CHALLENGES AND WAY FORWARD FOR TEACHING AND LEARNING OF CHEMISTRY IN A DEVELOPING NATION: CASE STUDY OF EBONYI STATE SECONDARY SCHOOLS.

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Abstract

It has been a serious issue of great concern to education administrators, the manner students avoid the study of chemistry and more worrisome is the level of failures recorded in chemistry external and internal examinations. This issue motivated this study 'Challenges and way forward for teaching and learning of chemistry in a developing nation: case study of Ebonyi state secondary schools (CWFC)'. The study has four research questions and two research hypotheses which were used to develop 39 items questionnaire as the instrument for the study. The instrument (CWFC) was subjected to both face validation and test re-test for its validity and reliability test and it passed with high grades. A total of 264 respondents made up of 240 chemistry students and 24 chemistry teachers of which 181 of them are male while 83 are female were used for the study. Results of the study showed that nature of chemistry as a subject, lack of qualified chemistry teachers, poor/wrong method of teaching, lack of teacher's and student's motivation, no job opportunity for chemistry graduates, poor or complete absence of chemistry laboratory in secondary schools, use of obsolete materials in teaching the subject, lack of modern chemistry textbooks and negative influence of friends, peer groups and parents/relatives are the major challenges to teaching and learning of Chemistry in secondary schools in Ebonyi state. The study showed no significant difference between the mean ratings of teachers and students and also they was no significant difference between the mean ratings of male and female on the challenges and way forward for teaching and learning of chemistry in senior secondary schools in Ebonyi State. The study recommends among other things: employment of adequate qualified chemistry teachers and technologists into the secondary school system, increase in funding of chemistry teaching and learning activities in the state by government and spirited individuals and groups, sponsoring of chemistry teachers and technologists in both local and foreign conferences, workshops and seminars, Proper and adequate supervision of teaching and learning of chemistry programmes in order to overcome the Challenges and way forward for teaching and learning of chemistry in the state.

***Keywords**: Challenges, Way Forward, Teaching, Learning*

Introduction

Effective teaching and learning of science is vital not only for examination or assessment purposes but also for empowering learners to live in a modern age of science, mathematics, and engineering. It is also to enable them to role-play the social and economic development of the developing countries and the whole world as well. The word Science is synonymous to development. It makes no sense to ask of the importance of science to humans since all the modern things and life one enjoys today is totally the product of science and technology. Science therefore is the name given to a group of subjects that are concerned with the bringing of development to human race. The major core science subjects studied in secondary schools include; Chemistry, Physics and Biology.

Chemistry as one of the pure secondary school science subjects deals with the study of nature, composition and properties of matter. The teaching and learning of senior secondary school chemistry is the foundation for high school chemistry, which also means that the teaching contains the recitation of a lot of basic knowledge (Igwe, 2015). For students who are new to this discipline, the boring concepts, obscure explanations, and teachers' wrong teaching methods can all increase the difficulty of chemistry learning to some extent. Chemistry as a pure science has its' usefulness/relevance in different areas of knowledge such as health, biology, and engineering among others. Chemistry is also known to be promoting intellectual development of students through the search to understand nature and its transformations. Adesoji and Olatunbosun (2008), describe Chemistry as a very important science subject due to its unequivocal importance in scientific and technological development of any nation. Chemistry is a prerequisite subject for offering science oriented courses in tertiary institutions, and this calls for the need to put efforts into its teaching for effective outcomes. Teaching of chemistry helps to instill scientific knowledge and stimulate science oriented attitude in learners. Dorothy (1999) reported that, 'the subject "chemistry" appears abstract to many students but the methods adopted in teaching it makes it real and close to the students. The teaching and learning of chemistry should be activity- based so that students will be actively involved. By this, the subject becomes real to majority of teachers teaching chemistry who are not current with the many methods of teaching chemistry. The majority of teachers who have been employed in the past decades have been doing the same thing the same way all along (Li Qinghua, 2018). They have no knowledge of the current ideas and innovations that have taken place in the educational field in the recent past. There are many active learning strategies that can be used in the chemistry classroom. They include, discussion, game playing, project demonstration, discovery, brainstorming, problem solving method and process based approach. These develop student's critical thinking skills, creativity, open mindedness, intellectual honesty etc. Other factors that can lead to poor methods of instruction are; the employment of non-professional teachers. This refers to teachers who teach chemistry without chemistry teaching qualifications. Such teachers may not be knowledgeable enough in teaching methods suitable for learning chemistry effectively and would not be abreast with the use of instructional materials to teach chemistry.

