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# CHEMISTRY TERMINOLOGIES AND LABORATORY FACILITIES AS IT AFFECTS CHEMISTRY PRACTICAL CLASS IN SENIOR SECONDARY SCHOOLS IN EKITI STATE, NIGERIA

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**Abstract**
This study examined chemistry terminologies and inadequate laboratory facilities as it affects chemistry practical class in senior secondary schools in Ikere local government area of Ekiti State, Nigeria. The research design used for this study was survey design of the descriptive type of research. The sample size of two hundred (200) respondents was used for the study using simple random sampling technique. The respondents were drawn from five (5) public secondary schools within Ikere local government Area of Ekiti State. The instrument for data collection for the study was a self-structured questionnaire. The instrument was subjected to validity and reliability mechanism. A reliability coefficient of 0.90 was obtained. Four research hypotheses were formulated for the study. The findings showed that there are no significance difference between the effects of lack of experimental work among the age groups. Also, the findings revealed that there is significance influence of chemistry terminologies on chemistry student's performance in chemistry practical class. The findings of the study also showed that poor understanding of chemistry terminologies and lack of adequate laboratory facilities were difficulties encountered by students in chemistry practical class. Based on the findings, appropriate recommendations were made.

**Keywords**:
Terminology, inadequate, laboratory facilities, practical class, senior secondary school.

## Introduction

The development of any nation depends largely on the level of education attained by her citizens especially in the area of science and technology. It is highly rated as the most important instrument of change since any definite change in the intellectual and social outlook of the people must be preceded by an educational revolution (Ezeugo, 2009). Aniodoh (2012) defined science as a way of investigating and a body of established knowledge. Ikwanusi (2011) stated that science is a powerful tool for nation development, it is this realization that chemistry curriculum had to adjust her academic knowledge, technical and vocational skills. In cognizance with the importance of science and technological in Nigeria, science subjects such as chemistry are taught in secondary schools to prepare a base for any science and technology development (Akinsola, 2011).

Teaching and learning of science have significant roles towards technological development in a developing nation since chemistry is embedded in our life and society, economical, ecological and societal influences (Hofstein, Eilks & Bybee, 2011). The performance of students in science based subjects like chemistry is closely related to their theoretical and practical knowledge while some are taught in isolation from the process of discovery or the conceptual applications. This however, depends solely on the subject at various classes and also on particular factors within and without the teaching and learning environment (Felder, Felder & Diet, 2013).

Chemistry has become one of the most important subjects of science in the secondary school curriculum and has become one of the major pillars of scientific and technological drive. Chemistry is a branch of science that is rational and mathematical, discipline where certain measured and controlled inputs lead to certain predictable outputs (Learning Things, 2014).It is worth to emphasize at this junction that the field of chemistry, science and technology are related to the economic heart of every highly-developed industrialized

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and technologically advanced society (Burmeister, Rauch & Eilks,2012). The benefit of learning and advancing in science and technology can be intrinsic and extrinsic, and such has been identified with chemistry.

The practical experience constitutes an integral part of chemistry teaching in secondary schools. The subject consist of many topics that can be verified experimentally with an objective to create an enabling environment to stimulate student learning about chemistry that is commonly presumed as abstract, quantitative, and boring (Read & Kable, 2007).If the availability of laboratory equipment, chemicals and materials, laboratory personnel, working conditions in the laboratory and safety measures, substantial recommended textbooks and accurate periods allocated for the teaching of the subjects are carefully controlled, then effective teaching of chemistry will be achieved (Adefunke, 2008). And this will in turn create a scholastically rich, rewarding environment for the students to learn the basic tools of Chemistry (Frank & Saxe, 2012).

Understanding and learning core science concepts and principles, including those in chemistry, are difficult; many research studies have revealed major learning difficulties and identified key causes of these difficulties. This difficulty could be as result of poor experimental activities in chemistry laboratories, inadequate availability of reference books, poor method of instruction, poor language of instruction, representation of materials in textbooks instead of practical display, and many others. The effect of conducting experimental activities, teaching and learning methods used by teachers in developing positive attitude in learning chemistry is also significant (Yunus & Ali, 2013). Practical work should be about thinking that is trying that can establish the relationship between evidence and theory to stimulate students learning. Low practical classes in secondary schools are the leading causes that bring negative impact on academic achievements in chemistry (Tilahun & Tirfu, 2016).

