



## **Teacher Variables and School Location as Predictors of Chemistry Teachers' Awareness of Ethno Science Practices**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author FAA supervised the work. Author NAO designed the study, performed the statistical analysis and wrote the protocol. Author OAF wrote the first draft of the manuscript. Author OAF carried out all field work. Author ONA managed the analysis of the study. Authors OAF and NAO managed the literature searches and author NAO edited the manuscript. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Innovative researches and findings of science educators and scholars on the effectiveness of ethno science based instructional model and approach remains unproductive in the field of chemistry education because of the continuous ignorance and neglect of ethno scientific practices by chemistry instructors. This neglect which could possibly be as a result of a lack or, inadequate awareness has stalled moves for contextualized system of chemistry education for more meaningful learning and effective teaching. In view of this, this study sought to ascertain secondary school chemistry teachers' level of awareness of ethno science practices and the predictive value of teacher variables and school location. The study adopted descriptive survey research design. Data were collected from a sample of 150 chemistry teachers drawn from rural and urban secondary

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schools in Akinyele, Ido and Lagelu Local Government Area, Oyo state. The instruments used were validated and each reliability tested; Chemistry Teachers' Questionnaire on Awareness of Ethno Science Practices ( $r=0.75$ ) and Chemistry Teachers' Questionnaire on Value for Culture ( $r=0.95$ ). Four research questions tested at 0.05 and 0.01 level of significance using Analysis of Variance ANOVA; which guided this study were answered using descriptive statistics of (mean and standard deviation), Pearson product moment correlation and multiple regression. The study revealed that chemistry teachers' awareness of ethno science was below expectation ( $\bar{x}=60.34$ ). The independent variables had significant composite contribution on awareness of ethno science (23.9%). Gender and School location both had no significant relative contribution on awareness while, Value for culture ( $B=0.128;t=3.166;p<0.05$ ) and Experience ( $B=5.490;t=3.551;p<0.05$ ) both had significant relative contribution on awareness. Gender had no significant relationship with awareness while, Value for culture ( $r=0.811;p<0.01$ ), Experience ( $r=0.242;p<0.01$ ) and School location ( $r=0.360;p<0.01$ ) had significant relationship with awareness. Following these findings, it was recommended that there is need to equip chemistry teachers with indigenous knowledge of the people in the area where they teach through training and re-training. The need for government and educational research institute to encourage research on profiling of ethno science practices for integration in science classroom was also suggested. Also suggested, is the need for chemistry teachers to be given the necessary support and opportunity to formally link culture with western science in classroom instruction.

**Keywords:** *Ethno science practices; teacher variables; school location; chemistry teacher awareness.*

## 1. INTRODUCTION

Ethno science practices presents an aspect of indigenous knowledge that expresses science principles exhibited in human interaction with their environment and created technology that ensure survival as a community. It studies how humans interact with their environment, construct reality by linking culture to advance scientific (chemical) knowledge [1]. Such knowledge is unique to different human societies because they are passed from one generation to another. Ethno science points to an indigenous knowledge in the form of the language, customs and culture, morals; as well as the technology created by the community or a particular person that contain scientific knowledge [2]. Therefore, ethno science connotes a culture-related education (culturally relevant) that opens the window to gaining knowledge of the complexity of natural phenomena through indigenous approach. It implores the use of cultural knowledge, prior experiences, frames of reference, and performance styles of culturally and linguistically diverse (CLD) students to make learning encounters more relevant and effective [3].

Scholars [4,5,6,7,8,9,10,11,12,13] have not only submitted ethno science as an instructional tool but have experimented and found it to have a significant effect on students' performance, achievement and interest as well as, a perfect link with learners' immediate environment when

integrated in science teaching. Thus, ensuring more meaningful science learning. Succinctly, science content is not decontextualized from students' and teachers' everyday experiences [14]. Invariably, ethno science becomes valuable instructional tool for the chemistry teacher to implement the curriculum, thereby, showing chemistry and its link with industry, everyday life benefits and hazards [15]. Chemistry's goal of developing both the individual and the entire society [16], vehemently achieved.

Despite the far-reaching effect of ethno science practices on science education, science teachers who are the enablers, the inspiration and the constraint of the science learned in school [17] and a stake holder in transmission of societal knowledge and culture rarely links culture with science instruction. Chemistry teachers fail to closely knit students' cultural backgrounds and science learning [18]. Similarly, [19], noted that science teachers do not apply a blend of culture and entrepreneurship character in their science lessons. Optimally, making sure that students understand that school science is neither magic nor a bundle of abstract facts unrelated to out of school experiences [20,21] is rather futile. Therefore, the need to assess chemistry teachers' awareness of ethno science practices becomes imperative.

In view of the above, the need to make science teaching more relevant and reflective of those issues concerning science in the society [22], as

well as National Research Council's [23] submission that teachers must present science (chemistry) as a significant part of human culture and a representation of one of the pinnacles of human thinking capacity, providing a laboratory of common experience for development of language, logic, and problem-solving skills in the classroom, this study seeks to identify the lacuna that hinders chemistry teachers' embrasure of culturally relevant chemistry education for an advancement of indigenous science and technology.

