

UNIVERSITY OF EDUCATION, WINNEBA

CHALLENGES ASSOCIATED WITH SCIENCE PRACTICAL LESSONS

ORGANIZATION IN SENIOR HIGH SCHOOLS IN SEKONDI –

TAKORADI



CYNTHIA EWURA ABENA ACKON

NOVEMBER, 2014


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The logo of the University of Education, Winneba, is a circular emblem. It features a central sunburst design with two stylized human figures holding hands, symbolizing education and unity. The text 'UNIVERSITY OF EDUCATION, WINNEBA' is written around the perimeter of the emblem.

**A DISSERTATION IN THE DEPARTMENT OF SCIENCE EDUCATION,
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PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD
OF THE MASTER OF EDUCATION IN SCIENCE EDUCATION**

NOVEMBER, 2014

DECLARATION

STUDENT'S DECLARATION

I, Cynthia Ewura Abena Ackon, declare that this dissertation, with the exception of quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature.....

Date.....

SUPERVISOR'S DECLARATION

I hereby declare that preparation of the dissertation was supervised in accordance with the guidelines for supervision of thesis as laid down by the School of Graduate Studies, University of Education, Winneba.

Name of supervisor.....

Signature.....

Date.....

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DEDICATION

This dissertation is dedicated to my husband, Capt. Francis Kweku Ackon, my lovely kids: Michael and Gabriel as well as my dear Brother, Dr. Ebenezer Odoom.



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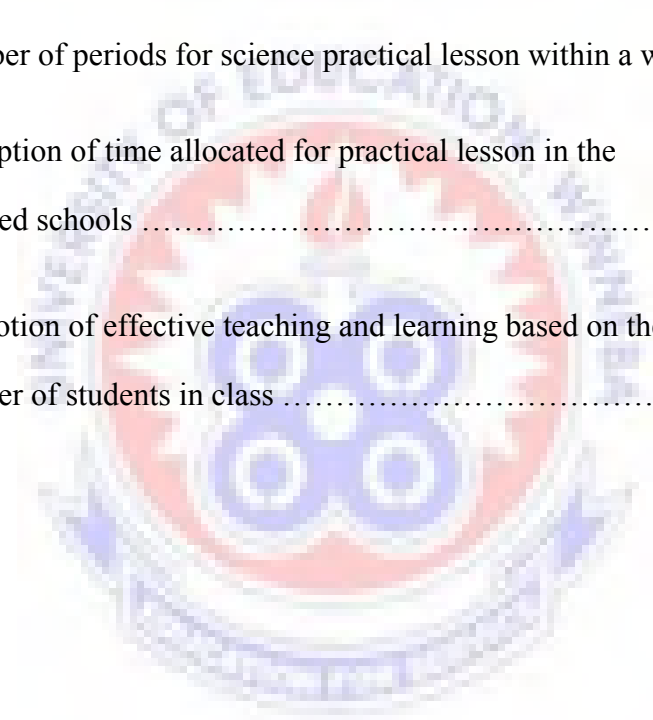
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ABSTRACT

The teaching and learning of science in the Senior High Schools (SHS) has of late not been very effective since the practical aspect of the subject is seemingly neglected by many teachers. The main objective of this study was to investigate the challenges associated with the organization of science practical lessons in some selected Senior High Schools. The sampled population for the study consisted of 165 students and 50 teachers from five selected Senior High Schools. The main instruments for gathering data for the study were questionnaire, document analysis and formal observation of some science lessons. Data collected were analyzed using frequency count and percentages. The research findings showed that both teachers and students from the selected SHS considered practical lessons as one of the effective means of teaching and learning science. However, the time allocated to practical lessons varied from one school to another. It also came out that, most of the schools have science laboratories that are not adequately equipped with equipment and materials. Again, the study also found out that, student' participation in science practical lessons is through the demonstration instead of the activity-oriented strategy to enhance students' understanding and experience. To ensure efficiency in the teaching of the practical aspect of science in the studied SHS, the study recommends that government and all stake holders in education must supply laboratories in the studied Senior High Schools with the necessary equipment, materials and chemicals to enable students and teachers to develop the necessary skills, attitudes and interest in science.

CHAPTER ONE

INTRODUCTION

Overview

This chapter looks at the background to the study, statement of the problem, purpose of the research, significance of the study, delimitation and limitation of the study and organization of the chapters.

Background to the study

In practical works, students observe or manipulate real objects or materials for themselves (individually or in small groups) or witness teachers' demonstrations (Hodson, 1993). Laboratory activities have had a distinctive and central role in the science curriculum, and science educators have suggested the many benefits that students gain when they are engaged in science laboratory activities. Over the years, many have argued that science cannot be meaningful to students without practical experiences in the laboratory that are worthwhile. Unfortunately, the term "laboratory" or "practical" has been used, too often without precise definition, to embrace a wide array of activities. Lots of these arguments have been raised in the past to give justification or rationale for its use. Even though laboratory sessions are considered as necessary and important, very little justification has been given for their inclusion (Hofstein & Lunetta, 1982).

Laboratory activities are designed and conducted to engage individuals, while others do engage small groups and large groups of students during practical lessons. However, science teachers face a lot of challenges when organizing science practical work. Some of the hindrances faced by teachers both at Secondary and Primary levels are:

1. lack of suitable laboratory facilities
2. lack of specialist training
3. safety risks pertaining to personal and environmental issues
4. length of time needed for practical work

The National Science Education Standards (National Research Council, 2000) reaffirm the conviction that inquiry in general and inquiry in the context of practical work in science education is central to the achievement of scientific literacy. Inquiry-type laboratories have the potential to develop student's abilities and skills such as: posing scientifically oriented questions, forming hypothesis, designing and conducting scientific investigations, formulating and revising scientific explanations and communicating and defending scientific arguments.

