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Volumetric Analysis and Secondary School Chemistry Teachers' Competencies in Eleme Local Government Area, Rivers State

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Abstract
The aim of this study was to examine volumetric analysis being a practical aspect of Chemistry and secondary school teachers' competence in Eleme Local Government Area of Rivers State. The study used survey design. Sample size of 144 senior secondary school Chemistry teachers were purposively selected from 64 public and private schools in rural and urban areas. Chemistry Teachers' Competency Observation Checklist (CTCOC) was the instrument for data collection. Three research questions were raised and answered using mean and standard deviation. Two hypotheses were tested at 0.05 level of significance using z-test. Related literature was reviewed. Pearson Product Moment Correlation was used to calculate the reliability coefficient which yielded 0.89. The results obtained after data analyses indicated that qualifications enhanced teachers' competencies and that the Chemistry teachers in urban area are more competent in handling volumetric analysis (quantitative analysis).Sequel to these findings, recommendations were made that teachers should be employed based on qualifications as this will improve the overall standard of education.

Keywords: volumetric, analysis, competence, chemistry, Eleme

INTRODUCTION

Practical work is of importance in the learning of Science, especially Chemistry which needs practical demonstration for students' understanding and applications. Thus, teaching and learning of Chemistry demands good laboratory trained teachers that can initiate the spirit and method of inquiry using appropriate teaching strategies that would enable the students to acquire the practical skills necessary for scientific literacy, knowledge and attitude for effective sustainable development of Science and Technology.

Volumetric analysis is a concept that expose students to a lot of practical activities and give the fundamental principles that are required in other practical concepts in Chemistry. Hence, teachers are to teach the concept (volumetric analysis) with intensive practicals using well equipped laboratory and teaching techniques.

There are hues and cries among Nigerians over the growing rate of failure in Science subjects including Chemistry in recent times. The students are often blamed for un-preparedness for examination as one of the major causes of failure. Sometimes, teachers are also blamed for lack of dedication to duty, lack of practical skills and other competencies that have inadvertently affected the performance of students (Michael 2014). Adeogun (2012) argued that the quality of any educational system depends on the competencies of its teachers and that a school without human resources may not be able to achieve the goals and objectives of an established educational system. Ayodele (2004) also noted that teachers are the major indicators and determinants of good academic performance. Hence, highly professional Chemistry teachers, who are dedicated in making the teaching of Chemistry more practical and real are needed in schools. Olayiwola (2015) stated that there is high correlation between the quality of teachers and learning outcomes. Thus the ability to conduct practicals effectively depends on a teacher's knowledge of the subject area. Sequel to this, the competencies of the teacher need to be very high for meaningful teaching and learning to take place. At the secondary school level where a distinction is made between junior and senior secondary school curricula, teachers' competencies for each level and subject vary.

However, to ascertain what these competencies are, the Chemistry curriculum needs to be examined within the context of the preparation of teachers that would implement the curriculum. Teachers' competencies should therefore relate to academic and professional preparation, professional growth, classroom interaction and evaluation (Obomanu & Nbina 2012).The nonchalant attitude of some Chemistry teachers while conducting practicals is known to result to poor performance of students in secondary school certificate examination (SSCE)

Chemistry practicals. Eggen and Kauchak (2012) opined that positive teachers' attitude is fundamental to effective teaching. Thus, teaching of Chemistry demands disciplined teachers and good Science laboratory where the teachers can introduce the learner into the spirit and method of inquiry using appropriate equipment, and also acquaint students with laboratory activities. Delivery of instruction in Chemistry also requires a lot of time, knowledge of other Sciences, Mathematics and working hard in the area of experimentation.

The success of any Chemistry teacher in the laboratory depends to a large extent on the teachers' preparedness. Literature is replete with the fact that most of the present Chemistry teachers in secondary schools are not professionally qualified and therefore have poor knowledge of the content of Chemistry practical. This by extension has affected students in terms of knowledge acquisition during Chemistry practicals. Teachers need certain level of academic qualifications to be able to function properly. The qualifications demanded of teachers depend on the quality and complexity of the education system of a particular society.