This study will explore the predictive value of teacher variables; value for culture, experience and gender and; school location in assessment of chemistry teachers' awareness of ethno science practices, in a bid to ascertain the possible constrain that has sustained the lingering shy-away attitude of chemistry teachers from embrasure of culturally relevant approaches to chemistry education in secondary schools within Ibadan, Oyo state.

### 1.1 Statement of the Problem

Research study by science educators have successfully exposed the effectiveness of an ethno science based instructional method in ensuring a more meaningful and realistic science learning, as well as improved interest and better science concept formation. However, chemistry teachers have not embraced this cultural approach to science education. The teaching and learning of chemistry which is a major branch of science, in schools, have largely remained abstract to learners who are the fruit of an indigenous system. This continuous separation of students from native science, increasingly contradicts what science stands for- knowledge of nature. In light of this is complicated, learners' cognitive structure due to a balance struggle between their native science and western mechanistic construct and; the chemistry teacher remains culturally handicapped.

The need for an enrichment of chemistry education with the ethno science approach will make our society do away with Eurocentric nature of our science education alien to our context which chemistry teachers have unconsciously contributed to, is brought to the front burner. For over dependence on foreign approaches force students into rote-learning and low performance in science, specifically chemistry as could be seen in Nigeria today. The indigenous views of the world and approaches to

education have been brought into jeopardy with the spread of western societal structures and institutionalized forms of cultural transmission [12]. Therefore, an assessment and questioning of chemistry teachers' knowledge of the indigenous base scientific practices becomes a worthwhile venture. The determination of whether chemistry teachers are aware of the scientific nature of indigenous knowledge (ethno science) of the area where they teach and the predictive value of teacher variables such as value for culture, experience and gender as well as school location form the problem of this study.

## 2. LITERATURE REVIEW

### 2.1 Ethno Science

Ethno science defines, identifies, and expresses a uniqueness of specific peoples' response to nature; relationship and survival skills in coping with challenges of daily life activities. Ethno science is a term and study that came into anthropological theory in the 1960s. It has been perceived from an array of perspectives by various scholars. It is mostly referred to as "indigenous knowledge" because it deals with native's own way of thinking that expresses how they have being relating with nature and reacting to life experiences. It is culturally related perception of the physical world and traditional time to explore and incorporate community knowledge and value [24]. Indigenous knowledge which is synonymous to ethno science is the local knowledge that is unique to a given culture or society, providing solutions to the existing problems of that time [25]. Such knowledge is not static but evolves and changes as it develops, influences and is influenced by both internal and external circumstances and interaction with other knowledge systems. Such knowledge covers contents and contexts such as agriculture, architecture, engineering, mathematics, governance and other social systems and activities, medicinal and indigenous plant varieties, etc. [26]. [27] simply referred to ethno science as indigenous technical knowledge systems. This is because it houses the native's social and economic skills. In the perception of [28], ethno science was expressed as the knowledge that is indigenous to a particular language and culture, that is to say, it introduces a perspective based on native perceptions of nature [29]. To [30] ethno science is a cultural classificatory system. Ethno science looks at the intricacies of the connection between culture and its surrounding environment [5], providing a solid

base for planting new ideas. In fact, it dictates what is and what's not acceptable based on threat to its continuous existence.

According to [9], ethno science is the knowledge derived from the norms and beliefs of a particular indigenous community which influences members' interpretation and understanding of nature. In other words, ethno science is the study of humans' interaction with the natural environment and the construction of realities that link culture with advance scientific knowledge [13]. However, ethno science can be said to be culture-related education that are scientifically explainable which opens the window to gaining knowledge of the complexity of natural phenomena through indigenous approaches. It studies how humans interact with the environment, construct reality by linking culture to advance scientific knowledge [1]. [31], present it as the sum total of knowledge and skills possessed by a group of people in a particular area, passed on from generation to generation. In line with this, [2] describes ethno science as indigenous knowledge in the form of the language, customs and culture, morals; as well as the technology created by the community or a particular person that contain scientific knowledge. In simple term, therefore, ethno science is the study that approximates or reflects the natives' own thinking about how their physical world is to be classified [32]. Hence, ethno science reflects "the materials, ideas, and believes from the students' environment and technology derived from the past and present cultural traditions of the people which in turn evolved from myth, supernatural, popular, and mystical realities and believes as well as from ongoing acculturation process" [4].

## 2.2 Awareness of Ethno Science

For delivery of a culture-related education to be made feasible, chemistry teachers' awareness of ethno science cannot be underscored. Awareness as defined by [33] refers to knowledge that something exists or understanding of a situation or subject at the present time based on information or experience. [34] expresses awareness as ability to acknowledge differences across cultures. More accurately, awareness depicts the behavioral component of mindfulness [35]. Therefore, awareness is a primary feature of consciousness [36], which is the essence of all that is known as education [37].