Students who learn by inquiry approaches are responsible for developing their own answers to questions rather than exclusively relying on the teacher and/or textbooks. The preceding arguments suggested that a lesson presentation that is consistent with active learning is characterized by activities in which students fully engage their higher order thinking mental capacities like concepts, procedures, predicting and justifying with each other (Sirhan, 2007). Teachers should cultivate work environments in which they are able to watch students at work and listen to them explaining learning strategies that could be used in the presentation. Giving responsibility and leadership in scientific activities, keeping the students informed of their progress in chemistry, providing opportunity for students demonstration, arranging for students cooperative enterprise in science, organizing field trips, science clubs and science fairs, creating a sense of healthy competition among the students (Tilahun & Tirfu, 2016). The learners should be actively involved in the learning experience. The teacher does not take center stage in the classroom but should be a facilitator and listener. The teacher should design activities that focus on allowing students support, refine or refute their theories about a particular event (Hussein, 2006).

Lack of competence in English language by both teachers and learners affect the teaching and learning chemistry and the immediate consequences of students' performance in school subjects including chemistry. Students are unable to communicate fluently in English and find it difficult to take part in class discussions. Examinations remain a critical factor in influencing the learning of chemistry. Teachers tend to focus on those aspects which gain examination grades rather than on important outcomes such as practical skills (Tilahun & Tirfu, 2016).

Anaso (2010) submitted that lack of chemistry practical skills in students' results in poor communication as well as observational skills which gives room to students' poor performance in chemistry. Also, good quality chemistry practical skills helps in developing students understanding of scientific processes and concepts, hence the heavy investment made in the provision and equipping of chemistry laboratories in secondary schools. Chemistry practical is an essential feature of secondary science education (Abrahams & Millar, 2008).Hence high proportion of chemistry lesson time in secondary schools is given to chemistry practical with assumption that it leads to distinctive attainments in students. However, Tilahun & Tirfu (2016) reported that there was a huge gap between what is intended in the national curriculum in terms of students' learning in chemistry, what actually happens in the classroom where students learning chemistry and shows students experience common difficulties in learning chemistry.

Chemistry is the scientific study of matter, its properties and interactions with other matters and with energy. It is the development of a coherent explanation of complex behaviour of materials, why they appear as they do, what gives them their enduring properties and have interactions among different substances and bring about the formation of new substances and the destruction of old ones. There is increase in lack

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of understanding, comprehension and assimilation of chemistry as a science subject or field of study. This can be related to the fact that chemistry students require practical for their depth understanding of the subject/field of study as majority of the concepts in chemistry seem to be abstract expect for the aid of the practical classes which help the these students to visualize what they have been taught.

During practical classes, the student still seem to be facing some challenges that is hindering their development and the use of practical class and instrument are found difficult among many secondary school students. As the perceived difficulties or constraints faced in chemistry practical classes are dreadful to the development of the student as well as that of the economy of the nation. Therefore, this study is designed to examine the chemistry terminologies and laboratory facilities as it affects chemistry practical class in senior secondary schools in in Ikere local government area of Ekiti State.

**Research Hypotheses**

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant influence of chemistry terminologies on chemistry practical class in senior secondary schools.
2. There is no significant difference in the impact of laboratory facilities on chemistry practical class between male and female students.
3. There is no significant difference between the effects of lack of experimental work among the age groups.
4. There is no significant influence of teacher characteristics on chemistry practical class in senior secondary schools.