Dienye and Ifeanacho (2014) posited that the educational processes of a society reflect its nature and its needs. And as these change, its educational processes may have to change too. Subsequently, the inadequacies of the teachers to disseminate the new body of knowledge needed by a changing society called for more qualified teachers. At the end of the teacher training program, the trainees are given certificates that qualify them to be teachers, yet there existed and still exists differences in the quality of teachers in relation to competence. As long as there are still have un-trained teachers and those with low qualifications in service, teachers' competencies may not be fulfilled. Perhaps, it is in realization of the above that the Federal Republic of Nigeria (FRN 2014) in National Policy on Education clearly stated that the minimum qualification for entry into the teaching profession shall be the Nigerian Certificate in Education (NCE).

It is in consonance with this view that the Federal Republic of Nigeria (FRN 2014) provided that, in-service training shall be developed as an integral part of continuing teacher education and shall be regularly exposed to innovation in their profession. This will also help the Science teachers including Chemistry teachers to acquire practical skills which will enable them to handle volumetric analysis better. Learning activities assist students to develop essential scientific skills, attitudes and creativity that birth a "total child". The Chemistry curriculum provides students with opportunities to perform practical work. Thus, the main question driving this study is the identification of gap in secondary school teachers' competencies in relation to the objectives of Chemistry as a Science subject.

Furthermore, competence has to do with the ability, fitness, capacity of carrying out a particular task with an accepted level of proficiency. For one to be competent in any field of endeavor, one must possess a high level of authority, ability, fitness and broad knowledge of what one does. Thus, a teacher's competence implies the ability, fitness and authority, experience and the manipulative dexterity to educate learners in such a way that the goals and objectives of educational systems are achieved. It is in line with the above that Wokocha and Okujagu (2014) remarked that a school is not merely a workshop, it transmits values and attitudes, skills, qualities of character, knowledge and physical wellbeing are all to be desired along with capacities for thought and sound judgment. The aforementioned attributes of man identified by Wokocha and Okujagu (2014) can only be achieved through the competence of a teacher who plays the teaching role.

To assess secondary school Chemistry teachers' quality through identification and use of laboratory apparatus, a checklist of commonly utilized apparatus, equipment and reagents are to be used in order to ascertain Chemistry teachers' competences. Etiubon and Udoh (2017) conducted a study on effects of practical activities and manual on science students' academic performance on solubility traced students' poor performance in practical Chemistry to teachers' inability to take students through practical sessions in the laboratory.

Etiubon and Udoh (2017) further expressed that Chemistry teachers were not able to display correct understanding of Science processes and unable to organize and conduct practical classes successfully.
A teacher's competence as remarked by David and Macayan (2013) has to do with:

1. Qualification in terms of certificates acquired
2. Experience in terms of years of service
3. Methodology in terms of ways of imparting knowledge.
4. Reading habit in terms of how often current materials are read.
5. Performance in terms of how well learners pass examinations.

WAEC chief examiners' reports (2015) and (2016) indicated that candidates performed poorly in practical Chemistry and areas that require demonstration of competency in preparation of gases. The implication is that students may not be having the exposure to practical experiences that should prepare them for the psychomotor and cognitive domains of learning and they may have been deprived of the acquisition of Science process skills that prepare them for external examinations.