Awareness of ethno science provide a means of meaningful teaching and learning thereby introducing a perspective based on native perceptions of nature [29]. It also exposes knowledge that is indigenous to a particular language and culture [28]. Hence, aiding concept formation. Through this, it becomes vehemently clear that every nation enjoys a unique approach and response to nature. Awareness of this undisputed uniqueness of nations and cultures, have gifted world super powers such as China, Japan, Germany, Russia, Israel to mention a few, front seats in scientific and technological innovations while the developing countries like Nigeria remains relegated to the back as imitator. It was on this note, that [38] called for a need for Nigeria to adopt Japan's wisdom of importation from the west into their educational system only those things that were necessary for the technological takeoff which were fused together to produce a cultural uniqueness in Japan rather than importing personnel. On the other hand, Nigeria does not find her unique blend, jettisons her indigenous knowledge and technology for many unsustainable western ones making development more elusive [39]. No wonder [39], were of the view that the contact with the European colonialists affected the production of domestic food, indigenous iron works, weaving, pottery, leather works and other hitherto well established economic activities that were already in place by 1300AD. This shift from indigenous approach to livelihood affects greatly development of indigenous knowledge and technology which are today criticised as outdated, old school and ineffective in modern times. Due to total neglect of indigenous knowledge, Nigeria is still with a cap in hand begging for bread from technologically advanced nations of the world [40].

However, [37] advised the need to have a concerted effort to experiment with new approaches to science education that will increase the quality and speed of knowledge transmission. This is in a bid to ensure a science teaching that is made more relevant and reflective of those issues concerning science in the society [22], which could be based on a cultural tool which enhance teaching and learning [41]. In addition, [19], moved motion for a teaching and learning process in the classroom where science teachers will apply their science lessons with a blend of culture and entrepreneurship character. For this to be feasible, the science teachers who are the enablers, the inspiration and the constraint of the

science learned in school [17] and a stake holder in transmission of societal knowledge and culture need to have an appreciative level of knowledge of ethno scientific practices peculiar to the learners or area where they teach. Hence, the possibility of predicting teachers' awareness of ethno science practices through school location.

### **2.3 Value for Culture/Appreciation of Culture**

Teacher value for culture or cultural appreciation could be said to be an emotional attachment to an ethnicity or traditional group's way of life. [42] describes cultural appreciation as creation of an environment in which people feel valued for their work and help those around to do the same, building a positive culture. A culture of impacting science through maximization of local resources in strengthening chemical concepts formation. For several resources are available in diverse forms for instructional purposes [43], with different level of appreciation. This follows the fact that teachers' belief emanates from their own personal value system shaped and reinforced through personal value experience as a student, through formal teacher training, teaching experience and family up bringing [44]. Therefore, the selection of resources for use in chemistry instruction is teacher dependent which stems from teachers' value for culture. These relationships are based on their personal experiences [45].

### **2.4 Experience**

Teacher experience refers to the time spent by a teacher in the teaching profession [46]. With the passage of time teachers get command of their subjects and become competent in the art of teaching through experience [46]. The quality of teachers in any educational system determines to a great extent the quality of the system itself [47]. To improve the quality of chemistry education in terms of an indigenous approach, teachers' experience becomes an interesting factor, for experience is expected to engineer improved quality of teaching. In the words of [46], "teaching experience improves the teaching skills and methodologies adopted" by teachers. Hence, experienced teachers should be more familiar with the scientific nature of indigenous knowledge. Chemistry teachers' awareness of ethno science which is predicted by experience, could as well be predicted by teachers' gender.

### **2.5 Gender**

Gender refers to the socio-culturally constructed or created characteristics and roles which are ascribed to males and females in any society [48]. [48] characterized the male attributes as bolds, aggressive, tactful with economical use of words; while females are fearful, timid, gentle, dull, submissive and talkative. This follows [49] view that masculinity refers to attributes considered appropriate for males such as being aggressive athletic, physically active, logical and dominant in social relations with females. Femininity refers to attribute traditionally associated with appropriate behavior for female such as docility, fragility, emotionally and subordinate for male [49]. The above traditionally defined roles of both male and female could affect teachers' choice of instructional material in chemistry instruction, as well as awareness of ethno science practices. This is engineered by difference in environmental exposure, interaction and experience.

### **2.6 School Location**

School location which is described as schools situated in either rural or urban areas [50], may influence chemistry teachers' delivery as much as they are known to influence students learning [51]. The wide gap that exists between rural and urban communities, is reflective in educational institutions of these areas. Rural schools face different problems in terms of infrastructure and staffing than urban schools which are requisite to improving instruction in science, technology, engineering, and math (STEM) [52]. Certainly, no understanding of STEM concepts can be complete without a grasp of their application, and hands-on labs can do wonders to reinforce these concepts [52]. This explains why students in urban schools have an edge and in fact better attitude towards study of science than those in rural schools [53]. However, this position is quite ironical to the study of science and especially chemistry which gives credence to nature and learners immediate environment. For culture which is well established in rural communities than the urban could serve as not just a medium of bridging this gap but of ensuring even better concept formation in chemistry and other sciences. In respect to this, schools in the rural communities in the nine Tennessee districts of America, have entered partnerships with local businesses that lend students their time, money, and resources; relying on professionals' expertise to help teach students [52]. The

business partners or professionals serve more like a mobile laboratory for hands-on activities, helping teachers reinforce their classroom lessons under different circumstances. Similarly, showing application and making things feel real for easy concept formation during chemistry instruction is achievable making reference to ethno scientific practices. Though teaching in urban location may limit the teachers' access to ethno science resources, its critical function in better concept formation and more meaningful learning [4,6,54,10], makes it a valuable instructional tool for any teacher anywhere. This efficiency boils down to chemistry teachers' awareness of ethno scientific practices which could be greatly influenced by their value for culture or cultural appreciation.

