



WHY MOST SCIENCE STUDENTS IN MOST SECONDARY AND TERTIARY SCHOOLS FAIL CHEMISTRY PRACTICAL AND REMEDIES

Christianah Chinenye Aniobi^{1*} and Sunday Alonge²

¹Department of Chemical Sciences, Bamidele Olumilua University of Education Science and Technology, Ikere Ekiti, Ekiti State, Nigeria.

²Department of Biological Sciences, Bamidele Olumilua University of Education Science and Technology, Ikere Ekiti, Ekiti State, Nigeria.

Corresponding author: aniobichigiveth4@gmail.com; aniobi.christiana@bouesti.edu.ng.

ORCID No: 0000-0002-0138-5171

Abstract

The difficulties encountered by most students in chemistry practical in Nigeria (colleges, and institutions) most especially in secondary schools is so great that it has become a great concern to various individuals and groups in the nation and as such as generated a lot of issues, argument in lectures, seminars, journals, and so on. The technological advancement of any country depends on the scientific background of such country. Chemistry teaching practical to be précised, has been faced with a lot of problems. Accordingly Nigeria students studying chemistry are expected to be taught what chemistry is [1], they are expected to acquire scientific skills of observing, and reporting, organizing of information, generalizing, predicting or speculating and designing experiment to test hypotheses. The teaching strategies used in carrying out chemistry practical prescribed for developing these skills in the labouratory rooms include:

- The involvement of students in opening ended field or lab work
- The inclusion of problems-solving activities
- The use of discovery teaching tactics whenever appropriate. On the contrary, there are various factors which have marred these methods such that objectives of teaching and learning of practical and experimental exercise which are geared towards improving the preparation of scientific background for technological advancement have not been activated. This book addresses some of the factors causing most students in both secondary and tertiary schools to fail chemistry practical as well suggest likely ways by which these difficulties could be solved.

Keywords: Science students, school, chemistry practical, labouratory, remedies

Introduction

Traditionally, laboratory classes comprise experiments that accompany the lecture and discussion portions of science courses. The laboratory class has become an established and required part of chemistry courses offered in higher education, [2] and laboratory activities have long had a distinct and essential role in the chemistry curriculum as a means of making sense of the natural world. The laboratory environment allows students to gain a first-hand experience with course concepts and further provides them with the opportunity to explore methods used by scientists in their discipline [3]. In this type of educational setting, it is expected that the five types of objectives proposed by Shulman and Tamir [4] can be achieved, which are as follows: (i) acquiring skills (manipulative, inquiry, investigative, organizational, communicative) (ii) understanding chemistry concepts (hypothesis, theoretical model) (iii) gaining cognitive abilities (critical thinking, problem-solving, application, analysis, synthesis) (iv) understanding the nature of science (scientific enterprise, scientists and how they work existence of a multiplicity of scientific methods, interrelationships between science and technology and among the various disciplines of science), and (v) developing good scientific attitudes (curiosity, interest, risk-taking, objectivity, precision, confidence, perseverance, satisfaction, responsibility, consensus, collaboration, and liking science). Although the value of laboratory classes has been questioned recently because there is little evidence of their impact on student learning, [5] the American Chemical Society (ACS) continues to emphasize the importance of a hands-on laboratory experience in all areas of chemistry. Less research has been performed evaluating the psychomotor and affective domains of learning, and for this reason, it is not clear whether the in-person and virtual modalities can provide equivalent experiences for students. In a study assessing affective measures (such as anxiety, emotional satisfaction, intellectual accessibility, and usefulness of the lab) in a traditional hands-on laboratory compared to a virtual environment, it was found that a decisive factor contributing to student success (regardless of the modality) was the instructor, [6] and thus, it would be important to conduct studies where the same instructor teaches in both environments. [7] Studies conducted during the COVID-19 pandemic, however, have revealed that students believe that the primary role of a teaching laboratory is to provide hands-on experience and that, overall, the online modalities do not compare favorably to the traditional in-person laboratory approach. [8] Indeed, it has also been found that students in a virtual environment struggle to meet skill-based objectives and understand how to use equipment [7]. This book tends to mention or address some of the factors causing most students in both secondary and tertiary school to fail chemistry practical as well as provide or suggest some likely ways by which these problems could be solved.

Lack of Laboratory and Equipment

What is laboratory?

Laboratory is a room or building for scientific experiments, or teaching or for the manufacture of drugs or chemicals. Now, laboratory for chemistry practical could be defined as a room or building equipped for scientific experiments and for the manufacturing of chemicals for experimental studies.