It is based on the above explained situation that this study becomes inevitable so as to unveil the current situation in the teaching and learning of chemistry in the secondary schools in Ebonyi State and proffer a way out of any identified lapses in the teaching and learning of the subject.

Statement of the problem

The problem of teaching and learning of chemistry in Nigeria and Ebonyi State in particular is a concern to all lovers of science and education. Pure sciences are today taught in

very poorly equipped classrooms and laboratories with very few number of chemistry teachers in the system. No fresh/young ones join the system. Such keeps the researchers of the subject restless. Of all the so many challenges that have been enumerated to be associated with the teaching and learning of chemistry in Nigeria, none of them was specifically associated directly to Ebonyi State. It is important to note that each state has her peculiar problems associated with teaching and learning. Every related problem needs peculiar solution. It is based on these facts that the researchers see it necessary to carry out a proper investigation on the problems and conditions of teaching and learning of chemistry in Ebonyi State and also find a way out of any identified hindrance to proper teaching and learning of chemistry in Ebonyi State, Nigeria. The above are the successes in which this study titled "**C**hallenges and Way Forward for Teaching and Learning Chemistry in a Developing Nation: Case Study of Ebonyi State Secondary Schools" wants to achieve.

Purpose of the study

The major purpose of this study was to determine the **c**hallenges and way forward for teaching and learning of Chemistry in Ebonyi State secondary schools. Specifically, the study sought to determine the:

1. Human resource challenges of teaching and learning of Chemistry in Ebonyi State secondary schools.
2. Material resource challenges of teaching and learning of Chemistry in Ebonyi State secondary schools.
3. Cultural and believe Challenges of teaching and learning of Chemistry in Ebonyi State secondary schools
4. Remedies to the challenges of teaching and learning of Chemistry in Ebonyi State secondary schools.

Research Questions

The following research questions guided the study:

1. What are the human resource challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?
2. What are the material resources challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?
3. What are the cultural believe challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?
4. What are the remedies to the challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

Ho$_1$ There is no significant difference between the mean ratings of teachers and students on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Ho$_2$ There is no significant difference between the mean ratings of male and female **on the c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Method

This study is a descriptive survey research design which according to Alio (2008) and Nworgu (2015) is one in which a group of people or items are studied by collecting and

analyzing data from only a few people or items considered to be representative of the entire population. This study was carried out in Secondary Schools in Ebonyi State of Nigeria.

The population of this study comprised of chemistry students and teachers in the 222 public or government owned senior secondary schools in Ebonyi State (EBSSEB, 2021). This population was considered most appropriate for these type of study because they were directly involved in everyday learning of chemistry in secondary schools. The study sampled out 240 senior secondary school students and 24 secondary school chemistry teachers in secondary schools in Ebonyi State. The researcher adopted a multi-stage random sampling technique to arrive at the sample. This multi-stage random sampling technique consisted of a number of distinct stages. The first stage will be to use simple random sampling technique to select the four senior secondary schools from each of the three educational zones, giving a total 12 sample secondary schools. In each of the sample schools 20 chemistry students and 2 chemistry teachers will be sample out for the study.