Chemistry is essentially a laboratory activity oriented subject. No course in chemistry can be considered as complete without including practical work in it. Laboratory activity, here, is used to describe the practical activities which students undertake using chemicals and equipment in a chemistry laboratory. The original reasons for the development of laboratory work in chemistry education lay in the need to produce skilled technicians for industry and highly competent workers for research laboratories. Practical work helps to motivate pupils, by stimulating interest and enjoyment, teach laboratory skills, enhance the learning of scientific knowledge as well as give insight into scientific methods and develop expertise in using it.

The 2004 Educational Reform Programme advocated the use of conventional approach to science practical activities and suggested that science practical work should be laboratory-based and carried out in the laboratory (Ministry of Education (MOE), 2004). The conventional approach includes the use of standard laboratories,

science kits, teacher demonstrations, and other activities. To achieve this goal, most Senior High Schools have to be provided with laboratories well-stocked with adequate equipment and apparatus. However, a close observation made about some Senior High Schools in Ghana, revealed that some schools do not have science laboratories. Even those having laboratories for science teaching are ill- equipped (Serwaa, 2007).

Practical work is an essential component of studying the natural sciences. The 'hands-on' approach has the potential to stimulate students' interest in the subject matter, teach laboratory skills, enhance the acquisition of knowledge, and give insight into scientific attitudes and objectives. Practical work, according to Beatty and Woolnough (1982) is usually done in school science for several reasons. Some of these reasons are to make phenomena more real through experience and to develop specific manipulative skills and to elucidate theoretical work as an aid to comprehension. All these benefits are lost if science lessons follow literary approaches only. Though practical lessons are to be used by tutors to help their students to achieve better results in the sciences, it is sad to find that in most of the schools, science laboratories are used for theory lessons and not practical lessons.

Although, some studies have been conducted in the past years to investigate the issue in the study area, still there seem to be a growing concern about the lack in practical lessons in some Senior High Schools. It is for this reason that this study investigated challenges associated with the organization of science practical lessons and its effect / repercussion on students' performance in some selected Senior High Schools in the Sekondi –Takoradi Metropolis of the Western Region.

Statement of the problem

Laboratories are one of the characteristic features in the sciences at all levels. It would be rare to find any science course in any institution of education without a substantial component of laboratory activity. Even though the instructional potential of the laboratory is enormous, most practical activities in higher education are by nature illustrative or demonstrative. Too often they emphasize the acquisition of observational skills; and allow students to see the concept dealt in action and relate theory more closely to reality. It is important to think about goals, aims and objectives in the context of laboratory work. Science teaching is often criticized for being prescribed, impersonal, lacking an opportunity for personal judgments and creativity. Science has become reduced to a series of small, apparently trivial, activities and pieces of knowledge mostly unrelated to the world in which students are growing up and inhibiting to their developing personalities and aspirations.

Practical work carried out by students is seen by many within the science education community as an important feature of science education (Abraham & Miller, 2008). Nonetheless, there have been concerns from the science community, industry and businesses as well as teachers themselves who argue that; schools are not doing enough practical work (Dillion, 2008).

In spite of the numerous policy provisions and other efforts by the Government of Ghana to lay emphasis on science education as engine for growth and development of the country, its achievement has not been up to expectation (Anamuah-Mensah, 1995). The teaching and learning of science have standards to be followed by teachers if effective learning by students is to be achieved. One very important aspect of science teaching is its practical lessons. However, the West African Examinations council (WAEC) Chief Examiner's Report over the years (2002-2012) have been

identifying some weakness on the part of science students, some of which are include the following:

1. Candidates' answers indicate that they have not been taken through adequate practical lessons.
2. Candidates wrote unobservable features, thus, they answered the practical questions from the theory they have learnt.
3. Standard of students' drawing were poor which indicates they do not practice biological drawings as required by practical examination.
4. Inability to outline a suitable procedure for the preparation of $ZnCl_2$ crystal from zinc granules.
5. Inability to take correct measurements with their scale rule
6. Wrong deductions from graphs.

In view of these reports, there are growing perceptions among the general populace suggesting that science students are not adequately taken through practical lessons. It is in the light of this perception that the researcher desires to investigate the challenges associated with the organization of science practical lessons.

Purpose of the study

The purpose of the study was to find out the challenges associated with the organization of science practical lessons in some selected Senior High Schools in the Western Region of Ghana.

Objectives of the study

The general objective of the study was to critically examine the challenges associated with the organization of science practical lessons and its associated effects on student performance.

The specific objectives were to:

1. examine the importance of practical work in the teaching and learning science.
2. identify some of the challenges associated with the teaching and learning science.
3. identify the extent to which these challenges affect the interest of teachers and students in practical lessons.
4. identify the effect of these challenges on student performance.
5. identify the mitigating factors for these problems.

Research Questions

The study was addressed by the following research questions:

1. What difficulties are associated with the organization of Science practical lessons?
2. What are students' attitudes toward Science practical lessons?
3. To what extent do these difficulties affect the performance of students?
4. What are the appropriate solutions to these problems?

Significance of the study

The essence of undertaking this research was to find out the importance of practical work, the challenges associated with science practical work as well as the effect these

challenges have on the performance of science students in the country. It is in light of this, that the research sought to explore the extent to which science practical lesson is contributing to help science students:

1. Make accurate observation and description;
2. Make phenomena more real;
3. Get aroused and maintain interest in the study of science;
4. Draw logical conclusions on science phenomena;
5. Improve upon their performance.