## 2.7 Theoretical Rationale

**Bandura's Social Learning Theory:** This theory pioneered by Bandura has often been called a bridge between behaviorist and cognitive learning theories. It centers on observation hence it's also called observational learning theory. This theory aroused from Bandura's thought that behaviorism alone could not explain all there is about learning, suggesting that behavior causes environment as well [55]. Bandura considered learners' personality which he viewed as an interaction between three components: the environment, behavior, and one's psychological processes (one's ability to entertain images in minds and language). Thus, presenting learner not as a passive but active recipient of information. Making learning more interesting as learners are motivated to attend maximally to information as they relate to their daily encounter.

Bandura in his social learning theory also proposed that learning can take place without change in behavior, after observation. Hence, learner is fully equipped with lots of information which are environmentally dependent, constantly built upon until the appropriate motivation is presented and its ability expressed. In view of this, Bandura explains learning under the following sub-headings; Attention (attending to modeled behaviour), retention (remembering modeled behaviour), reproduction (use of cognitive skills to implement modeled behaviour) and motivation (decision to reproduce or refrain).

Through this social learning theory, Bandura exercises the fact that learners come to the

classroom with lots of information patterning to cultural/indigenous approach to science hence, should not be treated as passive instrument, rather engaged actively. Focus on not only what people learn from observing but also interacting with other people helps teachers in selection of classroom activities that are beneficial to the students. Succinctly, indigenous curriculum which is in line with Albert Bandura's theory on modeling and imitation provides a base for meaningful social interaction among learners and between learners and professionals or teachers. Thus, meaningful learning and interest can be ensured by building on students' cognitive structure. The learners become gifted with the three modeling stimuli; live models, verbal instruction and symbolic, as outlined by Bandura. This theory is vital to this study because the chemistry teachers become more informed of learners' ability to learn from each other in a social context. Making reference to different ethno science practices helps students attend to information readily, remember easily, reproduce spontaneously and arouses the desire to reconstruct such information meaningfully for scientific advancement. This is ensured by the adoption of a variety of teaching methods such as role-playing, games, observation and demonstration, imitation, inquiring, self-teaching and learning and peer teaching used to transmit societal norms and values to the younger generation [56]. [57] expressed believe that how children will turn out will depend entirely on their rearing environment and the ways in which their parents and other significant people in their lives treat them and behave around them. Therefore, learners' behavioral change is shaped by the uniqueness of their environment, and may differ from person to person, depending on their interaction. These social learning theories therefore imply that exposing the learners to the right behavior in classrooms will help in achieving educational goals and objectives and build individuals who have the right attitude and values to live within the Nigerian society [56].

## 2.8 Research Questions

The following research questions have been formulated for this study:

- 1) What is the level of chemistry teachers' awareness of ethno science?
- 2) What is the relationship between experience, gender, value for culture and school location and; chemistry teachers' awareness of ethno science?

- 3) What is the composite contribution of experience, gender, value for culture and school location on chemistry teachers' awareness of ethno science?
- 4) What is the relative contribution of experience, gender, value for culture and school location on chemistry teachers' awareness of ethno science?

### 3. METHODOLOGY

#### 3.1 Research Design

The study adopted a descriptive survey research design. This was chosen because of the non-manipulation of the variables. The design assisted the researcher to draw inferences on the possibility of integrating ethno science by secondary school teachers of the subject investigated.

#### 3.2 Variables

**Independent variables:** Teacher variables (Experience, Value for culture and Gender) and School location.

**Dependent variable:** Chemistry teachers' awareness of ethno science.

#### 3.3 Sampling Procedure and Sample

The study adopted a three-stage sampling technique. The first was a purposive sampling technique which was used to select three local government areas within Oyo State, which were; Akinyele, Lagelu and Ido local government areas. These were selected owing to the presence of large rural and urban settlements as well as considerable number of secondary schools. After this, a random sampling technique that ensured selection of one hundred and thirty-seven Secondary schools was employed. Therefrom, one hundred and fifty Chemistry teachers were purposively selected as sample studied.

#### 3.4 Instrumentation

The study utilized two research instruments for data collection. These instruments were; Chemistry Teachers' Questionnaire on Appreciation of Culture (CTQVC) and Chemistry Teachers' Questionnaire on Awareness of Ethno Science Practices (CTQAESP).