Instrument for Data Collection

The instrument for data collection of this study is a structured questionnaire, for chemistry students and teachers. The structured questionnaire is called 'Challenges and Way Forward for Teaching and Learning Chemistry' (CWFC). It is made up of four point scale questionnaire designed to elicit information on the four research questions. Each item of the questionnaire has a four point scale rating thus; Strongly Agree (**SA**), Agree (**A**), Disagree (**D**) and Strongly Disagree (**SD**). The researcher scored the instrument using weighted mean. That is Strongly Agree (**SA**), Agree (**A**), Disagree (**D**) and Strongly Disagree (**SD**) was scored 4 points, 3 points, 2 points and 1 point respectively. The instrument received face validation from an expert in Education Foundation and two from Science Education Departments in Ebonyi State College of Education, Ikwo. Their experts' corrections and amendments were all affected. The reliability of the instrument was ascertained using test - retest form of reliability. This form of reliability test allows the same instrument to be tested on the same subjects (respondents) in two different occasions separated by some time interval not less than two weeks. To this end, the same instrument (CWFC) was administered to forty secondary school chemistry students and ten chemistry teachers who were not enlisted for the sample from Ebonyi State Secondary Schools. The test - retest was given a gap of at least two weeks. The mean value obtained was correlated using Pearson product-moment formula.

Method of Data Collection

The researchers visited the sample schools and with the help of research assistants from each school, the researchers sampled out 20 chemistry students and 2 chemistry teachers for the study. The structured questionnaire were administered personally by the researcher and the respondents were given time to scrutinize and painstakingly express their responses. The researcher patiently waited for them until they finished filling it before the collection of the questionnaires was made under the supervision and guidance of the chemistry researcher and his assistant.

Method of Data Analysis

The research questions were answered using mean and standard deviation. While t-test statistics was used to answer the null hypotheses at 0.05 level of significance. The decision for the mean will be based on the principle of real limits. Thus; the decision for 3.50 - 4.00 is Strongly Agree, 2.50 - 3.49 is Agree, 1.50 - 2.49 is Disagree and 1.00 - 1.49 is Strongly Disagree. The Standard Deviation was used to determine the homogeneity or deviation of the

respondents from the mean ratings. The t-test statistics was also used to test the null hypothesis at .05 level of significance.

Results Presentation

The result was presented in tables in accordance with the research questions and hypotheses that guided the study as follows.

Research Questions 1

What are the human resource challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?

To answer this research questions, reference was made to the information on table 1 below. The data was obtained by administering Questionnaire titled "Human Resource Challenges of Teaching and Learning of Chemistry in Ebonyi State secondary school

Table 1: Human resource challenges of teaching and learning of Chemistry in Ebonyi State secondary schools.

	CLUSTER A	x	2	**Decision**
1	Chemistry is a difficult subject	3.06	0.92	Accepted
2	There are lack of chemistry qualified teachers in secondary schools in Ebonyi State	2.66	0.97	Accepted
3	Teachers use non- learner centered method of teaching chemistry during teaching and learning.	2.74	1.09	Accepted
4	Poor or no motivation for chemistry teachers	2.87	1.18	Accepted
5	Lack of job opportunity for chemistry graduates	2.64	0.93	Accepted
6	Use of inexperience teachers in teaching chemistry	2.19	0.91	Rejected
7	lack of chemistry practical for secondary school student	2.80	0.88	Accepted
8	Lack of chemistry laboratory technicians or laboratory attendants.	3.24	0.59	Accepted
9	Chemistry teachers don't give enough assignment and take home work	2.88	1.04	Accepted
10	Chemistry teachers don't use to be friendly with their students	2.16	0.48	Rejected

11	Chemistry student are not always serious with their studies	2.32	0.98	Rejected
	Grand Mean	**2.69**	**0.91**	**Accepted**

Table 1 above show that items 1,2,3,4,5,7,8 and 9 of the human resource challenges of teaching and learning of Chemistry were accepted to be having effect in teaching and learning of Chemistry in Ebonyi state while items 6,10 and 11 were rejected. The grand mean of 2.69 and standard deviation of 0.91 also indicate acceptance of the general effect of human resource challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.

Research Questions 2

What are the material resources challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?