**Review of Related Literature**

***Roles of practical class in teaching of Chemistry***

The role of chemistry practical is to help students make links between two domains of knowledge. Millar (2004) categories the domain into domain of objects and observable properties and events on one hand, and the domain of ideas on the other. The quality of chemistry practical varies considerably around the world (Lunetta, Hofstein & Clough, 2007). Most curricula specify that practical and investigative activities must be carried out by students. However, there is a gap between policy and practice, between what is written in curriculum documents, what teachers say they do, and what students actually experience. Despite curriculum reforms aimed at improving the quality of chemistry practical, students spend too much time following recipes and, consequently, practicing lower level skills (Dillon, 2008). Similarly, where students only carry out instructions from worksheets to complete a practical activity, they are limited in the ways they can contribute. As a result, students fail to perceive the conceptual and procedural understandings that were the teachers intended goals for the laboratory activities(Lunetta et al., 2007). This is a case of under-utilization of the opportunities provided by practical activities. If teachers do not select appropriate chemistry practical, this may end up in laboratory work of doubtful quality. Such an approach is de-motivating for students and a poor use of teaching and learning resources and which may end up contributing to poor performance in the subject. The effect of practical in learning of chemistry in schools may be influenced by several factors. Factors such as nature, quality, and frequency of chemistry practical, facilities and equipment available and gender of the learners among others are leading influences on the teaching and learning of chemistry. They have crucial roles in determining different attitudes and learning styles of students and consequently different educational impacts on different individuals (Nieswandt & McEneaney, 2009).

Students acquire deeper and more extended understanding of an abstract idea or set of ideas in a gradual process, hence the need for frequent and varied practical activities. Laboratory work also gives the students the opportunity to experience science by using scientific research procedures. In order to achieve meaningful learning, scientific theories and their application methods should be experienced by students. Moreover, laboratory work should encourage the development of analytical and critical thinking skills and encourage interest in science (Ottander & Grelsson, 2006).

However, the major barrier to improving the quality and variety of practical activity is the constraints felt by teachers in terms of two interrelated factors: time and the demands of the national assessment

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frameworks. This may force teachers to use demonstration experiments rather than student experiments and sometimes teachers end up in applying 'drill and practice' to train students to pass examinations (Lunetta et al., 2007).There are two extreme thoughts regarding the importance of Chemistry laboratory practicals (Achor, Kurumeh & Orokpo, 2012). The first one is that in traditional approaches, little opportunity is given to student initiatives or circumstance. In this approach, all the laboratory procedures are carefully listed in the provided manual, and frequently the student is simply asked to fill in a well-planned report template. At the end of a laboratory session, students have no real opportunity of understanding or learning the process of doing Chemistry. The second one is that a student is given an opportunity to engage in deep learning. Chemistry practical should be conducted in such a way that they interact with ideas, as much as the phenomena themselves.

***Poor understanding of chemistry terminologies as a problem of teaching chemistry practical in senior secondary schools***

Chemistry as a subject is a laboratory activity oriented. There is no topic in chemistry that can be said to be completed without including practical activity in it. Practical activities have had a distinctive and central role in the science curriculum and science educators have suggested that many benefits mount up from engaging students in science laboratory activities (Tafa, 2012). Over the years, many have argued that chemistry cannot be meaningful to students without worthwhile practical experiences in laboratory. Practical have been used too often without precise definition, to embrace a wide array of activities. Lots of arguments have been raised in the past to give justification or rationale for its use. Even though laboratory sessions were generally taken as necessary and important, very little justification was given for their inclusion (Tafa, 2012).

Some laboratory activities have been designed and conducted to engage students individually, while others have sought to engage students in small groups and in large-group demonstration setting. Practical exercises are normally conducted in a laboratory using pieces of apparatus and chemical reagents (Ojukuku, 2012). Many students from secondary schools to universities in many countries struggle to learn chemistry and many do not succeed (Reid, 2008). Research has shown that many students do not correctly understand fundamental chemistry concepts (Kamisah & Nur, 2013). And also many of the scientifically incorrect ideas held by the students go unchanged from the early years of the schooling to university and sometimes beyond (Sozbiler & Pynarbapy, 2010). Woldeamanuel, Atagana & Engida (2014) stated that by not fully and appropriately understanding fundamental concepts, many students have trouble understanding the more advanced concepts that build upon these fundamental concepts.

Many secondary school students experience difficulties with fundamental ideas in chemistry. Despite the importance of the foundation of chemistry, most students emerge from introductory courses with very limited understanding of the subject (Woldeamanuel, Atagana & Engida, 2014). Chemistry had been regarded as a difficult subject for students by many researchers, teachers and science educators' because of the abstract nature of many chemical concepts, teaching styles applied in class, lack of teaching aids and the difficulty of the language of chemistry. All these cause students, from primary level to the university, to develop poor understanding and misunderstandings (Woldeamanuel, Atagana & Engida, 2014). Misunderstanding of concepts in chemistry has attracted attention over the last three decades.

