerian Science Education. *Journal of Science Teachers Association of Nigeria*, *58(1)*, 31–39.

Oladejo, A. I., Okebukola, P. A., Adebayo, I., Adeosun, G., Agbanimu, D. O., Ademola, I.; Onawugbeda, F. I., Peter, E., Gbeleyi,O., Awaah, F. (2022) I am CTCA, and This is my First Attempt in the Physics Class - How Will I Perform? [Conference paper]. *NARST 95th Annual International Conference: Unity and Inclusion for Global Scientific Literacy*,Vancouver, ;

Olude, A.S., Saibu, S. O., Sunday, E.F., & Akande, J. O**.** (2024). Using Everyday Life Experiences to Teach Chemistry Concepts in Secondary Schools: A Catalyst for Sustainable Global Development. *FNAS Journal of Applied Chemical Science Research*, *2*(1), 41-47.

Olusegun, B.E., Saibu, S.O., Alaka, M.O., & Olude, A.S. (2024). Revolutionizing Students' Success: The Dynamic Impact of the Cultural-Techno-Contextual Approach on academic achievement in difficult concepts in senior secondary chemistry. Ilorin *Journal of Education (IJE), 44(1), 222-236.*

Owolabi O., Okebukola P. A., Onafowokan O., Akintoye H., Akindoju O., Olugundu A., (2016). Effects of out-door experience with cultural flavour on students' achievement in physics. *African Indigenous Science and Technology*

Rychly L & Graves E (2012). Teacher Characteristics for Culturally Responsive Pedagogy. *Multicult. Perspect. 14(1)*:44–49.

Sakiyo, J. & Badau, K.M. (2015). Assessment of the Trend of Secondary School Students' Academic Performance in the Sciences, Mathematics and English: Implication for the Attainment of the Millennium Development Goals in Nigeria. *Advances in Social Science Research Journal, 2(2),* 31–38.

Smith, R., & Brown, J. (2023). Context-Based Learning in Disadvantaged Schools: Evidence from Chemistry Education. *Chemistry Education Research and Practice, 24(3), 345-360.*

Tsobaza, M. K., & Njoku, Z. C. (2021). Effect of Practical Chemistry Teaching Strategies on Students' Acquisition of Practical Skills in Secondary Schools in Kogi State. *African Journal of Science, Technology & Mathematics Education (AJSTME), 6(1)*.195-203

Ugwu, A. N. (2018). Effects of Ethno-Chemistry-based Curriculum Delivery on Students' Interest in Chemistry in Obollo-Afor Education Zone of Enugu State. *Journal of the Nigerian Academy of Education, 14*(2), 129–138.

Ugwu A. N. & Diovu C.I. (2016). Integration of Indigenous Knowledge and Practices into Chemistry Teaching and Students' Academic Achievement. *International Journal of Academic Research and Reflection. 4(4)* 22-30.

UNESCO. (2021). *Reimagining our futures together: A new social contract for education*. Paris: UNESCO.

West African Examination Council, (2016, 2017, 2018, 2019, 2020). May/June. Chief Examiners' Report. Lagos.

Wissinger, J. E., Visa, A., Saha, B. B., Matlin, S. A., Mahaffy, P. G., Kümmerer, K., & Corner, S. (2021). Integrating Sustainability into Learning in Chemistry. *Journal of Chemical Education*, *98*(4),5. https://doi.org/10.1021/acs.jchemed.0c01339.

Yusuf, M. A., & Folayan, B. O. (2022). Challenges and Prospects of Practical Chemistry Education in Low-Resource Settings. *Journal of Chemical Education, 99(4), 1215-1224.*

Zephrinus, C. N., Phoebe, I., & Eze-Odurukwe. (2015). Resolving Nigerian Secondary School Students' Learning Difficulties in Nuclear Chemistry using Computer Animation Solutions. *Procedia - Social and Behavioral Sciences, 1034-1040.*

Enekwechi, E. E., Okeke, O. C. S., Nwanze, A. C. & Chikwendu. A. A. (2019). Improving Students' Participation in Chemistry Learning Through the use of Flipped Classroom Instruction. *International Journal of Innovative Research and Advanced Studies (IJIRAS), 6*(2). 105- 110.

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