#### 3.5 Chemistry Teachers' Questionnaire on Appreciation of Culture (CTQAC)

This instrument was designed by the researcher due to the absence of a standardised instrument that could measure teachers' value for culture. The designed instrument assessed Chemistry teachers' understanding and reaction towards culture and culture related educational system. The questionnaire had two sections "A" and "B". Section "A" elicited respondents' demographic data while section "B" was a twenty-one (21) question items in a three (3) point rating scale. Option in each item that accommodates most cultural education was scored "3" while the option that least expressed its accommodation was scored "1". A face and content validation of the instrument was done by two experts in Science Education, after which six (6) question items were removed for lack of applicability and suitability for the sample based on clarity, breath and language; and purpose for which it was designed. After the scrutiny, fifteen question items scaled through and thus made up the instrument. The instrument was then administered on 20 secondary school chemistry teachers who were not part of the sample selected for the study. The reliability coefficient of the instrument was calculated to be 0.95 using Cronbach alpha.

#### 3.6 Chemistry Teachers' Questionnaire on Awareness of Ethno Science Practices (CTQAESP)

Chemistry Teachers' Questionnaire on Awareness of Ethno Science Practices (CTQAESP) was a thirty (30) question items designed by the researcher. This was designed because the researcher could not find an instrument that could elicit information on teachers' awareness of ethno science practices. The thirty (30) question items instrument designed contained two sections "A" and "B" respectively. Section "A" elicited Chemistry teachers' demographic data while section "B" which was drawn on a 4-point likert-type rating scale of "Strongly Agree" (SA) 4, Agree (A) 3, Disagree (D) 2 and Strongly Disagree (SD) 1, was used to measure Chemistry teachers' level of awareness of ethno science practices peculiar to the study area. The rating scale was reversed for the seven (7) negative question items that formed part of the 31 question items, that is, Strongly Disagree (SD) 4 to "Strongly Agree" (SA) 1. The instrument was validated by two

experts in science education. They determined its suitability for targeted study sample in terms of clarity, breath and language and its relevance to the study in general. The items all survived scrutiny, though some were rephrased. The instrument was trial tested on twenty (20) Chemistry teachers in secondary schools within Ibadan North local government area which was not part of the study area. The reliability coefficient of the instrument was calculated to be 0.75 using Cronbach alpha.

### 3.7 Data Collection Procedure and Analysis

The researcher collected data for this study by administration of questionnaire to the sampled participants (Chemistry teachers) of the selected Schools and Local government in Oyo State. Administration of the questionnaire was done by the researcher with the aid of two research assistants who were persons familiar with the environment understudied. The researcher sought permission from the principal of the schools and consent of the teachers. The questionnaires when issued were retrieved immediately from the respondents after they had filled them. In some cases, where the

respondents were very busy, the researcher retrieved same day before the close of school or as agreed. Explanation was provided respondents who needed clarification, to guide them through the questionnaires. Descriptive statistics of (mean and standard deviation), Pearson product moment correlation and multiple regression as well as analysis of variance (ANOVA) were used to analyze the data.

## 4. RESULT

**Research Question 1:** What is the level of chemistry teachers' awareness of ethno science practices?

The Table 1 shows the descriptive statistics of chemistry teachers' awareness of ethno science practices. The table shows that Chemistry teachers' awareness of ethno science practices of the area where they teach is below expectation, as it shows a mean average score of (60.34).

**Research Question 2:** What is the relationship between experience, gender, value for culture and school location and chemistry teachers' awareness of ethno science?

**Table 1. Mean score of chemistry teachers' awareness of ethno science**

	N	Minimum	Maximum	Mean	Std. Deviation
Awareness	150	30.00	87.00	60.3400	15.43152
Valid N (list wise)	150				

**Table 2. The relationship between experience, gender, school location value for culture and chemistry teachers' awareness of ethno science practices**

		School location	Gender	Experience	Value for culture	Awareness
School location	Pearson Correlation	1	-.058	.242**	.811**	.360**
	Sig. (2-tailed)		.479	.003	.000	.000
	N	150	150	150	150	150
Gender	Pearson Correlation	-.058	1	.057	-.118	-.042
	Sig. (2-tailed)	.479		.489	.152	.607
	N	150	150	150	150	150
Experience	Pearson Correlation	.242**	.057	1	.251**	.356**
	Sig. (2-tailed)	.003	.489		.002	.000
	N	150	150	150	150	150
Value for culture	Pearson Correlation	.811**	-.118	.251**	1	.442**
	Sig. (2-tailed)	.000	.152	.002		.000
	N	150	150	150	150	150
Awareness	Pearson Correlation	.360**	-.042	.356**	.442**	1
	Sig. (2-tailed)	.000	.607	.000	.000	
	N	150	150	150	150	150

\*\* Correlation is significant at the 0.01 level (2-tailed).



The Table 2 reveal that School location ( $r = .360$ ;  $p < 0.05$ ), value for culture ( $r = .811$ ;  $p < 0.01$ ) and experience ( $r = .242$ ;  $p < 0.05$ ) all had a significant relationship with chemistry teachers' awareness of ethno science practices. While gender ( $r = -.058$ ;  $p > 0.01$ ) had no significant relationship with chemistry teachers' awareness of ethno science practices.