There are different kinds of laboratory in various secondary schools and tertiary institutions today in which some are well equipped, while some are poorly equipped and some are inadequately equipped. Those that are inadequately equipped could be said to be insufficient laboratories while those that are poorly equipped could be referred to as laboratories with little or no equipment to carry out the necessary experiment for effective and efficient learning and well-equipped laboratories are laboratories which contain all the necessary equipment for experimental or practical purposes. If laboratory is a place equipped for scientific experiment, why are some schools (both colleges and tertiary institutions) still lacking it? Some that have it don't have equipment to conduct or carry out experiment then; how would students in such school pass chemistry practical?

By the special grace of God, I have been privileged to work as a teacher in both private and public secondary schools sometimes ago, and I can say vividly that science students in schools with laboratory and equipment do better than those without laboratory and equipment or those with laboratory without equipment. Now; commenting on the importance of laboratory equipment; Osuala (1979) states that; it is rare to find a school with complete laboratory equipment. Most schools lack laboratories and laboratory equipment yet candidates from such schools are expected to offer chemistry practical in SSCE examination. He is of the opinion that one cannot expect such students to perform excellently well in the related subjects. The place of laboratory cannot be overemphasized since the laboratory is the factory for the development of various scientific skills and attitudes for recognition, therefore; much time and space should be devoted to its administration and supply.

In addition; it should be realized that the degrees of laboratory control depends on the facilities available and availability of laboratory assistance [9]. Thus; the role of well-equipped laboratory in carrying out practical and in the teaching of chemistry cannot be overemphasized in a paper delivered by his excellency Loualds (1987) at the science seminars sponsored by the UAC Nigeria Limited titled "the role of science and technology in developing country" stated that the technological awareness of any country depends mainly on the study of science. He stressed that science teaching in Nigeria is ineffective because of lack of appropriate laboratory equipment.

In analyzing the effect of science teaching on the student's life, he expressed great disappointment over shallow knowledge of Nigeria students in science and practical work especially on chemistry.

Obabor (1987) stressed that effective and consolidative foundation of science in Education can only be accomplished by practical work or studies which involves the use of laboratories. He added that difficulties encountered by students in chemistry experimental studies or class constituted the highest percentage failure in sciences in the WAEC (2006-2009) and that this resulted from the government inability to provide secondary schools with adequately equipped laboratories. He concluded that ideally, the experimental studies in chemistry are supposed to be experimentally based, but now, the reverse is the case.

In addition to the points above; there was a particular year that I visited about eight secondary schools in trying to know if there are good laboratories that is; laboratory with equipment but the response I got from the teachers and the students in those schools frightened me. I discovered

that though there were laboratories in the schools, there was no separate laboratory for students taken chemistry even the combined laboratories for all the students offering science subjects were poorly and inadequately equipped such that there were no specific or important laboratory tools and equipment such as separating funnel, reagent bottles and so on as I have listed above, necessary for carrying out chemistry practical for the students concerned. How does one expect such schools to have laboratory assistants let alone having teachers that would engage student on experimental studies or work?

In a situation like this, will chemistry students in such schools know what they are supposed to know in practical related topics, likewise, the number of students that would have access to the available laboratory equipment will be few which perhaps may lead to the failure of chemistry practical during an examination especially an external examination (SSCE). Ejon (1981), referred the problems of chemistry practical teaching to large enrolment of students in a class. He said where the equipment is inadequate, students cluster around the few ones available, peeping and struggling among themselves only to have a grip of what is happening in any demonstration exercise. This constitute nuisance to the lesson thereby resulting to unhealthy situation for effective learning to take place. In addition; teachers find it difficult to control large chemistry practical classes.

In conclusion, he advocated that the government should endeavour to build more classrooms and laboratories and also employ more qualified chemistry teachers who can handle and manage practical classes effectively and efficiently.

Lack of Experienced and Adequate Teachers

There is difference between just a chemistry teacher and an experienced chemistry teacher. An experienced chemistry teacher could be referred to as an efficient teacher, one who has the basic knowledge about chemistry and had undergone series of practical in chemistry as well is able to impart the knowledge gained from both the theoretical and practical aspect of chemistry to students. It is only in schools where there are inexperienced teachers of chemistry that students will not be allowed to visit laboratory for experimental studies as long as there is provision for laboratory and its equipment such that any practical related topic is treated as ordinary topic in chemistry. Some of these inexperienced teachers will not even bother to talk about it (practical related topic) let alone taking the students to the laboratory to perform the experiment(s) related to the topic.

In most secondary schools, there are not just inexperienced chemistry teachers but a few teachers taking the subject. For example; how do one expect just one chemistry teacher to engage all the students in SS1, SS2, and SS3, at the same time engage them in practical classes especially in schools with large classes. If at all the teacher is able to teach all the students from SS1-SS3 as well as in practical classes, do you think that there will be effectiveness? If there is no effectiveness in what the facilitator is giving out to the students then; what do you think about the number of students that will eventually pass the chemistry practical?