The information obtained from the study uncovered the problems and challenges that hinder the use of practical work in the teaching and learning of science. Again, the study may afford teachers in Senior High Schools the opportunity to engage, encourage and involve their students in practical oriented- lessons.

The study may also provide very useful information to the Ministry of Education (MOE), government and other authorities and agencies to provide interventions so as to promote practical lessons in science in teaching and learning. It may be used to formulate educational policy at this level aimed at improving science teaching and learning in our senior high schools.

Furthermore, the research may help the Curriculum Research and Development Division (CRDD) of the Ghana Education Service (GES) to design effective science curriculum for schools. It may also help GES to organize in-service professional courses for senior high school science teachers to improve upon their own professional competencies in handling the science subjects so as to sharpen student's creative skills, interest and desirable attitudes to enable them develop interest in the sciences.

Additionally, the findings may augment the pool of data required by other educational researchers in their bid to design interventions to solve educational problems in the sciences in general and science practical lessons in particular.

Limitations of the study

The study is limited to only tutors and students of the following schools, St. Mary's Boys SHS, Bompeh SHS, Takoradi SHS, Archbishop Porter Girls SHS and Baidoo-Bonsoe SHS. It is the researchers hope that the findings of this research could be applied to other schools.

Delimitations of the study

The unavailability of funds and time constraint prevented the researcher from carrying out the study beyond Sekondi – Takoradi Metropolis.

Organization of the chapters

This research report is presented in five chapters. The first chapter deals with the background of the study, statement of the problem purpose of the study, research questions, significance of the study, limitations, delimitations as well as the organization of chapters.

The review of the relevant literature on the study constitutes the second chapter and chapter three deals with the methodology. It comprises the research design, population, sampling and sampling technique used instrumentation, data collection procedure as well as procedure for analyzing the data. Chapter four focuses on the presentation and analysis of data. Finally, chapter five deals with the discussion of

findings, summary of main findings, conclusions, recommendations, and suggestions for further research.



CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter discusses the relevant literature on the area of study. Areas that were looked at include; science practical work, teaching and learning of science, methods or strategies employed by teachers in teaching the science subjects and teaching and learning environment. The review also looked at the challenges facing science in terms of equipment and human resource. It finally discusses the impact of science practical on the study of science.

Science Practical Work

Practical work, which is 'hands-on' activities, is an essential component when it comes to the study of the natural sciences, such as biology, chemistry and physics. It is based on the assumption that learning by doing is the best for acquiring scientific skills. The 'hands-on' approach has the potential to stimulate student's interest in the subject matter, teach laboratory skills, enhance the acquisition of knowledge and give insight into the scientific attitudes and skill development. According to Freedman (1997), the motivation to learn science does not only depend on interests that the students bring to school. It can also be the result of certain learning situations, among which we find laboratory work.

Research on science teaching provides at least two reasons that support the inclusion of real-life issues in science teaching. First, real-life applications of science have been found to play a role in helping students reconcile their experience-based prior knowledge about the world with scientific explanations.

Studies of science learning as a process of conceptual change, as well as studies of knowledge transfer suggests that students need to use ideas and concepts in multiple real-world context in order to understand their meaning (Driver, Guesne & Tiberghien, 1985; Gardner, 1993; Gick & Holyoak, 1983; Hewson, Beeth & Thorley, 1988; Roth, 1995; Wandersee, Mintzes, & Novak, 1994).

According to McComas (1996) and Simon (2000), real-life applications may be a way to engage students' interest in learning science. From a learning theory perspective, it is hypothesized that students become more engaged in their learning when they see the practical importance of the knowledge they are studying (McCombs, 1996; Pintrich & Schunk, 1996).

Many studies provide evidence supporting the idea that students' interest is enhanced by their involvement in real-world science projects and investigations (Barron et al., 1998; Hmelo, 1995; Krajcik, Blumenfeild, Marx, Bass, Fredricks & Soloway, 1998; Moje, Collazo, Carillo & Marx, 2001; Roth & Roychoudhury, 1994; Siegal & Ranney, 2003).

Carrying out hands-on practical activities can also be engaging to students (Freeman, 1997). Although studies suggest that many students lose interest in science class after age 11 because they find school science boring (Doherty & Dawe, 1988; Ebenezer & Zoller, 1993; Simon, 2000; Simpson & Oliver, 1985), the aspects of science that students consistently report as most appealing is hands-on laboratory work (Millar, LeMarechal & Tiberghien, 1999; Molyneux-Hodgson, Sutherland & Butterfield, 1999; Myers & Fouts, 1992).

Teaching and Learning of Science

The science curriculum has an in-built flexibility to cater for the interest, abilities and needs of students. This flexibility also provides a means to bring about a balance between the quantity and quality of learning. Teachers should provide ample opportunities for students to engage in a variety of learning experiences as investigation, discussions, demonstrations, practical work, project, field studies, model-making, case-studies, oral report, assignment, debates, information search and role play. Practical work and investigations are essential components of the science curriculum. They enable students to gain personal experience of scientific knowledge through hands-on activities and to enhance the skills and thinking processes associated with the practice of science. Participation in these activities encourages students to bring scientific thinking to the processes of problem solving, decision making and evaluation of evidence.

Engaging in scientific investigation enables students to gain an understanding of the nature of science and the limitations of scientific inquiry. Presently, practical activities at all levels of education are to be provided through the use of either the conventional approach or computer assisted approach. The conventional approach includes the use of standard laboratories, science kits, teacher demonstrations and other activities. Thus there are procedures for organizing practical work in schools which tutors are expected to be following. But as to whether or not all tutors have been paying heed to such procedures remained an interesting phenomenon to investigate. The current approach to science teaching in most Senior High School is most often based on classroom and laboratory work which are intended to meet examination requirements.