**Research Question 3:** What is the composite contribution of experience, gender, value for culture and school location on chemistry teachers' awareness of ethno science?

From Table 3, the value of  $R = 0.509^a$  indicates that teacher's experience, gender, value for culture and school location have a significant composite contribution on chemistry teachers' awareness of ethno science practices.

The Table 4 presents an analysis of variance of multiple regression between the independent variables and chemistry teachers' awareness of ethno science practices to be ( $F(4,149) = 12.70$   $p < 0.05$ ); at 0.05 level of significance. This shows that there is a significant composite contribution of teacher's experience, gender, value for culture and school location on chemistry teachers' awareness of ethno science practices.

The adjusted R square (0.239) implies that the independent variables (teacher experience, gender, value for culture and school location) account for 23.9% of the total variance of chemistry teachers' awareness of ethno science practices. The remaining 76.1% could be due to other variables not included in this study.

**Research Question 4:** What is the relative contribution of experience, gender, value for culture and school location on chemistry teachers' awareness of ethno science?

The Table 5 shows the result of relative contributions of each of the independent variables to the prediction of chemistry teachers' awareness of ethno science practices. The regression Beta values and P values show that teachers' School location ( $B = -0.725$ ;  $t = -0.181$ ;  $p > 0.05$ ) and Gender ( $B = -0.396$ ;  $t = -0.173$ ;  $p > 0.05$ ) both had no significant relative contribution to chemistry teachers' awareness of ethno science practices. While, teachers' Value for culture ( $B = 0.128$ ;  $t = 3.166$ ;  $p < 0.05$ ) and Experience ( $B = 5.490$ ;  $t = 3.551$ ;  $p < 0.05$ ) both had a significant relative contribution to chemistry teachers' awareness of ethno science practices.

**Table 3. Multiple regression analysis between the predictors (experience, gender, School location and value for culture) and chemistry teachers' awareness of ethno science practices**

Model	R	R square	Adjusted R square	Std. error of the estimate
1	.509 <sup>a</sup>	.259	.239	13.46163

a. Predictors: (Constant), experience, gender, School location, value for culture

**Table 4. ANOVA showing regression of experience, gender, School location and value for culture on chemistry teachers' awareness of ethno science practices**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	9205.397	4	2301.349	12.700	.000 <sup>b</sup>
	Residual	26276.263	145	181.216		
	Total	35481.660	149			

a. Dependent Variable: Awareness

b. Predictors: (Constant), experience, gender, School location, value for culture

**Table 5. Summary of multiple regression analysis showing relative contribution of independent variables on chemistry teachers' awareness of ethno science practices**

Model		Unstandardized coefficients		Standardized coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	36.120	5.169		6.988	.000
	School location	-.725	4.004	-.022	-.181	.857
	Value for culture	.128	.041	.392	3.166	.002
	Gender	-.396	2.293	-.012	-.173	.863
	Experience	5.490	1.546	.264	3.551	.001

a. Dependent Variable: Awareness

## 5. DISCUSSION

The major purpose of this study was to ascertain chemistry teachers' awareness of ethno science practices as well as the predictive value of teacher variables such as experience, gender and value for culture and; school location on chemistry teachers' awareness of ethno science practices. The findings of this study are discussed below according to the research questions and tables.

**Chemistry teachers' awareness of ethno science:** The findings of this research revealed that chemistry teachers' awareness of ethno science practices of the area where they teach was not clearly stated. This means that chemistry teachers' awareness of ethno science practices of the area where they teach is below expectation. Therefore, it can be inferred from this study that chemistry teachers' awareness of ethno science practices of the area where they teach is only average.

Chemistry teachers' awareness of ethno science practices which prove to be below expectation could have been as a result of their vague understanding of the nature of science. It could also have been as a result of their inability to clearly distinguish between supernatural and natural phenomena. Inability to free their minds from stereotyped spiritual explanations to virtually every cultural events and activities. It might also have been due to the stereotyped assumption that indigenous resources are not durable hence, their lack of interest on probing into the intricacies that surround ethno science practices. The submission of this study is strengthened by the observation that less than 30% of chemistry teachers could confidently list indigenous practices that they thought exercise science concepts that can be used for chemistry instruction. Even among this little fraction, less than half identified more than three practices. In line with this finding, [58] in their study of "Teachers' conception of Indigenous Knowledge in Science Curriculum..." submitted that teachers showed awareness of indigenous knowledge but noted that the research participants were not teaching indigenous knowledge at the same level as school science, even when they said that they were aware that some indigenous knowledge was worthwhile as teaching material. Based on this, it can be concluded that chemistry teachers' awareness need to be improved by exploration of cultural practices that are science related.

**Relationship between experience, gender, value for culture and school location and; chemistry teachers' awareness of ethno science practices:** The result revealed that School location, value for culture and experience had a positive significant relationship with chemistry teachers' awareness of ethno science practices. While gender had no significant relationship with chemistry teachers' awareness of ethno science practices. This means that experience, value for culture and school location individually influence awareness of ethno science while gender does not influence chemistry teachers' awareness of ethno science.