The number of students failing chemistry practical today is on the high increase and this failure may not be traceable to the teacher's willingness to take the students both in chemistry and chemistry practical classes alone but may be as a result of too many number of students that are involved in the classes because it may be very difficult for such teacher or facilitator to attend to them at a time thereby leaving no room for question and answers from the students/teacher to ascertain the students' knowledge about the topic or the practical. This is because the teacher is no longer teaching based on the interest of the students but on the basis that he/she wants to finish up with the syllabus before the commencement of any external examination. At the end, if nothing is being done by the school to involve the government about the situation on ground (lack of adequate /experienced teachers) that is to ask them to provide for more competent chemistry teachers that will teach and engage the students in experimental studies effectively, such school will eventually graduate students who will not be capable of defending their results let alone imparting the knowledge gained to others or what would one expect from such set of students? They will definitely impart what they learnt (limited to learn) and whether it is right or wrong except for those who would have gone extra mile ahead of their teachers to carry out more research work on what they have taught and these are those that can impart others excellently.

Asazobor (1984) pointed out that there are two major problems of teaching chemistry practical in Nigeria secondary schools which are inexperienced and less qualified chemistry teachers who cannot even identify various practical materials or equipment as well as identification. Now; let me add more points to the above points by saying, a school that lacks labouratory or a school without labouratory and its equipment, how does one expect chemistry teachers in that school to teach practical related topics effectively? Yet we have schools with labouratory and few labouratory equipment but none of the teachers know how to make use of the equipment because the students who graduated many years ago or recently from schools with insufficient labouratories, or poorly equipped labouratories are the ones who became teachers in other schools and you don't expect them to give out what they don't have. Now, how would the students in such school be taught on the appropriate use of the labouratory? Peradventure, they are willing to inculcate the knowledge or engage the students on experimental studies on practical related topics and there are no equipment in the labouratory to do so, nothing would be done by the teachers.

There was a day, I was lecturing some sets of students of an institution on the theoretical aspect of a practical related topic and as I was explaining the topic to them, I remembered that I made mentioned of p^H meter which is used for testing the level of acidity or alkalinity of a substance then, I asked if the students all know it or probably have heard about it? Some of the students said No, while some said Yes. Immediately, I asked one of the labouratory assistants to bring to bring out all the various type of p^H meter we have in the labouratory and all were shown to them and they were very happy. Now, showing the students the equipment made the explanation on the topic for that course easier and interesting. Looking at it from the angle of the students who responded No and Yes; Were they not students who graduated from various secondary schools which everyone would have expected to have what it takes to graduate students? The difference between the two sets of students above based on their responses is that the first set of students graduated from schools with insufficient labouratories, poorly equipped labouratories, no labouratory and inexperienced teachers while the other set of students are those who graduated from secondary

schools with laboratory that is well equipped and with experienced teachers to appropriate these equipment.

Asazobor (1984) further stressed that there are few experienced and qualified chemistry teachers who can inculcate permanent knowledge or skills through experimental studies in the service, who are mainly posted to the schools in urban areas while the inexperienced and less qualified teachers are posted to schools in rural areas. The inexperienced teachers lack the technique or skills to handle and use the laboratory equipment in teaching effectively. These make them to escape or doge various topics that require the use of equipment. Regarding the less qualified teachers, he spoke against the teaching of chemistry practical in classes by NCE holders. This is because their programmes were structured in such a way as to teach from classes one to three (JSS1-JSS3). These teachers commit a lot of errors in an attempt to handle the subject or being unable to give out the right stuff of materials needed by students.

In addition; Duruji (1984) said poor chemistry teacher produces none other than poor science students in general as he went against one idea of posting the few qualified teachers who can handle practical exercise amicably to the schools in urban area while the NCE graduates whose programme is structured to serve at the junior schools level are posted to schools in rural areas where they are made to teach higher classes. He concluded that the ministry of education should endeavour to post at least one experienced and qualified science teachers to every school that will help in monitoring and coordinating science practical especially in chemistry practical in the schools.

I will add that ministry of education, should not just post bat least one experienced teacher but many experienced teachers and qualified teachers to all the public secondary schools especially schools with large number of students.

Aramide (1894) addressed on the inclusion of practical work in the teaching of chemistry practical which can only be done when there are enough qualified chemistry teachers. He acknowledged the need to train more chemistry practical teachers to handle experimental studies. These points are very noteworthy because in most secondary schools, there are few chemistry teachers while in some, there is just one and this very one teacher is still struggling to complete the chemistry syllabus with the students let alone having more time and strength to engage them in chemistry practical. Therefore; there is need for such school to employed more trained chemistry practical teachers.