A number of studies have been conducted on different topics in chemistry, and in other areas such as biology, physics, or in general, in science. An examination of studies on students' learning of basic physical and chemical concepts clearly demonstrates that most of the basic concepts were poorly learned (Woldeamanuel, Atagana & Engida, 2014). More research needs to be done to identify what sort of difficulties students face in the learning of physical and chemical concepts. Learning difficulties are important for both teaching and learning. Both science educators and cognitive researchers agree that efforts to understand and improve science education should be focused on fundamentally important knowledge domains (Risch, 2010).

Njoku (2007) attributed students descending differential achievement of chemistry students in three categories of quantitative analysis, qualitative and theory of practical questions to wrong way and manner teachers teach practical chemistry. Efforts have been made in enhancing chemistry teachers' level of competency in effective execution of laboratory activities with the learners in senior secondary schools (Njoku, 2003 & Kaufman, 2010).

***Lack of adequate laboratory facilities as a problem of teaching chemistry practical in senior secondary schools***

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Fundamental research among chemistry educators and cognitive scientists focuses on how people learn science and how they apply this knowledge in their daily lives. Chemistry education provides students with knowledge, training, and learning experience while stimulating their physical and mental growth in chemical analysis and product. William & Maureen (2012) stated that it is necessary to provide students with a strong broad background in chemistry which can only be achieved when laboratory facilities are adequate in schools. Students should be offered opportunities to enable them grow in their problem solving abilities, think critically and acquire scientific and technological literacy.

Academic achievement of students in chemistry subjects generally had witnessed a deplorable trend in the past decades. Science education at all levels of education in Nigeria is in a deplorable state from the primary, secondary to the tertiary institutions. There is a dearth in science (chemistry) facilities in the laboratories and this contributes to students' poor academic performance in science (Chemistry) at the secondary school level (Ihuarlam, 2008). Practical work in chemistry has evolved through a series of stages over recent years. According to Gott & Duggan (2007) there has been a tendency for most practical works to be illustrated in nature, characterized by a teacher demonstrating a concept or law, or by guiding learners to discover concepts or laws themselves. Practical work later involved more open-ended investigations which were still laboratory based tasks. Learners were encouraged to design their own investigations, collect and interpret their data, though it was in more contrived context. Science is different from other disciplines by its processes which are observations, classification, measurement, prediction, problem identification, collection, analysis and interpretation of data, drawing conclusion and experimentation.

Practical work plays an important role in teaching and learning of chemistry. Apart from helping students to gain insights into scientific knowledge, it also helps them to acquire a number of scientific skills, namely cognitive and manipulative, and not to mention motivational factors it creates in the student. The attainment of these goals, however, depends on the way practical work is organized. Mafumiko (2006) argues that practical work forms essential component of chemistry education provision in secondary schools in Tanzania. Abrahams & Millar (2008) emphasize that not only does practical work with real objects and materials help us to communicate information and ideas about the natural world, but also they provide opportunities to develop students' understanding and scientific approach to inquiry.

According to Omosewo (2006) a deeper understanding of the science and technology process can be achieved through laboratory activities, which encourages active participation and serve to develop critical thinking. It also provides concrete experiences to substantiate the theoretical aspect that has been taught. Usmani (2011) believes that students with a lot of practical experience are much more likely to perform well than those with limited practical skills. Thus, it implies that there is a strong relationship between theories and practical meaning that performance of students in one could be used to determine performance in the other. Students also see practical work as being both effective in terms of their learning and enjoyment of chemistry. One cannot imagine chemistry being taught without experimental work; but however necessary, such work is not sufficient (Petty, 2009).

Hamidu, Ibrahim & Mohammed (2014) stated that Chemistry educators have believed that the laboratory instruction is an important means of instruction in science since late 19th century. They further emphasized that laboratory instruction was considered essential because it provided training in observation, supplied detailed information, and arouse students' interest. To align with their summation, laboratory instruction can be considered as an essential tool to arouse young mind into the doing of chemistry practical.

