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The Impact of Ethno-Chemistry Activities on Senior Secondary School Students' Development Of Entrepreneurship Skills in Kogi State, Nigeria

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Abstract
The need for self-employment has increased in recent time due to the increasing number of graduates in Nigeria. To solve this problem students, need to be equipped with the necessary skills to become successful entrepreneurs. This study determined the impact of Ethno-chemistry activities on senior secondary school students' development of entrepreneurship skills in Kogi state. The research was guided by six (6) objectives and three hypotheses. The research adopted mixed research design with entrepreneurship checklist, questionnaire, pre-test-post-test control group, observation and structured interview used as instruments for data collection. The population comprises of all the 24,517 senior secondary school students in Kogi state, while the study sample is 840 senior secondary school students which were selected using multi-stage sampling technique from all the 21 local government areas (40 from each LGA) of Kogi state. The instrument was validated by three experts with a reliability coefficient of 0.77 and 0.74 were used for pre-ethno chemistry and post-ethno chemistry activities respectively. The data was analyzed using descriptive and inferential statistics. The analysis shows that there was a significant difference based on gender on various entrepreneurship interests at 0.05 level of significance, the result also revealed that Chemistry students Entrepreneurship skill/interest mean scores were high when taught with Ethno-chemistry teaching approach. It was also discovered from the result that male students have higher interest in the production of dyes for clothes, petroleum jelly and essential oils than the female students while the female student has higher interest in Soaps/toiletries and food additives/colourants production than the male students. Generally, both male and female chemistry students developed high interest in self-employment (entrepreneurship). Recommendations were made, among which was, attention should be given to the application of ethno-chemistry activities in senior secondary school to ignite entrepreneurial interest and subsequently acquire necessary skills needed.

Keywords: Ethno-Chemistry, Chemistry, entrepreneurship skills, indigenous knowledge.

Introduction
Chemistry, a branch of physical science, is concerned with the study of matter, its properties, and how substances interact with energy, combine, or separate to form other substances (Ajayi et al., 2017). Despite its centrality in science education, chemistry is often perceived as abstract by students, particularly when taught using conventional methods. The teaching strategies employed significantly influence students' achievement and interest in science subjects. Aniodoh and Eze (2014) argued that the instructional techniques commonly used in chemistry classrooms are frequently inappropriate and uninspiring. This inadequacy has been linked to students' persistent underachievement in chemistry, largely attributed to ineffective teaching methods adopted by many chemistry educators (Giginna, 2014). Effective teachers, by employing diverse instructional strategies, can inspire students and facilitate meaningful learning, especially in science-oriented fields like chemistry.

Recent research (Siwale et al., 2020; Risdianto et al., 2020) highlights the importance of adopting culturally relevant teaching approaches that connect science to students' everyday experiences and indigenous contexts. Ethno-chemistry is one of such approaches. The term "ethno" broadly encompasses socio-cultural contexts, including language, behavior, myths, and symbols (Risdianto et al., 2020). Ethno-chemistry, therefore, refers to

the study of culturally rooted chemical practices that reflect the knowledge systems of specific communities. This approach supports contextualized, meaningful learning while promoting the preservation of cultural diversity and indigenous wisdom. Odo (2013) defines ethno-chemistry as a unique system of indigenous knowledge about matter, its characteristics, interactions, and applications expressed within the framework of a particular culture.

Odo (2013) also noted that the traditional knowledge of societies like Nigeria is often marginalized and dismissed as inferior or backward compared to Western scientific knowledge. This perception has hindered the development of indigenous communities and the integration of local cultural practices into formal education. The expansion of Western educational structures has disrupted traditional knowledge systems, weakening indigenous approaches to learning and cultural preservation. Integrating indigenous knowledge systems into the chemistry curriculum through ethno-chemistry can foster entrepreneurial skills among students, equipping them for self-employment and societal contribution.