Apart from the part that there is shortage of qualified chemistry practical teachers and lack of inadequacy in laboratory equipment, most of them have negative attitude to work. Most of the few schools that are fully equipped do not make appropriate use of it. The chemistry practical teachers only use this laboratory equipment when it is two weeks to exams.

Furthermore; chemistry practical students' teachers only teach chemistry experimentally during the practical teaching exercise while undergoing training but result to lecture method once they are graduates which should not be so.

Students' Poor Background and Parental Upbringing.

Today, a lot of parents are so fast in putting blame upon the government, teachers/lecturers for their children/wards failure in a particular school (college or institution). Some of these parents are equally good at pushing all their parental responsibilities to the school such that they expect the school be it college or institution they have put the child or ward not to only provide a conducive environment for learning, quality infrastructures and teaching aids, teaching facilitators or personnel and so on but also expect the teachers/lecturers to help the students pass by all mean even after they have taught them what they need to know, how to read and write to pass such subject or course.

A lot of parents today have really deviated so much in their responsibilities towards their children or wards such that they don't even ask about what they have been taught or they are in school or not because often time, some of these students will not come to school let alone attending classes yet they must pass. Some of these students are from autocratic homes while some are from democratic homes. Most parents whose child or ward is from such an autocratic home don't really pay attention to the needs of their child/children or wards yet they expect them to do well. For example, in a situation where students are being asked to buy practical manual or workbook or labouratory coat for their experimental studies, you will be so baffled about the responses of these students towards this. Some of them who are from autocratic homes will tell you that there is no money as though the parents will not provide for him or her and some of them are not even serious enough to even tell their parents about what they need to succeed in school while the rest that are serious and that are not from autocratic homes will buy those items needed for practical.

I could remember when I was still teaching in a particular secondary school, in one of the subjects that I was taking them which involves practical class, and as such they need to but items like drawing board, technical ruler, set square and so on. I sent a message to their parents though at first through their wards, some of the parents didn't respond then I sent message to some of these parents who didn't respond, some complained that their wards didn't tell them about it and thereafter, some of these parents responded while others who heard from both their wards and teacher didn't buy for their wards. Some may say, did I know if those that didn't buy for their ward/wards have money to do so? My response will be if all they don't have money but their eagerness to provide those things for their wards will be seen or felt. The funny part of it is that most of these parents that have non-challant attitudes towards their children' education, will be the ones to complain that their wards are not doing very well or that the teacher or teachers is/are not teaching well and would expect that their wards or children pass very well by all means.

In most homes, once the parents are aware that the students have completed their examination most especially in higher institutions, some of these parents will come to school and be looking for means to see the lecturer in charge of that course to know if the child passes or not and eventually the child fails, such parent(s) would want the lecturer(s) handling the course to do something to avert the failure where as the parents of such child may not have visited the child's school even once to complain to any of the lecturers about the child' attitudes towards learning or ask for support of the department to help in monitoring such student.

Looking at the students' attitudes and social economic background; Tunde (1987) said that effective teaching of chemistry practical in schools depends on the relationship or the degree of interaction between teachers or facilitators and students' comfortability, he said, determine to a large extent the strength of the teacher-students relationship in schools. Students he said have different economic background. A student's cooperation with one laboratory attendance or the teacher in the practical class is subject to modification by his or her kind of home environment, while some students have all the necessary materials needed for effective learning, some have not and this set of students who lack materials like textbooks, notebooks, practical guards, graph and science workbook etc, hardly listen to the teacher's instruction while practical exercise is going on in the laboratory rooms instead they find something to keep them busy in the laboratory class thereby distracting the attention of the few serious ones. This might employ the practical teachers involved to take a disciplinary action against them, thereby distorting or neglecting the experimental studies.

In addition; I have seen students coming to the laboratory for practical with snacks and drinks in their hands despite several warnings. Apart from the fact that doing this negate the rules guiding the use of science laboratory, it is not ideal in the sense that it brings a lot of distraction because the focus of such student will be on the snacks and drinks thereby shifting his or attention away from the instructor or facilitator taking the practical course

Also; students eating during the practical class in the laboratory is not hygienic such the student's health may be affected holding to the fact that the students always have contact with vessels such as test tubes, conical flasks and so on containing chemicals and will eventually use the same hands to put food or snacks into his/her mouth. This is why it is advisable for students to eat before or after the experimental studies in order to be at a safer side. A lot of students are also fond of talking or making or receiving calls while practical class is on-going, now, will such student have full attention towards what the instruction giving by the lecturer or instructor in charge on how to perform the experiment?.