Literature is replete with the fact that a teacher who is fully prepared for instructional delivery derives pleasure when students demonstrate high achievement or gains than those whose teachers are not fully prepared (National Council for Accreditation of Teacher Education NCATE 2014, WAEC Chief examiners' reports of 2014-2016, Nwosu & Nzewi 2015). In some secondary schools however, there are well-equipped Chemistry laboratories but engagement in practical activities is inadequate and irregular. The inadequacy and irregularity of practical activities certainly contribute to poor performance in Chemistry and these in turn can be attributed to teachers' incompetency in handling Chemistry practicals. And so, when a teacher lacks the necessary teaching competences, learning outcomes will be poor and therefore affect the general goal of Science Education. In view of the on–going, WAEC and NECO Chief Examiners' reports of May-June, 2014, 2015 and 2016 confirmed that poor performances of students in Chemistry could be attributed to poor exposure of students to practical works or teachers' in-competences regarding laboratory activities. It is therefore, the intention of this study to examine Chemistry teachers' competencies in handling practicals (volumetric analysis) in Eleme Secondary Schools. Thus, this study intends to focus on the assessment of Chemistry teachers' competencies in teaching volumetric analysis in Eleme L.G.A Secondary Schools from the following points of view:

i. Knowledge of the practical skills.
ii. Presentation of the lesson
iii. Effective communication
iv. Laboratory organization
v. Setting up of the apparatus for practicals
vi. Preparation of reagents
vii. Risk assessment

Research Questions

Three research questions were posed and answered in this study.

1. How do the qualifications of Chemistry teachers enhance their competencies in handling volumetric analysis?
2. What difference exists between the competencies of Chemistry teachers in public schools and those in private schools in handling volumetric analysis?
3. Would there be any difference between the competencies of Chemistry teachers in urban and rural secondary schools in handling volumetric analysis?

Hypotheses

Two null hypotheses were formulated and tested at 0.05 level of significance.

HO_1 There is no significant difference between competencies of Chemistry teachers in public secondary schools and those in private secondary schools in handling volumetric analysis?

HO_2. There is no significant difference between the competencies of Chemistry teachers in urban secondary schools and those in rural secondary schools in handling volumetric analysis

METHODOLOGY

The study adopted survey design. The area of this study was Rivers State and was carried out specifically in public and private senior secondary schools in Eleme local Government area. Population consisted all Chemistry teachers in 64 senior secondary school both public and private. Multi-stage sampling technique was adopted in selecting the sample. In the first stage, the schools were stratified due to their grouping into public and private secondary schools before randomization. Thus, stratified random sampling technique was used in the selection of sixty-four (64) schools. At the second stage, schools were stratified due to their grouping into urban and rural schools. Finally, all the Chemistry teachers in the sampled schools were purposively selected to form the subjects (sample size) for study giving a total of one hundred and forty-four (144) teachers. (87) from public senior secondary schools and 57 from private senior secondary schools).

The instrument for data collection was observation checklist tagged Chemistry teachers' competences observation checklist (CTCOC) which was constructed by the researchers on a modified four point Likert scale. The instrument was validated by two experts in the field of Science Education. The instrument was modified using the inputs and suggestions from the experts to ensure both face and content validity. Test re-test method was used for the reliability of the instrument and the obtained were collated and correlated using Pearson Product Moment Correlation to obtain reliability index of 0.89.

The administration of the instrument followed a procedure. The procedure was based on the permission obtained from the principal for entry into Chemistry laboratory of the selected schools for this study with the help of research assistants to ensure 100% retrieval. The research instrument CTCOC was weighted: very good 4 points, good 3 points, average 2 points and poor 1 point. All the research questions were answered using mean and standard deviation while the hypotheses were tested with z-test for significance at the 0.05 alpha level of significance.

RESULTS

Data collected were analyzed and discussed based on the research questions and hypotheses.

Research Question One

How do the qualifications of Chemistry teachers enhance their competencies in handling volumetric analysis?