Adebisi & Ajayi (2015) commented that if chemistry is to be learned effectively, it must be experienced and close to the students through practical activities. The characteristics of chemistry demands verifications which can be effectively done through the use of resources in the laboratory. With the use of laboratory teaching students are avail opportunities to grow in problem solving abilities, acquire scientific and technological literacy. The National Policy on Education (NPE, 2013) stated clearly that the need to train students to be able to manipulate their environment in order to develop the society. This is only possible when students are trained with relevant resources in the laboratory. The laboratory practical is one of the most effective experiences geared towards the development of scientific skills of students in Chemistry (Adebisi, 2014). It is on this platform that the society and the nation can be benefitted from science and technology.

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**Methodology**

The survey design of the descriptive type of research was used for this study. The geographical area for this study was Ikere local government area of Ekiti State.

The population of the study comprised of all public secondary school chemistry students in Ikere local government area of Ekiti State. The public senior secondary school students in Ikere local government have a total population of 6,596 out of which 2,911 were male and 3,685 were female. It was from this population of the students that the number of respondents that will be used for the study will be selected.

The sample size of two hundred (200) students was used for the study. The respondents were the selected students from public secondary schools in Ikere local government area of Ekiti State. There are ten (10) public secondary schools in Ikere local government area of Ekiti State. Eight (8) secondary schools were used for this study. A simple random sampling technique was used to select eight (8) public secondary schools. The purposive sampling technique was used to select chemistry students from senior secondary class 2 from these schools. Thereafter, simple random sampling technique was used to select twenty five (25) respondents from each of the selected secondary schools. The selection cut across both boys and girls from S.S.S 2.

The research instrument for this study was a self-constructed questionnaire. The questionnaire was made up of two sections, A and B. Section A was used to collect the bio-data of the respondents which include: name of the school, gender, class, age. Section B was relevant items used to elicit information for data analysis. The likert scoring ranges from four points for Strongly Agree (SA), three points for Agree (A), two points for Disagree (D), one point for Strongly Disagree (SD) was adopted.

The instrument was subjected to validity and reliability mechanism. The face and content validation of the instrument were ensured. The reliability index of 0.90 was obtained for the instrument.

The questionnaire was administered to the students with the help of two (2) research assistants trained by the researchers and, the filled questionnaire was collected on the spot.

In analysing the data gathered from the administration of instrument, the researchers used descriptive statistical tools of frequency counts and percentage to analyse the bio-data of respondents while inferential statistics of Chi-square ($x^2$) Pearson Correlation was used to test the hypotheses at 0.05 level of significance. The analysis was computed through the use of Statistical Package for Social Sciences (SPSS) software.

**Results and Discussion**

**Hypothesis 1:** There is no significant influence of chemistry terminologies on chemistry practical class in senior secondary schools.

***Table 1: Chi-square test of students' response***

| **Response** | **Chemistry Terminology & Practical Class** | **Cal $\chi^2$** | **Tab $\chi^2$** | **Remark** |
|---|---|---|---|---|
| Agree | 95 | 23.17 | 3.84 | significant |
| Disagree | 105 | | | |
| **Total** | 200 | | | |

The result of the analysis in Table 1 above shows the difference in the responses of students on the influence of chemistry terminologies on practical class. The chi-square test revealed that calculated $\chi^2$(23.17) was greater than the critical $\chi^2$ value (3.84) at the 0.05 level of significance. This means that there is significant influence of chemistry terminologies on chemistry practical class. Hence, the null hypothesis was not upheld.

**Hypothesis 2:** There is no significant influence of laboratory facilities on chemistry practical class in senior secondary schools.

***Table 2: Chi-square test of students' response***

| **Response** | **Laboratory facilities & Practical Class** | **Cal $\chi^2$** | **Tab $\chi^2$** | **Remark** |
|---|---|---|---|---|
| Agree | 123 | 15.62 | 3.84 | significant |
| Disagree | 77 | | | |
| **Total** | 200 | | | |

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The result of the analysis in Table 2 above shows the difference in the responses of students on the influence of laboratory facilities on practical class. The chi-square test revealed that calculated $\chi^2$(15.62) was greater than the critical $\chi^2$ value (3.84) at the 0.05 level of significance. This means that there is significant influence of laboratory facilities on chemistry practical class. Hence, the null hypothesis was not upheld.