Before now, students have been told to always put their phones on silence as well as always keep quiet during the practical class especially when explanation on the practical topic is on-going before the commencement of the experiment, yet some of them will still make calls, pick up their phones whenever it rings, talk and do all manners of silly things thereby distracting the attention of other students who are ready to learn. This is one of the reasons a student or some students will always ask the lecturer or instructor or facilitator to repeat what has been said earlier. Therefore; students are to be cautioned seriously on this if there must be reduction in the rate at which most of them fail chemistry practical.

Another important point to note is the students' poor background of scientific knowledge. How do I mean? In many institutions today, there a lot of students that cannot define chemistry let alone able to balance equations correctly. There was this fateful day, I was taking the students on practical titled "acid and base titration" one would have expected almost all the students to be familiar with this topic. Then I asked who can define an acid and a base correctly, though they attempted the question but none could define both correctly. I thought on what could be the problem then, I resorted that the problem could be as a result of the students' foundation which

may be traced to the students' interest towards the subject chemistry or on the teacher/lecturer taking the course or could be traceable to the kind of secondary school such student must have graduated from before entering into higher institution.

According to Tunde, S.O. (1987); in his lecture, he said, students tend to shy away and become afraid of the subject chemistry because of their poor scientific knowledge of the subject. The students based their judgments on the fact that chemistry practical is different and this makes them to be weak academically, others think that chemistry practical is very easy, hence little or no attention is being paid to the subject in the laboratory room. Nwosu (1985) made his contribution to the simplicity of chemistry by saying that "chemistry is usually the first science subject to be offered by any school and because of its knowledge centered nature thus, make it a sure subject for school certificate both for the Arts and Science oriented students. Therefore; parents should be well guided on the kind of school to put their children/wards, the kind of environment the school is located, and teach their wards or children on how to be behave well while in school and even after school as well as be responsible enough in the way they responsible enough in their dealings with their teachers/lecturers/facilitator.

Moreover; parents are supposed to know the level of interest their wards/children have towards a particular subject from the beginning in order for them to be assisted or guided properly. Also; teachers/facilitator/lecturers taking a particular subject or course especially those handling chemistry practical should instill in the heart of every student that no subject is difficult to understand as long as the student is ready to know it or learn.

Questions parents are expected to ask their children teachers to improve their theoretical and practical skills

Every parent is expected to frequently ask these questions from their children teachers to know their weakness and how to help them from home to improve their mental skill, most especially on practical skills;

- (i). How does my child participate in class/practical discussions?
- (ii). Is my child able to express him/herself in practical classes?
- (iii). How is my child performing in theoretical/practical classes?
- (iv). What else can I do at home to support my child in his/her learning and development? Is there any specific activities or resources you recommend? Take for instance, some chemistry practical(s) are being practiced at home, **separation techniques** as a case study, e.g. filtration, (sieving of powered cassava flour), and evaporation, (removing excess water from watery prepared food, e.g. stew by heating using either gas cooker or electric cooker/hot plate). Good interpersonal relationship between a child and his/her parent will help them to relate what is being thought during practical sessions in the laboratory to what they practice at home, this can help to refresh the student' brain.
- (v). What is my child' strength?

(vi) How else can we work together to support my child?

Insufficient or Lack of Classrooms for Science Students Especially Students taking Chemistry.

The problems in most secondary schools or tertiary institutions in teaching chemistry practical include lack of classrooms for taking large number of students offering the chemistry practical or course. I have been to institutions where there are large numbers of students in a classroom or laboratory such that the noise alone from the students could not even allow the facilitator of the course to carry all the students along or engage all the students effectively. In such situation, some of the students will benefit while others will just be there gisting, answering calls, dividing the classroom and this could also lead to serious health challenge since there would be little or no space for air to penetrate and circulate.

According to Ejon, (1981); he referred the problem of chemistry practical teaching to large enrolment of students in a class. He added that where the equipment is inadequate, students cluster around the few ones available, peeping and struggling among themselves only to have a grip of what is happening in any demonstration exercise. This constitute nuisance to the lesson thereby resulting in unhealthy situation for effective learning to take place. In addition, teachers find it difficult to control large chemistry practical classes. I was privileged to visit some secondary schools few years ago and based on my observation, I realised that they lack enough classrooms for all the students let alone having separate classrooms for science students in the schools. Now based on my findings, I have discovered that a lot of public secondary schools tend to manage the available classrooms for teaching thereby making teaching and learning to be so difficult as a result of overpopulation of students in a classroom or laboratory. As a result of insufficient classrooms, there was no separate classrooms or laboratory for students taking chemistry practical. For instance, during practical in a particular secondary school, about 80 students were forced to manage just a small class or laboratory and along the line, many were being choked after they have inhaled different kinds of chemicals which could cause suffocation and may lead to death if care is not taken as well breakage of delicate laboratory equipment that may lead to chemical hazards

In addition; schools that are seriously facing these challenges find it difficult to go to other neighbouring schools whose classrooms could accommodate enough students for practical classes. Due to this reason, chemistry teachers in most schools would prefer to forfeit the teaching and handling of chemistry practical which has led to the students' poor performances in SSCE chemistry examination.