To answer this research questions, reference was made to the information on table 2 below. The data was obtained by administering Questionnaire titled "Material Resource Challenges of Teaching and Learning of Chemistry in Ebonyi State Secondary Schools

Table 2: Material resources challenges of teaching and learning of Chemistry in Ebonyi State secondary schools

	CLUSTER B	x	2	**Decision**
1	No or poor chemistry laboratory in my school	3.10	1.11	Accepted
2	Teachers use old or obsolete material to do practical and to teaching of chemistry	3.13	0.96	Accepted
3	There no current textbooks and laboratory materials in my school	2.99	1.00	Accepted
4	Consumable chemistry materials are always available	3.08	1.10	Accepted
5	There are poor state of chemistry laboratory and classroom in my school	3.05	0.73	Accepted
6	Chemistry teacher lack the ability to improvise some local laboratory materials	1.96	1.35	Rejected
7	Chemistry teachers teach without proper lesson preparation.	2.96	0.85	Accepted
8	Chemistry teachers usually teach without instructional materials	2.49	1.12	Rejected
9	Students are not allowed to use practical materials during practical	2.86	1.03	Accepted
10	Spoiled laboratory materials are not always replaced.	3.19	0.89	Accepted
11	There is improper care of chemistry laboratory and teaching materials	2.32	0.99	Rejected

12	Laboratory Seats and desks are not enough and even to befitting.	2.46	0.86	Rejected
	Grand Mean	**2.80**	**1.00**	**Accepted**

Table 2 above show that items 1,2,3,4,5,7,9 and 10 of the material resources challenges of teaching and learning of Chemistry were accepted to be having effect in teaching and learning of Chemistry in Ebonyi state while items 6,8, 11 and 12 were rejected. The grand mean of 2.80 and standard deviation of 1.00 also indicate acceptance of the general effect of material resources challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.

Research Questions 3

What are the cultural believe challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?

To answer this research questions, reference was made to the information on table 3 below. The data was obtained by administering Questionnaire titled "Cultural Believe Resource Challenges of Teaching and Learning of Chemistry in Ebonyi State Secondary Schools.

Table 3: Cultural believe challenges of teaching and learning of Chemistry in Ebonyi State secondary schools

	CLUSTER C	x	2	**Decision**
1	Culture forbid me from taking part in some aspect of chemistry work.	2.12	0.88	Rejected
2	I don't use to study chemistry it a hard nature of the subject	2.19	0.88	Rejected
3	Chemistry is for intelligent student only	3.24	0.91	Accepted
4	My parents discourages me from studying chemistry	2.29	1.03	Rejected
5	My friends discourages me from studying chemistry	2.56	1.15	Accepted
6	Teachers discourages me from studying chemistry	2.16	1.03	Rejected
7	There are not incentives for chemistry students	2.88	1.11	Accepted
	Grand Mean	**2.49**	**1.00**	**Rejected**

Table 3 above show that items 3, 5 and 6 of the cultural believe challenges of teaching and learning of Chemistry were accepted to be having effect in teaching and learning of Chemistry in Ebonyi state while items 1, 2, 4 and 6 were rejected. The grand mean of 2.80 and standard deviation of 1.00 also indicate non-acceptance of the general effect of cultural believe challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.

Research Questions 4

What are the remedies to the challenges of teaching and learning of Chemistry in Ebonyi State secondary schools?

To answer this research questions, reference was made to the information on table 4 below. The data was obtained by administering Questionnaire titled "Remedies to Challenges of Teaching and Learning of Chemistry in Ebonyi State Secondary Schools.