The finding of this study on experience predicting chemistry teachers' awareness of ethno science could have been as a result of the advancement of knowledge of subject area gained by chemistry teachers from exposure to the content of chemistry curriculum and observation of the environment over the years. Studies offer compelling evidence of an uneven distribution of inexperienced teachers that is systematically related to school and student characteristics [59,60,61]. [62] reported that teaching experience is positively associated with student achievement gains throughout a teacher's career. Adding that gains in teacher effectiveness associated with experience are most steep in teachers' initial years but continue to be significant as teachers reach the second, and often third, decades of their careers. A teacher that is more exposed to the chemistry curriculum and delivery should easily reflect on environmental and cultural knowledge that exercise chemical concepts.

Value for culture discovered to be a predictor of chemistry teachers' awareness of ethno science flows from the fact that teachers that see cultural practice as archaic are indirectly incapacitated to understand the scientific nature of such practices. This follows [63] who pointed out that indigenous knowledge is still an underutilized resource in development activities and it needs to be intensively and extensively studied. [64] cites John Madeley's (2004) lamentation that indigenous knowledge is the largest single knowledge resource not yet mobilized in the development enterprise. These scholarly submissions are only reflective of the low value placed on ethno science practices. Hence, all institutions of society, the school included, need to be cognizant of the important role indigenous knowledge can and should play in community and national development [31]. Therefore,

chemistry teachers' value for culture predicts awareness of ethno science.

The finding on school location been a predictor of chemistry teachers' awareness of ethno science stems from the fact that the working environment of the chemistry teachers, especially if rural, would have influenced their awareness because the practices and livelihood/ survival skills of the rural dwellers are still intrinsically local but rich in science principles. In spite of the fact that the chemistry teachers live in urban areas, their shuttling of rural location exposes them to the cultural practices of rural dwellers unlike their colleagues who reside and work in the urban.

The submission of gender not to be a predictor of chemistry teachers' awareness of ethno science could be due to the exposure of both male and female chemistry teachers to similar environmental and professional background. The decreasing distinction of gender roles in society, both culturally and professionally might have also influenced the findings of this study. Edu, Edu and [65] also discovered in a study that teacher's gender is not a factor in teaching, that other factors like environment, attitude and others also affect a teacher. However, [66] submitted that socialization patterns in Nigeria and most African setting, place enormous restrictions on the female gender and from her a higher input of daily domestic labour than from the male. Consequently, the finding of this study disagrees with that of [66] because in the teaching profession gender roles are totally absent as both male and female chemistry teachers are expected to give their best as well as deploy best teaching resources and approaches to ensure students' performance.

**Composite Contribution of Experience, Gender, Value for Culture and School Location on Awareness of Ethno Science Practices:** The findings of this research revealed that all the independent variables (experience, gender, value for culture and school location) showed significant contribution to chemistry teachers' awareness of ethno science practices. This means that when all the independent variables were put together, they jointly influenced chemistry teachers' awareness of ethno science practices. Therefore, it can be inferred from this study that experience, gender, value for culture and school location are composite predictors of chemistry teachers' awareness of ethno science practices.

This submission simply asserts that the three teacher variables (experience, gender and value for culture) and School location are joint predictors of chemistry teachers' awareness of ethno science. Experience made an impact as much as gender, value for culture and school location. This might have been because teachers are expected to advance in mastery as they advanced in experience, segregation in terms of gender roles in the society, value/appreciation of culture is personally driven and difference in school location exposes one to an awareness in different perspectives. According to [67], quality teaching lies at the teacher's capacity to transform written knowledge into forms that are pedagogically powerful and yet adaptive to the students' abilities and backgrounds, hence, the role of teachers' experience and value for culture which is modified by their school location and; also gender sensitive. Succinctly, teachers' understanding of local knowledge and its language, places them in a position where they are able to accommodate different learners' learning styles [31].

**Relative Contribution of Experience, Gender, Value for Culture and School Location on Chemistry Teachers' Awareness of Ethno Science Practices:** This study revealed that the independent variables (experience, gender, value for culture and school location) had varying relative contribution to chemistry teachers' awareness of ethno science practices. Where school location and gender had no relative contribution, value for culture and experience both had a significant relative contribution on determination of chemistry teachers' awareness of ethno science practices. This exposes the fact that school location and gender plays no significant role in prediction of chemistry teachers' awareness of ethno science, while, value for culture and experience contributes immensely to prediction of chemistry teachers' awareness of ethno science.

The finding of this study which showed that experience is a contributor/predictor of chemistry teachers' awareness of ethno science might have arisen due to the fact that experience is expected to bring about subject mastery, hence chemistry teachers understanding of the intricate relationship between school science and ethno science practices. In congruence with the finding of this study, [62] reported that more experienced teachers support greater student learning for their colleagues and the school as a whole, as well as for their own students. It becomes clear

that through time, chemistry teachers are expected to understand not only their subject matter but also their learners; environmentally, socially, educationally and otherwise. In congruence, [68] and [69] exposed that a problematic way in which teachers sometimes access Aboriginal histories, worldview and knowledge is through Aboriginal students who may have little experience with discussing the cross-cultural realities which they may have experienced; which can have both positive and negative ramifications. The idea is that experience, gained over time, enhances the knowledge, skills, and productivity of workers [70]; chemistry teachers not an exception.