Lack of Standard Chemistry Textbooks

The role of chemistry in the development of the scientific base of a country cannot be overemphasized and Nigeria is not exempted in the consideration. Despite the increasing importance of chemistry to the upbringing world, the performance of Nigerian students in the subject at various levels of schools especially in secondary schools remains a dismal failure. However, it is disappointing to note that the student's performance in chemistry at internal and

external examination has remained considerably poor despite the relative importance of chemistry [10].

A lot of schools today both private, public colleges and tertiary institutions hardly check on the type of chemistry textbooks to be used by students in schools because most of these schools are just after the monetary gain not minding if the contents are well written as well as note if the textbooks could be recommended for students. An adage says “a reader is a leader”. This means that there are so much information embedded in a book and the kind of book one reads will determine the kind of information such fellow will get whether the information would be useful or not, make or mar such life will depend on the information that has been provided in the book.

In most public schools, students are allowed to get the textbooks from any bookshop by themselves though government do provide some of these textbooks for the schools which are usually kept in the school library as school properties and use. In whichever way, the most important thing is for the management of the schools to ensure that the students get the right textbooks for learning or better still recommend the best ones for them. I have taught in private school before and I could say that most private schools proprietors/proprietresses only fight that the parents pay for their wards/children’ textbooks which is good but to most of them is a way of making just money. To me generating money from the textbooks sold to the students is not my problem, but the issue is that, are the textbooks worth selling to the students? Are they impactful?

Today; there are still many public/private schools having substandard textbooks in their library with no viable ones, or newly edited textbooks. Teachers in most of these schools especially chemistry teachers are teaching a lot of chemistry topics which are not in line with the school curriculum and syllabus due to the use of wrong and not well detailed textbooks. As a result of this, most chemistry teachers teach with the available textbooks whether it is detailed or not just to cover up the syllabus. In most cases, students are not taught what they are supposed to know before and during SSCE chemistry exams in both theory and practical.

Furthermore; there are so many existing public secondary schools which do not have textbooks let alone having quality and well detailed chemistry textbooks and practical workbooks for both the teachers and the students to use, how do one expect such school to teach chemistry/practical effectively?. Most students only read whatever teachers have taught and given them as notes. They do not have the idea of even reading beyond what they have been taught; most of them limit themselves to the information provided to them by their teachers rather than to consult other textbooks that are relevant to chemistry in order to pass excellently during SSCE chemistry examination. This has contributed to one of the reasons why a lot of students usually fail chemistry practical even theory during external examination.

Lack of Chemistry Teachings Aids/Improvisation by the Teachers

I believe that you will agree with me that students need to be taught from known to unknown basis. That is; for students to understand difficult topics even though that I don’t believe that there difficult topics that cannot be understood, yet teachers need to teach the students from the simple ones first. A lot of schools especially secondary schools, both public and private are lagging behind

due to lack of teaching aids most especially for science students. in most schools; one hardly find video tapes, audio tapes, projectors, audio visual aids and other type of teaching aids as well practical tools such as weighing balance, fume hood, reagents and so on for practical studies. For God' sake, we are now in the 21st century where teaching/learning is supposed to be a thing of joy. Is it possible for one to ask a student who cannot identify an acid to prepare an acid? Peradventure the student can recognize reagents but there are no reagents in the labouratory, then, from which reagent will they prepare solution from? Now, how will the student perform well in practical courses since every practical is based on abstract? It has been discovered by many educationists that that for teaching/learning to take place effectively, there is need for schools to have enough teaching materials or aids that can quicken the understanding of the students on the topics taught. Based on research, it has been noted that schools which have enough instructional aids perform better than those with few or no instructional aids. The essence of using instructional or teaching materials is for learning to take place and for students to be able to remember all that they have been taught and learnt. There are so many forms of teaching aids such as visual, audio, and audio-visual type and so on; that will help the teachers to deliver the subject –topic or teach the course effectively without beating about the bush. For example; as a chemistry teacher/lecturer who intends to teach on “chemical hazard” and “fire” as the sub-topic may not necessarily arrange for physical fire to burn which may cause an accident or even burn the classroom but may bring a video tape showing where there is reaction between fuel and air called “fire” in order for the students to understand what fire is all about. By so doing, teaching and learning have already taken place. Many public schools today do not have instructional or teaching aids and a lot of teachers/schools do not even bother to make an attempt to improvise for themselves in order to teach effectively and due to this, many students find it difficult to understand topics taught which may result to failure on the part of the students during an external examination.