Table 4: Remedies to the challenges of teaching and learning of Chemistry in Ebonyi State secondary schools

	CLUSTER D	x	2	**Decision**
1	There should be workshops for chemistry teachers on the modern ways of teaching chemistry	2.49	1.12	Rejected
2	Enough teaching and learning material should be provided for every lesson.	3.01	0.93	Accepted
3	Both teachers and students should be properly motivated for teaching and learning of chemistry.	2.83	1.07	Accepted
4	Enough chemistry teachers should be employed into the system	3.53	1.64	Accepted
5	Learner centered methods for teaching should always be used in teaching chemistry	2.78	1.04	Accepted
6	Teachers should try to relate their chemistry lessons with what is obtainable around the learners.	2.79	1.16	Accepted
7	Consumable laboratory materials should be adequately provided for practical use.	2.89	1.09	Accepted
8	Laboratory technicians should be employed and supplied to all secondary school chemistry laboratories	2.91	0.98	Accepted
9	Teachers should try to be more friendly with their students	2.56	0.92	Accepted
	Grand Mean	**2.56**	**1.11**	**Accepted**

Table 4 above show that items 2, 3, 4, 5, 6, 7, 8 and 9 of the remedies to the challenges of teaching and learning of Chemistry were accepted to be having effect in teaching and learning of Chemistry in Ebonyi state while only item 1 was rejected. The grand mean of 2.56 and standard deviation of 1.11 indicate acceptance of the general effect of the remedies to the challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.

Research Hypotheses 1

There is no significant difference between the mean ratings of teachers and students on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Table 5: Test of Hypothesis 1

Variables	No	x	SD	Df	LS	t-Cal.	t-Crit.	Decision
Teachers	24	2.63	0.92					
				263	0.05	0.048	1.960	Accepted
Students	240	2.64	1.18					

Table 5 above displayed the result of the mean t-test of the hypothesis which sort to know if there is no significant difference between the mean ratings of teachers and students on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State. The calculated value of 0.048 is far less than the critical value of 1.960. Based on this value we now state that there is no significant difference between the mean ratings of teachers and students on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Research Hypotheses 2

Ho$_2$ There is no significant difference between the mean ratings of male and female on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Table 6: Test of Hypothesis 2

Variables	No	x	SD	Df	LS	t-Cal.	t-Crit.	Decision
Male	181	2.76	0.97					
				263	0.05	0.965	1.960	Accepted
Female	83	2.63	1.09					

Table 6 above displayed the result of the t-test of the hypothesis which sort to know if here is any significant difference between the mean ratings of male and female on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State. The result show a calculated value of 0.965 which is less than the critical value of 1.960that means that there is no significant difference between the mean ratings of male and female on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Discussion of Results

The main aim of this study is to unveil the challenges and way forward for teaching and learning of chemistry in a developing nation: case study of Ebonyi state secondary schools. Data collected and analyzed revealed as summarized below;

1. Research question 1 implied that, nature of chemistry as a subject, lack of qualified chemistry teachers, poor/wrong method of teaching, lack of motivation of teachers and students, unavailable job opportunities for chemistry graduates and lack of finances were accepted to

be human resource challenges to teaching and learning of chemistry that affect teaching and learning of chemistry in Ebonyi state.

2. On the second research question which sought for the material resources challenges of teaching and learning of Chemistry, it implicated; poor or complete absence of chemistry laboratory in secondary schools, use of obsolete materials in teaching, lack of modern chemistry textbook, non-replacement of used consumable chemistry laboratory materials, lack of seriousness of some chemistry teachers and students and poor maintenance culture on the part of teachers and students as the material resources challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.
3. In verifying the cultural believe as little effect to teaching and learning of Chemistry, only negative influence of friends, peer groups, parents/relatives and nature chemistry as a subject, lack of dedication and seriousness were seen as cultural believe challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.
4. Research question 4 sought for remedies to the challenges of teaching and learning of Chemistry and they include; provision of enough teaching and learning chemistry laboratory materials, motivation of both secondary school chemistry teachers and students, employment of more qualified chemistry teachers in secondary schools, organizing regular workshops, seminars for chemistry teachers to update them on modern methods and materials for teaching chemistry.
5. The study showed no significant difference between the mean ratings of teachers and students on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.
6. They was also no significant difference between the mean ratings of male and female on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

Educational Implications

Based on the results of this study the following educational implication can be deduced;

1. There is lack of qualified chemistry teachers and technologists in secondary schools in Ebonyi State. This calls for government and education administrators to employ qualified chemistry teachers and technologists into the system. It is by so doing that the subject will have enough capable hands to handle the course.