Unfortunately, the examination-driven mode of science teaching has limited the scientific and technological scope and perspectives of the students. Not only does the approach tend to make the study of science uninteresting and boring, but also students find it difficult to relate the theoretical knowledge with the practical realities of life and the use of manipulative skills. There is also very little orientation for problem solving, inculcating of investigative skills and counseling on science career opportunities.

The process skills reveal some of the processes of science. These include observing and describing, classifying and organizing, measuring and charting, communicating and understanding communication with peers, predicting and inferring hypothesizing, hypotheses testing, identifying and controlling variables, interpreting data and constructing instruments (Agbola, 1984). According to him all these processes can be achieved through group work during practical activities.

He is also of the view that some of the specific human abilities important in the process skills domain are visualizing (thus producing mental images), combining objects and ideas in new ways as well as offering explanations for objects and events encountered. Others are questioning, producing alternate or visual uses of objects, solving problems and puzzles, designing devices and machines, producing usual ideas and devising tests for explanations created. Development of the above domain will not be achieved if the practical work is not effectively used during science lessons.

Attitudinal domain such as values, human feelings and decision making skills is also important enough to be addressed at the senior high school level. Practical work done in groups enables students to develop positive attitudes towards themselves, positive attitudes towards the science subjects in general and science teachers. It also affords

the students the opportunity to develop sensitivity and respect for others, express personal feelings in a constructive manner and to make decision about personal values and social environmental issues.

In application and connections domain, Adedapo (1976) observed that science is related to everything, especially subjects such as mathematics, social science, vocational subjects and the humanities. Practical work done by students during science lessons enable them to develop scientific concepts in everyday life experience and to apply learned science concepts and skills to everyday social problems. Not only that, practical work enable students to understand scientific and technological principles involved in household technological devices and to evaluate the mass media report of scientific development.

Methods Used In Teaching the Sciences

There are many methods of teaching employed in the teaching of science at the senior high school level. No simple method can be said to be sufficient to be used in the teaching and learning of science at the senior high school level. There is, therefore, the need to search for more effective strategies that are likely to improve achievement in senior high school science.

Such strategies include co-operative learning/instructional strategies (activity based) which have been found to improve science learning outcomes (Okebukola, 1984; Iroegbu, 1998; Slavin, 1990). The benefit of co-operative learning for science students are well documented (National Institute for Science Education College, 1997; Springer & Stanne 1999; Lord, 2001). Cooperative learning improves student achievement and enhances student enjoyment of and attitudes towards learning science (Springer & Stanne, 1999; Lord, 2001).

Cooperative learning works, because it is active, student centered and social (Johnson & Johnson, 1998). A cooperative learning activity might involve reading, writing, planning experiments, designing questions, or solving problems. This multi-layered approach toward student interaction with the content improves understanding and retention. Since, cooperative learning shifts emphasis from the instructor to the students, the latter have opportunities to build social support networks and to learn and practice many social skills, such as leadership, communication, inquiry and respect for diversity (Lord, 2001). The development of social relationships and skills helps students to build confidence as learners and to build trust in their teammates. This leads to improve attitudes toward the subject and often to the retention of underrepresented populations in science programmes. Peer tutoring is a type of cooperative learning/instructional strategy. It is a personalized system of instruction which is learner rather than teacher-oriented. Studies have shown that this instructional strategy benefits both the students being tutored and the teacher, although the teacher is associated with greater cognitive gains than the student being taught (Annis, 1982, Bargh & Schul, 1980, Lambiotte et al., 1987). It has also been observed that when science lessons are done in groups, students are allowed to make valuable decisions which together lead to a satisfactory accomplishment. Mary (1996) explained that group work during practical is a pervasive and an influential feature of the classroom ecosystem, which must be encouraged in the teaching and learning of science in schools.

The Activity-based Methods of Teaching

The procedure used for the activity-based methods of teaching is based on current information and research in developmental psychology involving cognitive, affective,

experimental and maturational issues. Some of the methods used for teaching science lessons include group activity, project work, practical work, inquiry, discovery, discussion and demonstration. In all these methods, practical work is found to permeate all aspects and they in turn relate to one another. According to Lazarowitz, Lazarowitz-Heads and Bird (1994), teaching methods generally involve heterogeneous groups working together on tasks that are deliberately structured to provide specific assignments and individual contributions for each group member. Von Secker and Lissitz (1999) found that “Teacher- centered instructions is negatively associated with achievement. On the other hand, mean science achievement is expected to increase with the amount of emphasis on laboratory inquiry” (p.1194). The authors concluded that de-emphasizing traditional, teacher-centered instruction is expected to increase average science achievement and minimize gaps in achievement between individuals of different socio-economic status.

The Teaching and Learning Environment

There are many aspects to determine the success of learning process. One of the aspects is learning environments. A research study conducted by Fraser (2002) showed that learning environments do not only have the positive correlation with the students’ outcomes, motivations, and attitudes, but also teachers’ motivation. Fraser’s study on learning environments is focus on student’s outcomes, students’ and teacher’s perception, and evaluation of the strategies. According to him, the factor that contributes most to self-evaluation is the learning environment. Such an environment allows students to synthesize, analyze, explore, criticize and create their own concepts about the learning material.