Ahiakwo, (1984) stated that the absence of labouratory rooms in secondary schools hinders the teaching of chemistry practical, he also emphasized on the need for a chemistry practical teacher to undergo a course on how to improvise. He said that teachers (in general) inability to improvise is the major problems in teaching, particularly in chemistry practical. He advocated that a course on improvisation should be incorporated in science teachers training programme. Still on improvisation, Gabriel Sunday in his book titled “science teaching in the period of recession” stated that, the need for improving is to extract ideas and teacher’s ability to improvise particularly in sciences will help to mitigate the difficulties of lack of equipment and finance involved in the establishment of labouratories.

He concluded that it is true that science deals with the practical and experimental understanding of natural phenomena. Through activities based on child-centered learning, the child develops strategies for solving problems through first-hand experience which in turns guarantees learning of most vital and lasting qualities. He said that the need for “improvisation” in teaching practical cannot be ruled out.

In addition; Amao (1981) claims that in view of the current phenomena increased in school enrolment in the face of a corresponding declining economic prosperity, the need for maximizing lower resources for effective teaching of chemistry practical should be taken into consideration. In

his analysis, this defines improvisation as teaching, which rates to the act of using alternative materials and resources to facilitate instruction whenever there is lack of shortage of some specified firsthand teaching aids.

Insufficient Periods Allocated for Teaching Chemistry/Practical Topics and Methods of Teaching Chemistry.

I could still remember when I was teaching chemistry in one of the secondary schools, before I could finish explaining the theoretical aspect of the topic, time would have gone while the remaining minutes may not be sufficient enough for the main practical. This is one of the reasons a lot of teachers/facilitators will end up reading out the topic in the textbook to the students or just ask them to copy notes without laying proper foundation on the topic that they may have enough knowledge as well as the ideas that will enable the students to carry out the experimental aspect of the topic effectively. One of the results of insufficient periods allocated for the teaching of chemistry practical is that it causes the teacher or the course facilitator to rush the topic or do the teaching haphazardly just because they want to beat the time given, as a result of this, many students will find it difficult to flow along or understand the practical topic. There was a time I had an opportunity to teach in one secondary schools few years back, then I discovered that the students don't visit the labouratory because there was no time allocated on the school time table for experimental studies. As a result of this, students hardly understand practical related topics while teaching them and this had been the case in so many other secondary schools.

In addition, I have discovered also that many teachers in most schools do not engage their chemistry students in practical classes not until they are about to sit for SSCE examination and this has continued for years due to the fact that period(s) for chemistry practical was not given on the school time table. For instance, in a situation, whereby some schools that have only one chemistry teacher and the teacher would probably be the only one to take all the three senior chemistry classes (SS1-SS3) may find it difficult to create time to reach and handle chemistry practical related topics in such school on his/her own. This has been a serious issue in so many secondary schools and even in higher institutions and if care is not taken may eventually lead to failure on the part of the students. Apart from the fact that there is limitation in the periods allocated for the teaching of chemistry/practical related topics, some teachers in most schools have negative or non-challant attitudes to work such that they make use of the labouratory /equipment when the examination time is very close probably 1 or 2 week(s) to the exams.

Irregularity in the Payment of Salary

Non- payment of salary should not even be heard or being experienced by workers as well non-regularity in the payment of workers' salary. Sincerely, teaching/lecturing is not an easy task not to talk about practical aspect of it and as such teachers/lecturers needs enough stamina to strand and talk for a long period of time. I discovered that many teachers in both public and private schools always complain about irregularity in the payment of their salaries and whenever there is delay or continuous delay in payment of salary most especially in public secondary schools, most teachers resort to the following:

1. Academic/teaching morale becomes very low such that some will find it hard to teach even when they attempt to do so; the teaching may not be effectively carried out as expected.
2. Some may not even bother to come to school probably they don't have any other means of transporting themselves to the school. I have realized that sometimes when salaries are delay or there is irregularity in the payment of salaries, most car owners who don't have money to buy fuel will park the cars at home thereby, look for another alternative to get to school. When this is happening, the students would be affected such that what they expected to know and have been taught would be dragged down. Moreover, a situation whereby teachers are available in the school but there are no materials for them to use and they are yet to be paid in order for them to improvise since the school lacks those materials for teaching, what would the teachers do and what should become the fate of the students?. These are some of the challenges teachers are facing whenever there is much delay in the payment of salaries and as such, one of the difficulties encountered by students since whatever affect the teachers/facilitators will directly or indirectly affect them.