2. The study also revealed that there is always issue of negligence in provision and taking care of chemistry teaching and learning equipment by the education administrators. The implication of this negligence is that chemistry equipment are allowed to spoil or in most times damaged by some individuals. To solve this, there should be a well build chemistry laboratory and enough chemistry teaching and learning aid be provided in every secondary school that offer chemistry in Ebonyi State.

3. There is absence of motivation of chemistry teachers thereby bringing about the “I don’t care” attitude of teachers to their teaching of the subject. This could be curbed by increasing some of the allowances accrued to the chemistry staff.

4. Chemistry teachers should be encouraged and motivated to improvise their teaching materials in order to boost effective teaching and learning of the subject. This encouragement could be financially, materially and verbally.

5. This study encourages better remunerations for both teachers and students involved in teaching and learning chemistry in secondary schools of the state. This will be done through sponsoring teachers and students for workshops, seminars and conferences and their entitlements promptly paid them.

6. Funding of chemistry study at all levels should be increased. As this study discovered that science education in the state is poorly funded. It is always treated like other subjects that have no practical topics.

Conclusion

This research work aimed at unveiling the challenges and way forward for teaching and learning of chemistry in a developing nation: case study of Ebonyi state secondary schools. The study made use of weighed mean, standard deviation and t-test statistics in analyzing the data collected from students and teachers of secondary schools in the state. The analyses revealed that; nature of chemistry as a subject, lack of qualified chemistry teachers, poor/wrong methods of teaching lack of motivation of teachers and students, unavailable job opportunities for chemistry graduates and lack of financial assistances as human resource challenges to teaching and learning of chemistry were accepted to be having effect in teaching and learning of chemistry in Ebonyi state.

It also showed that poor or complete absence of chemistry laboratory in secondary schools, use of obsolete materials in teaching of chemistry, lack of modern chemistry textbooks, non-replacement of used consumables in chemistry laboratory, lack of seriousness of some chemistry teachers and students and poor maintenance culture on the part of teachers and students are the material resource challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.

Not done, the study indicated that negative influence of friends, peer groups, parents/relatives and nature of chemistry, lack of dedication and seriousness were seen as cultural believe challenges of teaching and learning of Chemistry in secondary schools in Ebonyi state.

The remedies to the challenges of teaching and learning of Chemistry as verified include; provision of enough and efficient teaching and learning chemistry laboratory materials, motivation of both secondary school chemistry teachers and students, employment of more qualified chemistry teachers in secondary schools, organizing regular workshops and seminars for chemistry teachers to update them on modern methods and materials for teaching chemistry.

The study showed no significant difference between the mean ratings of teachers and students on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State.

They was also no significant difference between the mean ratings of male and female on the **c**hallenges and way forward for teaching and learning chemistry in senior secondary schools in Ebonyi State..

Recommendations

Based on the results of this study the researchers make the following recommendations:

1. Government and education administrators should endeavour to employ qualified chemistry teachers and technologists into the system. It is by so doing that the subject will have enough capable hands to handle the subject.
2. Chemistry teachers should be encouraged to learn and adopt different chemistry made-easy methods of teaching chemistry. This can be achieved by encouraging and sponsoring chemistry staff in local and foreign conferences, workshops/seminars
3. Government should increase funding of chemistry teaching and learning in the state.
4. Proper and adequate supervision is needed in teaching and learning chemistry in order to overcome the issue of poor, imprudent and careless management of science education funding in the state.
5. Government and education administrator should endeavour to provide enough teaching aid for the teaching and learning chemistry.
6. Teachers and students involved in teaching and learning chemistry should be encouraged financially and materially by education administrators.
7. Government and educational administrators should ensure that academic research works are put in use especially those involving teaching and learning chemistry.

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