Value for culture which was also discovered by this study to be a contributor/predictor of chemistry teachers' awareness of ethno science explains the role of one's appreciation of culture in relating with learners' environment. Based on this, [71,72,73,74,75 and 76] submitted that the most obvious, but also most lacking among teachers is an awareness and understanding of indigenous cultures, histories, worldviews, language barriers, and current social, economic and political issues. Chemistry teachers' knowledge or awareness of these is determined largely by their interest or personal value for culture. For in [77] it was noted that some students, being singled out for attention on the basis of their aboriginality as pseudo-expert is unwelcome or shaming. This is similar to teachers' response to personal or environmental culture. The finding of this study supports the view of [54], statement that integrating the Native indigenous knowledge into the conventional school curriculum would enhance curriculum relevance and better understanding of concepts through the use of local languages, among other aspects of Indigenous Knowledge. This will be possible if chemistry teachers have the right value for learners' culture or that of the area where they teach to ensure an adequate awareness of their ethno science practices.

Gender which has been proven not to be a contributor/predictor of chemistry teachers' awareness of ethno science, supports the finding of [12] who in their study of Integration of indigenous knowledge and practices into chemistry teaching reported that integration of indigenous knowledge into chemistry teaching had no significant effect on male and female students' achievement in chemistry. This could possibly be due to the fact that both males and females (students and teachers alike) participate

in local practices within the society and so are both conversant with the indigenous knowledge and practices of their cultures. However, Davison as cited in [5] noted that some culture forbids females from participating in some practices that can make them understand the environment and its function. Consequently, this restriction affects female students' awareness of cultural practices hence, gender contributing to teachers' awareness of ethno science which is in contrast to the findings of this study. This discrepancy of findings might have been affected by time owing to the rapid changes in practice that could have taken place.

The submission of this study that school location has no predictive value on chemistry teachers' awareness of ethno science supports the view of [78] that teachers often transform their instruction when they recognize that students' informal and non-formal knowledge and practices are resources for science education. Teachers' transformation of instruction in such sensitive situations explains their awareness of the link between ethno science practices and formal/western science irrespective of their school location. However, [79] submission that school locations influence learning disagrees with the findings of this study in the sense that [79] see urban students as better achievers which contrast similarities in conditions of rural and urban schools' teacher awareness as discovered by this study. For this difference may have arisen possibly from teachers of urban areas having better knowledge, understanding or awareness of subject matter or resources which brought about the improved students' achievement. This opposition means that teachers' quality determines students' achievement. Therefore, the need for teachers to bridge the gap in students learning following school location by transforming their instruction when they recognize that students' informal and non-formal knowledge and practices are resources for science education [78].

## 6. CONCLUSION

Chemistry teachers' awareness of ethno science practices of the area where they teach is below expectation. This makes feasibility of a culture-related chemistry education unlikely except measures are put in place to improve on this average status. Chemistry teachers' awareness of ethno science could be enhanced through profiling of indigenous practices relevant to science (chemistry) education.

The teacher variables experience, gender and value for culture and; school location contribute compositely to chemistry teachers' awareness of ethno science. Experience and value for culture are significant relative contributors to chemistry teachers' awareness of ethno science, while gender and school location are not significant relative contributors to chemistry teachers' awareness of ethno science practices. In terms of relationship, experience, value for culture and school location have significant relationship with chemistry teachers' awareness of ethno science, while gender has no significant relationship with chemistry teachers' awareness of ethno science. There are other factors that predict chemistry teachers' awareness of ethno science practices.

## 7. RECOMMENDATION

Following the findings of this study, it is therefore recommended that concerted effort be put in place by government, curriculum planners and other educational bodies in encouraging culture-related chemistry education for betterment of the society by organisation sensitization exercises and training of chemistry teachers on innovative indigenous methods of instruction and newly profiled ethno science practices as they surface to eliminate abstraction of chemistry concepts.

Chemistry teachers should be given the necessary support and opportunity to use the educational root of learners' immediate environment to establish chemistry literacy for scientific and technological advancement and to ensure proper footing of chemistry students for meaningful impact in the society by encouragement of educational research in profiling ethno science practices. It is also recommended that the government fund indigenous researches on profiling of ethno scientific practices to ensure improved awareness of ethno science practices. This will help pilot a cultural approach to science education for development of indigenous science and technology.

Due to the limitations and challenges faced by the researcher, the following areas have been identified for further research:

- Replication of the study on teachers of other science subjects like Physics, Biology, Agricultural Science and Basic Science and Technology
- The study should also be carried out on Primary school teachers both science and

non-science experts as they are the foundation on which a dependable home-grown science education can be built.

- A similar study that would assess other predictors such as School type, Teacher qualification and Self efficacy as well as teachers' training should be attempted to cover other areas that were not considered by this study
- A study that will probe into the intricacies of ethno science practices through profiling of indigenous practices will undoubtedly be helpful in ensuring a culturally relevant science education.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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