A study conducted by Onyegegbu (2001) revealed that secondary schools science students in Nigeria, approach laboratory activities with mixed emotions. For some, these activities are windows on the world of science, allowing them to gain experience with the techniques, concepts and emotions that go with real research. For some others, practical lessons in science laboratory are exercise in preordination, tedious derivation of answers that are already known to questions that do not seem important.

According to him, one of the major problems that he experience as a science teacher in the secondary school laboratory, is that, teachers feel that demonstrating or carrying out activities in the laboratory amounts to inviting trouble, and is tedious. Often this turns out to be major cause of their indifference to practical work. Moreover, science topics are so restricted to examination scheduled curriculum that teachers must comply with if their students are to pass their external examination.

A survey of secondary school science laboratories in Nigeria reveals that many of them are underfunded with outdated equipment (Onyegegbu, 2001). The classroom experience shows that large number of the secondary school science students face considerable difficulty in appreciating and learning scientific concepts in a meaningful way, especially in laboratory activities. This is a clear reflection of their poor ability to solve simple day to day problems, make predictions in given situations and poor ability to apply scientific concepts to explain ordinary natural phenomena.

However, on the part of science teachers, it is rather disturbing to note the apathy or indifference, with which science practical activities are conducted in the laboratory. Practical activities if done in the laboratories are done with the mundane, unimaginative manner (Onyegegbu, 2001). These findings in the Researcher's

opinion are not different from what pertains in the senior high schools in Ghana. The classroom, laboratory and the school environment can be made conducive to teaching and learning of science through improvisation of materials by teachers when standard laboratory equipment are not available.

Time Allocated for Science Lessons

Time, is a resource which is not renewable, non-interchangeable and finite. Most science teachers overlook the practical aspect of the subjects perhaps because of time allocated for the teaching and learning of science and the number of topics to be covered. Pratt (1980) is of the view that the greatest amount of the time that is used in schools and that spent by pupils, is the time that is committed not by their consent but by order of their elders.

Mathew (1989) is also of the opinion that a pupil's level of attainment was directly related to the period of time actively spent on learning. This finding was also supported by the International Assessment of Educational Progress (IAEP) Projects in 1991/92. Mathews' opinion also holds for the science practical work. The science curriculum for senior high schools advocated for seven periods of forty minutes a period in a week. It also recommended that 4 periods and 3 continuous periods be respectively allotted to theory and practical work (Ministry of Education, 2003). Though the idea of time allocation was clearly spelt out in the syllabus, most senior high schools could only have six (6) periods of forty minutes per week allotted for science. The one extra period is allotted to other subject areas depending on the school. This inadequacy of lesson time for science perhaps has forced teacher to ignore the practical work when teaching in order to be able to complete the syllabus.

Fisher and Fraser (1990) gave two ways by which time for subjects can be allotted in the curriculum. The two ways were time allotment in periods and allotment of time to the subjects, taking into consideration the number of activities' involved in the teaching and learning of the subjects. This to them will give adequate time for practical lesson. Fisher and Fraser (1990) reviewed a substantial body of research in which measures of time to learn a particular kind of subject matter and conventional measures of intelligence, have both been used to predict learning. The time to learn measures are usually good of better predictors than are intelligence measures.

Kraft (1994) in his view sees the amount of time spent on the basis of language and mathematics as a critical factor in the achievement level of students in science. Kraft's study which was focused on primary education gives insight into time allocation and use in our schools.

According to him, while the length of primary school year in Ghana was 800 hours per year, it was 1080 hours, 1290 hours and 1128 hours per year in Benin, Burkina Faso and Nigeria respectively. He is of the opinion that not only do Ghanaian children spend less time in school than many others, but that the actual academic learning time is less by two to three hours a day. This means that the underutilization or mismanagement of instructional time could result in a limited coverage of the designed curricula, which will finally have negative effect on the student's performance.

Due to that, Hurd (2002) suggested increasing the amount of time allotted for active experimentation in science as a way of increasing participation by students who are poorly motivated. He cautioned that often teachers use teacher centered instructional techniques and assign seat work to unmotivated students while more motivated

students perform laboratory activities and are given assessment involving problem solving.

Instructional time refers to a family of concepts, some of which have not yet achieved the status of concepts in other, more matured scientific fields (Berliner, 1990).

Berliner gave different dimensions as follows:

1. Allocated time, usually defined as the time that the states, districts, schools, or teachers provide for the instructions for the students.
2. Engaged time, usually defined as the time that students appear to be paying attention to material or presentation that have instructional goals.
3. Time-on-task, usually defined as engaged time for a particular learning tasks. The engagement must be on particular learning tasks but not just general task.
4. Academic learning time, usually defined as that part of allocated time, in subject matter area (science, mathematics, etc) in which a student is engaged successfully in the activities or with the material to which he or she is exposed, which are related to educational outcomes that are valued.
5. Transition time, usually defined as the non- instructional time before and after some instructional activity.
6. Perseverance, usually defined as the amount of time a student is willing to spend on learning a task or unit of instructions.
7. Pace, usually defined as the amount of content covered during some time period.

Instructional time intended for science varies across countries participating in the Trends in Mathematics and Science Study (TIMSS). Some countries spend up to 32% of instructional time on science (Martin, Mullis, & Chrostowski, 2004). Lynn (1989)

and Stigler, Lee and Stevenson (1987) found that Japanese and Chinese children spent much more time on learning than American children. In the United States the curriculum does not specify the percentage of total instructional time intended for science, except for bench marking, which indicated an average instructional time for science of 180 minute per week. This amount of instructional time is comparable to one in higher achieving countries such as Singapore.