Table 1 Mean and standard deviation of the assessment of Chemistry teachers' competencies based on their qualifications

S/N	Chemistry teachers' Qualifications	Sample size	Sum of competency scores	Mean competency score	SD	Remark
1.	NCE	8	18.85	2.36	1.00	Average
2.	HND	15	37.92	2.53	0.96	Average
3.	B.Sc	20	56.67	2.83	0.92	Average
4.	B.Ed	28	84.37	3.01	1.16	Good
5.	HND/PGDE	21	63.01	3.00	1.20	Good
6.	B.Sc/PGDE	22	66.43	3.02	1.04	Good
7.	M.Sc	12	37.12	3.09	1.10	Good
8.	M.Ed	16	50.37	3.15	1.21	Good
9.	Ph.D	2	7.42	3.71	1.12	Very Good

Source: Researchers' field survey 2018

As reflected on Table 1, An analysis was carried out to determine if Chemistry teachers' qualifications enhance competencies in handling practicals in general and volumetric analysis in particular. The result showed that teachers with NCE, HND and B.Sc have mean competency scores of 2.36, 2.53 and 2.83 respectfully; teachers with B.Ed, HND/PGDE, M.Sc and M.Ed have a good performance with a mean competency score of 3.01, 3.00, 3.02, 3.09 and 3.15 respectfully; while the Ph.D Chemistry teachers have mean score of 3.71. The highest level of performance of 3.17 was obtained from those teachers with Ph.D. qualification. It was observed that Chemistry teachers with higher qualifications are more competent in handling volumetric analysis than those with lower qualifications which is an indication that qualifications enhance teachers' competencies.

Research Question Two

What difference exists between the competencies of Chemistry teachers in public and those in private secondary schools in handling volumetric analysis?

Table 2 Mean and standard deviation of the assessment of Chemistry teachers' competency in public and private schools

S/No	School proprietorship	Sample size	Total competency score	Mean competency score	SD	Remark
1.	Public school	87	269	3.09	1.12	Good
2.	Private school	57	161	2.82	1.05	Good

Table 2 indicates the difference between public and private schools Chemistry teachers' competencies in handling volumetric analysis. The public schools Chemistry teachers have a good competency score with a mean of 3.10, while private schools Chemistry teachers have an average competency score with a mean of 2.83. It is observed that there is a difference in mean competence performance between teachers from the two types of schools in their mean, the public school teachers have a higher mean as compared to the private school teachers.

Research Question Three

Would there be any difference between the competencies of Chemistry teachers in urban and rural secondary schools in handling volumetric analysis?

Table 3 Mean and standard deviation of the assessment of Chemistry teachers' competency in urban and rural schools

S/No	School location	Sample size	Total competency scores	Mean competency score	SD	Remark
1	Urban	75	228	3.04	1.08	Good
2	Rural	69	202	2.93	0.91	Average

Table 3 indicates the difference between urban and rural secondary schools Chemistry teachers' competencies in handling volumetric analysis. The urban schools Chemistry teachers have a good competency score with a mean of 3.04 while rural schools Chemistry teachers have an average competency score with a mean of 2.93. It is observed that there a difference between teachers from urban and rural schools in their mean scores. Chemistry teachers in the rural schools have a lower mean score compared to that of Chemistry teachers from urban schools.

Test of Hypotheses

In this study two null hypotheses were tested as follows:

Null hypothesis one (Ho_1)

There is significant difference between competencies of Chemistry teachers in public secondary schools and those in private secondary schools in handling volumetric analysis. In testing this hypothesis, z-test for significance at the 0.05 alpha level of significance for difference in mean of the two groups (public and private) secondary schools was calculated (see Appendices (VIII & IX; page 121 – 124)

Table 4: Z-test analysis for the significant difference between public and private secondary schools Chemistry teachers' competency in handling volumetric analysis

S/No	School proprietorship	N	Mean	SD	Df	z-cal	z-critical	Decision
1.	Public	87	3.10	1.16	142	0.065		Not
2	Private	57	2.83	0.99				significance

Since the calculated z-value (0.065) is less than the critical z-value (1.96) at 0.05 level of significance with 142 degrees of freedom, the result is not significant, hence null hypothesis is accepted. Meaning therefore, that there is not significant difference between the level of competencies of Chemistry teachers in public secondary schools and those in private secondary schools in handling volumetric analysis.