Nigeria continues to face a significant unemployment crisis, with many youths seeking avenues for self-reliance (National Bureau of Statistics, 2023). This situation underscores the importance of alternative educational strategies, such as entrepreneurship education, that can empower young Nigerians. Science education, particularly when embedded with indigenous knowledge, holds potential for promoting entrepreneurship and economic self-sufficiency (Oviawe, 2016). Numerous studies have investigated the effects of ethno-science and ethno-chemistry on students' learning outcomes. Risdianto et al. (2020), for example, examined the impact of an ethno-science-based direct instruction model on students' critical thinking skills in physics. Their results showed significant improvements in students' critical thinking when taught using culturally relevant instruction. Similarly, Wiratma and Yuliamiastuti (2023) explored the potential of vine-based ethno-chemistry from *Lontar Usada Taru Pramana* and found that it enhanced students' scientific explanation skills. Singh and Chibuye (2016) also reported that incorporating ethno-chemistry practices in secondary school chemistry classes positively influenced students' attitudes toward the subject.

Oladejo et al. (2023) argued that many chemistry concepts though considered abstract in formal education are already practiced within communities through indigenous knowledge. In Nigeria, for instance, the concept of saponification is applied in local soap production, while separation techniques such as sieving, decantation, evaporation, and distillation are part of traditional practices. Despite their widespread use, these practices are often disconnected from formal chemistry education, reinforcing the misconception that chemistry is irrelevant to everyday life.

To bridge this gap, it is essential to integrate indigenous practices into the formal chemistry curriculum. Doing so not only demystifies chemistry but also demonstrates its practical applications, thereby enhancing student engagement and promoting entrepreneurial thinking. Therefore, this study investigates the impact of ethno-chemistry activities on the development of entrepreneurial skills among senior secondary school students in Kogi State, Nigeria

Statement of Problem

Despite the effort of the Nigerian Government in ensuring that student perform better in their exams and also acquire some entrepreneurship skills during the course of their learning, it has been observed that the order of the day now is to merely pass examination which have made the mode of learning in senior secondary no longer driven by thirst or desire for knowledge but grade driven thus giving forth scientist who find it difficult to create or innovate something relevant that can be of use to the society. Chemistry education particularly lacks contextual applications. However, most existing studies focus on academic achievement rather than skill acquisition for entrepreneurship. This study addresses this gap by evaluating the impact of ethno-chemistry activities on senior secondary school chemistry students' entrepreneurship skills in Kogi State.

Aim and Objectives of the Study

The aim of the study is to assess the Impact of Ethno-chemistry Activities in Senior Secondary Schools Student's Acquisition of Entrepreneurship Skills in Kogi State. Specifically, the study aims to achieve the following objectives, to:

1. Find out the difference between male and female senior secondary school chemistry students' interest in various entrepreneurship skills such as dyes, petroleum jelly, essential oils, soaps/toiletries, and food additives?
2. Examine the mean interest score on the impact of ethno-chemistry activities and teaching approach on students' entrepreneurial skills.
3. Investigate the influence of ethno-chemistry on students' self-employment intentions.

Research Questions

The following research questions were raised to guide the study

1. What is the difference between male and female senior secondary school chemistry students' interest on various entrepreneurship skills such as production of dyes, petroleum jelly, essential oils, soaps /toiletries and food additives?
2. What is the mean interest scores on the impact of ethno-chemistry activities and teaching approach on senior secondary school chemistry students' entrepreneurial skills?
3. What is the influence of ethno-chemistry on senior secondary school chemistry students' self-employment intentions?

Null Hypotheses

The null research hypothesis was formulated and tested at 0.05 level of significance.

HO: There is no significant difference between male and female senior secondary school chemistry students' interest on various entrepreneurship skills such as production of dyes, petroleum jelly, essential oils, soaps /toiletries and food additives

Methodology

This study employed a mixed-method approach. The population comprised 24,517 senior secondary school students across Kogi State. A sample of 840 students was selected via multi-stage sampling. Participants were divided into control and experimental groups. The experimental group was taught using ethno-chemistry methods, while the control group received conventional instruction. Instruments included entrepreneurship checklists, structured interviews, and observation schedules. Reliability coefficients for instruments were 0.77 and 0.74. Teachers were trained for six days prior to a 12-week teaching intervention. Data was analyzed using descriptive statistics and t-tests at 0.05 significance level.