As indicated by Sheppard and Robbins (2002) there has been very little discussion about the time allocation for science in US high schools. The committee of ten recommended that 25% of curricular time in each year of high school be devoted to science. Currently students spend 15% of curricular time on science. This estimate is based on six periods a week out of 40 periods per week.

Time allocation in Ghana is somewhat smaller considering that other countries allow their students to enroll in more than one science course per year, thus leading to greater time allocation. Because of the experimental nature of science, more time should be devoted to it in the classroom. Curricular time in science in Ghana, like many other countries, has not matched the significant increase in the number of science topics to be taught at the senior high school level.

The Concept of Attitudes

The concept of attitudes is very complex and difficult to measure (Page-Bucci, 2003). Many definitions and explanations have been put forward in many areas of learning; including social psychology and social science. There seems to be an interrelationship between beliefs and attitudes. The attitudes towards science may be viewed as a more purposeful way of summarizing a wide range of beliefs about science which in turn allows the prediction of science related behaviour.

Scientific attitude implies certain ways of approaching problems. It also implies an attitude of wanting to find explanations that are secular and do not refer to authority (Schreiner & Sjoberg, 2004). Attitude toward science, however, may be viewed as a wide variety of beliefs about science.

The investigation of students' attitudes towards studying science has been a substantive feature of the work of the science education research community for the past 30 years. Its current importance is emphasized by the now mounting evidence of a decline in the interest of young people in pursuing scientific careers (Department for Education, 1994; Smithers & Robinson, 1988).

Combined with research indicating widespread scientific ignorance in the general populace (Durant & Bauer, 1997; Durant, Evans & Thomas, 1989; Miller, Pardo & Niwa, 1997), and an increasing recognition of the importance and economic utility of scientific knowledge and its cultural significance, the falling numbers choosing to pursue the study of science has become a matter of considerable societal concern and debate (House of Lords, 2000; Jenkins, 1999; Lepkowska, 1996).

Consequently, the promotion of favourable attitudes towards science, scientists and learning science, which has always been a component of science education, is increasingly a matter of concern. Several studies have been carried out with the focus on students' attitudes toward a particular discipline, such as Physics (Angell, Guttersrud, Hendrickson & Isnes, 2004) or Chemistry (Salta, Tzougraki, 2004) and a few focusing on students' attitudes toward science (Spall, Stanisstreet, Dickson & Boyes, 2004).

Challenges facing science practical work in terms of equipment

Equipment for science education

The term 'equipment', as used in this report, covers all the support material for science teaching excluding textbooks, other printed materials and the usual classroom materials and facilities, such as chalk, blackboards and furniture. It may also include perishable items (e.g. glassware) and consumables (e.g. chemicals).

Practical activities at different levels of sophistication are present in the majority of school science curricula at the primary level and particularly at the lower and upper secondary levels. Practical activities usually require special facilities and equipment. Although fully equipped laboratories and sophisticated equipment are by many considered essential, it is not necessarily so.

In many countries, science education is suffering from a lack of appropriate facilities and supporting materials, including equipment. Modern curricula and textbooks based on discovery learning are sometimes used, but in the absence of practical activities it is questionable if the students receive a better understanding of science than they did when books and curricula were based on lecturing and blackboard teacher demonstrations (Hakansson, 1983).

To improve the situation, many national, regional and international projects have been launched, emphasizing laboratories and equipment. However, their success was in many cases far below the expected. The World Bank has supported secondary school science in over 100 projects; generally the equipment components were a substantial part of the total expenditures. In Bank evaluations, almost half of the outcomes were assessed to be negative. Other Bank projects, which were successful from the equipment acquisition and distribution point of view, were found not to improve the quality of science education substantially (World Bank Document, 1992). In some

cases the equipment provided was not used at all, and it was possible to find twenty years old equipment kits still in their original packages (Schmidt, 1983a).

Materials for Science Practical Work

Availability of teaching and learning materials for science practical work plays an important role in the learning of science. Many scholars (Bajah, 1986; Akinwumju & Orimoloye, 1987) contended that the availability of physical and material resources is very significant for the success of any worthwhile educational endeavour. These researchers agreed that, availability of adequate school buildings, number of classrooms, chairs, desks and laboratories for science teaching are imperative for the attainment of any educational objectives.

In his study, Bajah (1986) found a significant relationship between teachers, facilities and schools' academic performance. In his view, Bajah noted that teachers are more important than the equipment of the laboratory for the understanding of the science concepts.

Laboratory equipment may remain teaching materials for the improved performance without teachers. Despite conventional wisdom that school inputs make little difference in student learning, a growing body of research suggests that school can make a difference and a substantial portion of that difference is attributable to teachers.

Though practical lessons are to be used by teachers to help their students to achieve better results in science, it was sad to find that in most of the Senior High Schools (SHSs), the science laboratories were used for theory lessons but not practical lessons. This is because the laboratories were ill-equipped with materials and equipment necessary for practical lessons (Serwaa, 2007).

Adequate provision of instructional materials is an important method that science teachers can use to promote skills acquisition by students (Eshiet, 1987). Ogunyemi (1990) found out that when physical and material resources are provided to meet the needs of the school system, students will also learn at their own pace. The net effect is that it increases the overall academic performance of the students.

In his own contribution, Gamoran (1992) noted that school resources and books in the library alone, had little impact on the students achievements once background variables are not taken into account. This meant that for students to perform well in higher educational level, their background variables must be catered for in addition to supplying them with the requisite educational materials at the secondary level to propel the students to the higher achievement.

Distribution

In some cases, purchased equipment are not supplied to schools, but are stored in a central warehouse for a very long time (Gaillard & Ouattar, 1988). Reasons may be different, ranging from bureaucratic procedures to physical inability to distribute the equipment across the country.