Likely remedies

1. Government/school proprietors/proprietresses should endeavour to equip all the public/private schools most especially the public secondary schools with sophisticated laboratory and enough laboratory equipment for effective and efficient experimental studies to take place.
2. Government/school administrators should employ more experienced teachers and put them in the classes that fit their cadre for effective/efficient teaching/learning to take place.
3. Government should no longer post only the experienced teachers to urban schools but post both experience/qualified teachers into secondary schools both in rural/urban areas. Private school proprietors/proprietresses should do same. In addition, administrators in higher institutions at federal, state and private level should ensure that they employ efficient/competent lecturers that fit into various fields of study.
4. Administrators in ministry of education should create enabling environment and time to train more chemistry/practical teachers.
5. Students are to be well guided by their parents on appropriate ways of dealing with their teachers/lecturers/ school authorities/management while in school and off school environment. Teachers/ lecturers/parents are to join hands together to help every child/student appreciate every subject/course of study in school, by so doing; no student will have any reason for failing a particular subject/course.
6. Government/proprietors/proprietresses should endeavour to provide or build enough classrooms that will accommodate all students as well create separate classrooms for science oriented students most especially those taking chemistry/chemistry practical courses.
7. School authorities/management are to advise the government on the need to supply chemistry textbooks that are relevant in the teaching of chemistry/practical.
8. Government based institutions/secondary schools are to provide specified firsthand teaching aids that can facilitate better understanding of the subject topics/course outlines.

9. The minister for education both at federal, state level should see that enough time is allocated for the teaching of all science subjects especially chemistry/practical based topics for effectiveness.
10. In the past and up till now in some schools, allocation of funds is at the mercy of the priority of the principals of the schools. The government who has now seen this importance of science/technology should increase the science/technology schools and see that without unit fund no practical because it has been discovered that the most important problem in the teaching of chemistry practical is the provision of funds to purchase chemistry equipment, services and repairs and even the labouratory building.
11. Chemistry labouratory should be built in schools by the government/parents-teachers association and fund should be provided by the government for the purchase of labouratory apparatus.
12. Teachers should endeavour to hold practical classes for every practical topic that is taught in the class and some degree of freedom should be given to students to work on their own in the labouratory.
13. Teachers already in the field and untrained ones should be made to undergo a training programme so as to enhance their method.
14. More graduates and NCE teachers should be empowered to teach and those untrained teachers who are interested in the profession and already on the field should undergo in-service training in order to enhance their teaching method.
15. The 6-3-3-4 system of education should not be seen as a change of subject matter but as an introduction of a technological orientation.
16. Affective and cognitive teaching strategies should be interwoven or combined during chemistry teaching and learning since both have impact on chemistry reasoning.
17. Both lecturers/teachers and students should be involved in the design of teaching and learning materials.
18. The Universal Basic Education (UBE) should incorporate laboratory of pre-primary to junior secondary levels so that they can have good foundation in science before proceeding to tertiary institutions and the labouratories should be well developed in Teacher Education Institution Facilities of Education and Institutes of Education.
19. Practical should also carry some credits in grading of students and the language in which chemistry tests are written must be simple and in all cases within the level of the ability of students in English language
20. The use of questions in teaching and learning of chemistry is very essential. According to finding made by research studies, it has been established that the value or benefits of asking and attempting to answer questions cannot be ruled out or overemphasized. An instructional environment that encourages asking of questions is known to have positive effect on comprehension [11]. A link was also reported to exist between question asking and improved problem-solving skills [12] and that asking of questions aid in the developing independent learning skills [13]. Questions are usually asked by teachers, students and also generated in textual materials. Transfer of whatever is learnt in the classroom enables students to appreciate the relevance of chemistry in different spheres of human life. More

opportunities for students to actively participate in the analysis of problems will improve confidence in solving chemistry problems.

21. Every school should have an adequate and functionally library manned by at least one professional librarian since not all students can afford to buy expensive textbooks. The contents of such library should be supportive of the curriculum and reflective of our indigenous culture and home experiences and should accommodate future development and desirable world-view.
22. The various teaching methods that have been tested to be very effective should be made popular in the school system and chemistry lecturers/teachers need to be exposed to such methods which could be in form of conferences or workshops to update their knowledge of subject matter and teaching techniques.
23. There should be effective school psychological services which would lead to good teacher-students relationship, effective classroom management and motivated lecturers/teachers and students which will eventually provide a conducive school climate for effective learning processes of chemistry.

Conclusion

Good background of scientific knowledge through the provision and use of laboratory/ equipment and all the necessary teaching aids play an important role in the teaching and implementation of chemistry practical in all schools at all levels.

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