Null hypothesis two (Ho_2)

There is no significant difference between the competencies of Chemistry teachers in urban secondary schools and those in rural secondary schools in handling volumetric analysis. In testing this hypothesis, z-test for significance at the 0.05 significance level for difference in mean of the two groups (urban and rural) secondary schools was calculated (see Appendices X & XI, page 127-131).

Table 5: Z-test analysis for the significant difference between urban and rural secondary schools Chemistry

S/No	School proprietorship	N	Mean	SD	Df	z-cal	z-critical	Decision
1.	Public	75	3.04	1.91	142	0.024	1.94	Not
2	Private	69	2.94	1.01				significance

The decision on the hypothesis to be accepted or rejected was based on comparing the calculated z-test value and the critical z-test value from the table.

Since the calculated z-value (0.024) is less than the critical z-value (1.96) at 0.05 level of significance with 142 degrees of freedom, the result is not significant. Hence, null hypothesis is accepted. Meaning therefore, that there is no significant difference between the Chemistry teachers' competencies in urban secondary schools and those in rural secondary schools in handling volumetric analysis.

DISCUSSION

The finding that, the more qualified a teacher is, the more competent the teacher in teaching volumetric analysis. This is supported by Ali (2006) who is of the opinion that the qualification of a teacher tells immensely on the ability and the competence in the classroom. Ali (2006) opined that for a teacher to perform maximally, the teacher should be exposed to a lot of training. In line with this finding, David and Macayan (2018) affirmed that a teacher's competence has to do with the qualifications in terms of certificates acquired. Also, the findings revealed that Chemistry teachers in public secondary schools had good competency score with a mean of 3.10, while Chemistry teachers in private schools had an average competency score with a mean of 2.83. It was observed that there was difference between both the public and private school teachers' mean scores. The private schools had a lower mean as compared to that of the public schools. It was expected in this study that private secondary school teachers will perform more than public secondary school teachers, but the findings seem to have justified the observation made by Kaegan (1996) that beautiful buildings and expensive equipment stocked will not lead to effective learning without qualified teachers putting them into use and making students to participate in the experimental procedures.

The study also revealed that there is a difference between the competency of Chemistry teachers in urban and rural schools in handling volumetric analysis. The urban teachers have a good competency

score with a mean of 3.04, while rural schools have an average competency score with a mean of 2.93. It is observed that the urban schools perform better than their rural counterparts. This finding did not come as a surprise, considering the poor state of Chemistry laboratory in the rural secondary schools as buttressed by Ibe, Adah and Ihejiamaizu (2013) that there is difference in the ability of urban and rural senior schools Chemistry teachers in identification of the commonly used pieces of laboratory apparatus. Ibe et al (2013) also found that teachers in urban schools recorded higher mean achievement in identification of pieces of apparatus than those in rural schools. It indicates that the location of Chemistry teachers may have influenced their competency in handling volumetric analysis as a concept in practical Chemistry. Also, in line with these findings, Okebukola (2002) noted that good learning environment stimulates positive response in teaching and learning situation, but the reverse is the case where such is lacking.

RECOMMENDATIONS

The following recommendations were made based on the findings:

1. Teachers should be employed based on their qualifications as this will improve the performance of learners.
2. Chemistry teachers should endeavor to improve on their level of competence by making effort to acquire higher qualifications and attending seminars, subject panels, workshops and conferences organized by Science Teachers' Association of Nigeria and Chemical Society of Nigeria.
3. Employment of teachers by private schools should not be based on profit maximization and minimization of cost. It should be based purely on assessment of the performance of the teacher as this will go a long way in effecting the overall performance of the school.
4. Rural schools should be equipped so that they can compete favorably with the urban schools

CONCLUSION

Based on the findings, the researchers concluded that:

1. Qualification of Chemistry teachers enhanced their competencies in handling volumetric analysis. The more qualified a Chemistry teacher is, the more competent he/she is in handling volumetric analysis.
2. The experience of Chemistry teachers enhances competencies in handling volumetric analysis. The more experienced a teacher is, the more competent the teacher in handling volumetric analysis.

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