Another kind of problem is connected with the relative inflexibility of supply and distribution schemes. It often happens that the same standard sets of new equipment are distributed to all schools even when the existing supplies vary considerably. It might also happen that certain items are not included in the pack, because the majority of schools already have them. The result is that a number of schools will never get that particular piece of equipment, while other schools will get equipment they already have.

Supply of consumables

Consumable materials (for example chemicals) represent a significant part of the total costs of science education in developing countries. They are necessary for utilization of the equipment. However, the funds for consumables are not always available. This is particularly true if they have to be imported (i.e. must be paid in foreign currency). Distribution problems occur also here, similar to the problems encountered at the distribution of equipment. Many countries are still using hazardous chemicals in secondary school classrooms. These chemicals are now no longer used in most developed countries at this level (Ware, 1992).

Maintenance, repair and replenishment

Teachers and laboratory technicians (where available) are rarely trained properly in the maintenance of the equipment, either in pre-service or in-service training programs (Lowe, 1983). If the equipment is in use, it will eventually break down teachers and laboratory technicians should be able to carry out simple repairs, but the necessary training is seldom provided. Centers for more complicated maintenance and repair are organized in some countries, but generally they are not available.

A missing or broken inexpensive part may render a whole equipment kit unusable unless it is replaced. Single items for replenishment are not always in stock and available for schools to acquire.

Challenges facing science practical work in terms of human resource

Practical Work and the Student's Learning of Science

Good use of practical work can help students become positively motivated towards science. Conversely sub-standard implementation can have the adverse effect. Recent studies have observed science teachers' poor use of this tool and the negative affect it

has had on students' opinion of science. (Science Community Representing Education, 2009).

Where science teachers focus more lesson time on assessment, less time is available for practical work. A diminished use of practical work is shown, not only, to be detrimental to student's understanding of scientific concepts, but also, to quash their interest towards science (Osborne, Simon & Collins, 2003).

Who is teaching our students?

General disenchantment towards teaching has depleted supplies of physical science expertise within UK Science departments (Menter, Hutchings, & Ross, 2002). Furthermore, difficulties have prevailed with the recruitment and retention of teachers specializing in these subjects (Office for Standard in Education, 2008). For schools to ensure the delivery of these sections of the Science curriculum, new directives have been introduced, whereby qualified science teachers, irrelevant of subject, are expected to adopt any of the science disciplines to teach to students (Fuller, 2002). Where students have perceived, and consequently selected, pre-university biology courses, as the easiest science qualifications to attain (Fuller, 2002), biology graduates, and hence postgraduate-trained biology teachers have become more prevalent (Ross, & Hutchings, 2003). As a result, there are more biology trained teachers than physical science teachers, especially physicists, within science departments (Smithers, & Robinson, 2005). Schools, lacking in any specialism supply, have been compelled to fill these gaps with non-specialist science staff (Kind, & Taber, 2005).

These sequences of events have culminated to significantly decrease the numbers of students exposed to teachers with physical science subject knowledge

Why students need specialist teachers to supply their learning

Studies portray non-specialist teachers produce more rote learning, 'recipe style' practical work and less creativity in students' science lessons. This is attributed to science teachers being insufficiently confident with technical ability to safely deliver practical work during Science lessons (Abrahams, & Millar, 2008; Soares, & Lock, 2007).

Furthermore, non-specialist teachers, allocated with physical science subjects, display a greater reluctance to use practical work (Science Community Representing Education, 2008). Effective practical work becomes more unlikely in science departments, where teachers lack crucial updates in technical skills and the available skills are dissipating (Science Community Representing Education, 2008). How teachers portray their subject matter can drastically influence students' career choices and options at non-compulsory qualifications (Soares, & Lock, 2007).

Problems with non-specialist science teaching

Studies portray non-specialist teachers produce more rote learning, 'recipe style' practical work and less creativity in students' science lessons. Blame has been attributed to science teachers being insufficiently confident with the technical ability to safely deliver practical work during science lessons (Abrahams, & Millar, 2008; Soares, & Lock, 2007). Furthermore, non-specialist teachers charged with physical science subjects display a greater reluctance to use practical work (Science Community Representing Education, 2008).

Practical work needs to be appropriately implemented, within science lessons, to provide relevance for students and an improved access to understand abstract, scientific concepts (House of Lords, 2007). However, literature show, schools with

insufficient supplies of specialist science teachers affects students' choice and performance at pre-university level (House of Lords, 2007) and lowers their chance of attainment. Although quality teaching and passion, towards subject matter, are important, for student motivation and interest this wanes where students attain no inherent value, for inspiration (Cerini, Murray, & Reiss, 2003).

Impact of science practical work on the study of science

In Shulman and Tamir's (1973) review of research on science teaching, they identified three rationales generally advanced by those that supported the use of the laboratory in science teaching. The rationales included:

- 1) The subject matter of science is highly complex and abstract,
- 2) Students need to participate in enquiry to appreciate the spirit and methods of science
- 3) Practical work is intrinsically interesting to students.

Shulman and Tamir also compiled a list of objectives of using laboratory work in science teaching. The list included the teaching and learning of skills, concepts, attitudes, cognitive abilities, and understanding the nature of science. Also, there is hardly any science method's book that does not usually list the objectives of science laboratory work (Abdullah, 1982; Collette & Chiappetta, 1984).