**Hypothesis 3:** There is no significant difference in the impact of laboratory facilities on chemistry practical class between male and female students.

**Table 3:** t-test analysis of students' responses

| Variable | N | Mean | SD | df | $t_{cal.}$ | $t_{tab.}$ | Decision |
|---|---|---|---|---|---|---|---|
| Male | 89 | 2.95 | 1.47 | 198 | 1.53 | 1.96 | Not significant |
| Female | 111 | 2.78 | 1.24 | | | | |

$P < 0.05$ significance level

Table 3 shows the result of analysis of responses of male and female students on the impact of laboratory facilities on chemistry practical class. The table revealed that the mean rating for male students (2.95) was greater than the mean rating for female students (2.87) with a mean difference of (0.08). The t-test revealed that t-calculated (1.53) was less than the critical t-value (1.96) at the 0.05 significance level. Hence, the null hypothesis was upheld. This means that there is no significant difference in the impact of laboratory facilities on chemistry practical class between male and female students.

**Discussion of results**

The result of test of hypotheses indicated that for hypothesis 1, poor understanding of chemistry terminologies was significantly a difficulty encountered by students in chemistry practical class in senior secondary schools. This indicates that chemistry terminologies is immense to students understanding of chemistry practical. This findings agreed with the report of Woldeamanuel, Atagana & Engida (2014) that examination of studies on students' learning of basic physical and chemical concepts clearly demonstrates that most of the basic concepts were poorly learned. Over the years, many have argued that chemistry cannot be meaningful to students without worthwhile practical experiences in laboratory. Practical have been used too often without precise definition, to embrace a wide array of activities. Kamisah & Nur (2013) stated that many students do not correctly understand fundamental chemistry concepts. Chemistry had been regarded as a difficult subject for students by many researchers, teachers and science educators' because of the abstract nature of many chemical concepts, teaching styles applied in class, lack of teaching aids and the difficulty of the language of chemistry.

Hypothesis 2 showed that that there is significant influence of laboratory facilities on chemistry practical class. William and Maureen (2012) stated that it is necessary to provide students with a strong broad background in chemistry which can only be achieved when laboratory facilities are adequate in schools. Students should be offered opportunities to enable them grow in their problem solving abilities, think critically and acquire scientific and technological literacy. Practical work in chemistry has evolved through a series of stages over recent years. Practical work later involved more open-ended investigations which were still laboratory based tasks. Ihuarlam (2008) stated that there is a dearth in chemistry facilities in the laboratories and this contributes to students' poor academic performance in Chemistry at the secondary school level. Practical work plays an important role in teaching and learning of chemistry. Apart from helping students to gain insights into scientific knowledge, it also helps them to acquire a number of scientific skills, namely cognitive and manipulative, and not to mention motivational factors it creates in the student. There is a strong relationship between theories and practical meaning that performance of students in one could be used to determine performance in the other. Students also see practical work as being both effective in terms of their learning and enjoyment of chemistry. The characteristics of chemistry demands verifications which can be effectively done through the use of resources in the laboratory. Hence, laboratory facilities have significant impact on chemistry practical class.

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The test of hypothesis 3 revealed that there is no significant difference in the impact of laboratory facilities on chemistry practical class between male and female students.

**Conclusions**

Based on the findings of the study it is concluded that:

1. Poor understanding of chemistry terminologies was difficulty encountered by students in chemistry practical class in senior secondary schools.
2. Lack of adequate laboratory facilities influenced difficulty encountered by students in chemistry practical class in senior secondary schools.

**Recommendations**

The following are recommended for action based on the finding of the study:

1. Chemistry teachers should endeavor to make use and explain the meaning both in concept and usage to chemistry students in secondary schools so as to accustom them to the chemistry terminologies and therefore enhancing chemistry practical class performance among senior secondary school students.
2. The state government should ensure that adequate provision of funds are made available for the purchase of adequate laboratory facilities that will facilitate effective and efficient learning of chemistry practical among secondary school students.
3. Also, when the laboratory facilities are provided, chemistry teachers should make judicious use of the facilities to enhance learning impacted knowledge of students.
4. State of ministry education, science and technology should work hand in hand with school administrators and head of science department in secondary schools to ensure that experimental work are done in Chemistry practical each time it is schedule for students.

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