Presentation of results

Research Question 1: What is the difference significant difference between male and female senior secondary school chemistry students' interest in various entrepreneurship skills such as dyes, petroleum jelly, essential oils, soaps/toiletries, and food additives?

S/N	Activity	Mean male	SD male	Mean female	SD female	t-value	Sig. Diff
1	Dyes for clothes	4.56	0.74	3.85	0.82	8.91	Yes
2	Petroleum jelly production	4.45	0.78	3.72	0.81	9.05	Yes
3	Essential oil extraction	4.22	0.69	3.68	0.75	7.94	Yes
4	Soaps/toiletries production	3.92	0.71	4.64	0.65	-10.44	Yes
5	Food additives/colourants	3.74	0.67	4.51	0.69	-11.15	Yes

Table 1 presents a comparison between male and female students' interest in specific ethno-chemistry entrepreneurial activities. The t-tests reveal that all the gender differences across the five skills are statistically significant ($p < .001$). Males are more interested in industrial activities like dyes, petroleum jelly, and essential oils, while females show greater interest in domestic-oriented skills such as soaps and food additives. This confirms that gender plays a significant role in determining students' entrepreneurial interests in chemistry.

Research Question 2: What are the mean interest scores on the effect of ethno-chemistry activities and teaching approach on senior secondary school chemistry students' entrepreneurial skills?

Table 2: Mean and Standard Deviation Scores of Students' Entrepreneurial Skills (Pre- and Post-Ethno-Chemistry Activities)

Group	N	Mean (Pre-test)	Mean (Post-test)	Mean Gain	Std. (Pre-test)	Std. (Post-test)	d
Experimental	415	38.47	56.87	18.40		6.62	2.91
Control	425	41.13	48.61	6.04		5.51	1.04
				6.48	7.54		

Significant at $p < 0.05$

Table 2 shows that students in the experimental group who were exposed to ethno-chemistry activities had a significantly higher mean gain (18.40) compared to the control group (7.48). The t-values and p-values confirm the statistical significance of these gains. Moreover, Cohen's d of 2.91 for the experimental group indicates a very

large effect size, demonstrating that the intervention had a strong impact on entrepreneurial skills development. The control group also improved, though with a moderate effect size (d = 1.04). This means that ethno-chemistry activities effectively enhanced students' entrepreneurship skills.

Research Question 3: What is the influence of ethno-chemistry on senior secondary school chemistry students' self-employment intentions?

Table 3: Self-Employment Intentions Before and After Ethno-Chemistry Activities

Category	N	Mean (Pre-test)	Mean (Post-test)
Self-employment	840	3.21	4.65

Table 3 presents the mean scores of students' self-employment intentions before and after participation in ethno-chemistry activities. The pre-test mean score was 3.21, while the post-test mean increased to 4.65. This notable improvement suggests that ethno-chemistry activities had a positive influence on students' intention to pursue self-employment.

Testing of Null Hypotheses

HO_1: There is no significant difference between male and female senior secondary school chemistry students' interest in various entrepreneurship skills.

Table 4: Independent Samples t-test on Students' Entrepreneurship Skills by Gender

Gender	N	Mean	SD	t-value	df	p-value	Decision
Male	413	78.34	4.85	3			
Female	427	74.15	5.02	3.47	838	0.01	Reject HO_1
Total	840						

Significant at $p < 0.05$

Table 4 presents the result of a t-test that was conducted to test the null hypotheses that male and female Chemistry students do not differ in their interest on various entrepreneurship skills such as production of dyes, petroleum jelly, essential oils, soaps /toiletries and food additives. Male students had an average mean score of 78.34 with standard deviation of 4.85 while the female chemistry students had an average mean score of 74.15 with standard deviation of 5.02. The result shows t (838) =3.47, p = .001 ($p< 0.05$). Therefore, the null hypothesis which states that there is no significance difference between male and female senior secondary school chemistry students' interest on various entrepreneurship skills such as production of dyes, petroleum jelly, essential oils, soaps /toiletries and food additives was rejected. This indicates that gender influences students' interest in ethno-chemistry-based entrepreneurial activities.

Discussion of Findings

The findings in Table 1 revealed significant differences between male and female students across all five activities, with males expressing more interest in industrial-based skills such as producing dyes, petroleum jelly, and essential oils, while females were more inclined toward domestic applications like making soaps and food additives. The findings of this study is supported by the study of Said-Ador (2017), who emphasized that students' familiarity and domestic experiences with certain chemical products influence their interest. The significant t-values and p-values across all activities confirm that gender significantly affects interest in specific entrepreneurship skills. The corresponding hypothesis (HO1) was rejected, establishing a statistically significant difference between male and female senior secondary school chemistry students' interest on various entrepreneurship skills such as production of dyes, petroleum jelly, essential oils, soaps /toiletries and food additives.

Research question two assessed the impact of ethno chemistry activities and teaching approaches on students' entrepreneurial skills. As shown in Table 2, the experimental group, exposed to ethno-chemistry-based instruction, showed a significantly higher post-test mean score (M = 56.87) and greater mean gain (18.40) compared to the control group (M = 48.61; gain = 7.48). The large effect size (Cohen's d = 2.91) further affirms the effectiveness of ethno chemistry in developing entrepreneurship skills. This aligns with prior findings by Ajayi et al. (2017 Ajayi et al. (2017), who reported that the ethno chemistry teaching approach significantly improved students' achievement and retention in chemistry. This aligns with the findings of Ezeanya et al. (2023), who reported that students taught using ethno-chemistry instructional approaches showed improved academic achievement and retention in chemistry. Similarly, Odume et al. (2023) found that ethno chemistry based

instructional packages positively impacted students' achievement in chemistry. It also agrees with Singh and Chibuye (2016) who reported a positive change in students‟ attitude to chemistry due to ethno chemistry practices.

Research Question 3 investigated the influence of ethno-chemistry activities on students' self-employment intentions. The findings show a strong increase in mean scores from pre-test (3.21) to post-test (4.65), indicating that the intervention heightened students' motivation toward entrepreneurial self-reliance. This corroborates the findings of Odo (2013), who emphasized the role of integrating ethno-chemistry into the curriculum to promote sustainable development and self-reliance among students.

Conclusion

Based on the findings from this study, the following conclusions were made: Ethno-chemistry significantly improved entrepreneurship skills. Male students performed better in industrial-based entrepreneurial tasks, while females preferred domestic applications. There was increased interest in self-employment across both genders. Ethno-chemistry was demonstrably **more effective than conventional methods** in fostering student engagement, contextual learning, and entrepreneurship development.

This clearly indicates that ethno-chemistry is a potent tool in fostering entrepreneurship skills among senior secondary school students. The differences observed between male and female students' interests provide insights for gender sensitive curriculum planning. Given the educational and economic implications, these findings affirm that ethno-chemistry provides a practical, culturally relevant, and engaging platform for bridging science education with entrepreneurship, thereby contributing to sustainable development and employability among Nigerian youths.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Ethno-chemistry activities should be incorporated into the senior secondary chemistry curriculum by education policymakers to promote practical entrepreneurial skills.
2. Schools should be equipped with local materials and tools required for implementing ethno chemistry activities effectively.
3. Continuous assessment mechanisms should be established to evaluate the effectiveness of ethno-chemistry-based interventions in entrepreneurship education.
4. Teachers should undergo continuous professional development programs on integrating indigenous knowledge into science teaching.

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