All science curricula in Ghana list practical activities that should go with each curriculum item listed. The West African Examinations Council (WAEC) syllabus (WAEC, 1988) which was in use in 1996, recommended that the teaching of all science subjects listed in the syllabus should be practical based, perhaps, to demonstrate the importance it attached to practical work in science. Thus, several decades of emphasizing the assumed importance of laboratory work in science

teaching have elevated the importance to the level of a dogma. Thomas (1972) and White and Tisher (1986) are of this opinion. This position is, perhaps, why Yager (1981 p. 355-363) thought that science educators should treat laboratory work as the "meal'-the main course" rather than an "extra" or "the desert after a meal". Also, Bajah (1984) said, "All science teachers and students know that practical work is the 'gem' of science teaching" This dogma about the importance of laboratory work originated from the views of a few American educationists in the early sixties that extolled the importance of laboratory work in science teaching. Notable among these personalities are Bruner (1961), and Gagne (1963), they all extolled the virtues of teaching science as a process of inquiry or discovery.



CHAPTER THREE

METHODOLOGY

Overview

This chapter describes briefly the area where the study was carried out. A total of five senior high schools were selected from the Western Region of Ghana. The chapter also describes the research design used for the study. The descriptive sample survey was used to describe what existed with regards to how science practical work is done in senior high schools. The population and sampling procedures used were also dealt with in this chapter. Again the instrument used in the collection of data for the study and how they were designed have also been captured in this chapter. The chapter ended with the description of the validity and reliability of the instrument used to analyze the data, not leaving out the data collection procedures and method of data analysis.

The Study Area

The study was carried out in the Sekondi-Takoradi Metropolis in the Western region of Ghana. Sekondi-Takoradi Metropolis forms part of twenty two (22) Metropolitan, Municipalities and Districts in the Western Region of Ghana. The Administrative Capital of the Metropolis is Sekondi. This makes it the smallest, but the most highly developed. Indeed, it is the third largest metropolis in the whole of Ghana. It is located on the coast, about 200km west of Accra. The Metropolis shares boundaries with Shama District to the east, to the north with Mpohor District, to the west with Ahanta West District and to the south with Gulf of Guinea. Sekondi-Takoradi is the region's largest city and an industrial and commercial centre, with a population of 445,205 people. Sekondi-Takoradi has several secondary schools, colleges, and

special schools, ranging from single-sex to co-educational institutions. Among the tertiary institutions are, Takoradi Polytechnic, Nurses and Midwifery Training College and Holy Child College of Education.

Research Design

The research design used in the study is a descriptive survey. This describes what exist with respect to how science practical work is done in Senior High Schools (SHSs).

According to Gay (1987), the descriptive sample survey involves collecting data in order to test hypothesis or answer questions concerning the current of the subject of study.

The descriptive sample survey has also been recommended by Babbie (2001), for the purpose of generalizing from a sample of a population so that references can be made about some characteristics, attributes or behavior of the population.

This design is suitable for the study since the purpose of the research to survey and compare how science practical work is conducted in some selected senior high schools in the Sekondi-Takoradi Metropolis in the Western Region of Ghana.

Population

The targeted population consisted of all the science teachers and students from Senior High Schools in the Sekondi-Takoradi Metropolis of the Western Region of Ghana. The accessible population however, comprises all science teachers and students from five selected Senior High Schools in the Sekondi-Takoradi Metropolis.

Sample and Sampling technique

For the purpose of this study, the research employed the use of random sampling technique to select sample from the population. A sample size of 50 science teachers and 165 students were selected from the five Senior High Schools. The selection as regards to the numbers of students and teachers in each of the selected Senior High Schools was done equally, that is, ten teachers and thirty - three students from each schools.

Instrumentation

The major instrument used in the study to gather views, opinions and suggestions were informal observation of practical lessons, document analysis and questionnaires. In agreement with Barnes (1985), the Researcher undertook unscheduled observations of some practical lessons. An unsystematic instrument was used. As reported in Johnson (1978) and in Smith (1982), this method does not require the use of a check list; instead of a free-form procedure of recording data used. This recording procedure enabled the researcher to capture as closely as possible, the total picture of what happened during the observed lessons. A thorough examination of some documents related to the study was also done. The documents analyzed included biology, physics, chemistry and integrated science curriculum and materials such as text books and syllabuses. Other documents used were West African Examination Council (WAEC) Chief Examiners' Reports.

Two types of questionnaires were designed; Appendix A contains the questionnaires for the students and Appendix B contains questionnaire for the teachers.

Both sets of questionnaires were designed in such a way that they contained open-ended and close-ended type of questions. For the close-ended type of questions options were given and the respondents were asked to tick the answer which was applicable. With the open-ended type of questionnaires, respondents were required to express their own kind of responses in the spaces that were provided on the questionnaire.

Validity

According to Joppe (2000), validity determines whether the research instruments truly measures that which was intended to measure. To ensure the validity of the questionnaire it was given to my supervisor who painstakingly went through and gave the necessary suggestions and corrections to ensure its content and face validity. The expertise of some Senior Science Tutors and English Tutors from the Department of Science Education and English Education respectively, of the Colleges of Education was also drawn on to validate the questionnaires and to ascertain the content and face validity of the items.

Pilot test

The questionnaire was pre-tested in a pilot test carried out at Mpohor Senior High School in the Western Region of Ghana. The school was selected because it shares similar characteristics such as having large students' population and inadequate infrastructure and equipment with the selected schools. The pilot test enabled the Researcher to restructure the questionnaire to help elicit the right responses. This is emphasised by Johnson and Christensen (2008) who states that pilot-testing of instrument can reveal ambiguities, poorly worded questions, questions that are not

understood, and check how long it takes participants to complete the test under circumstances similar to those of the actual study.

Reliability

A pilot test of the instrument was carried out with twenty (20) students offering elective science at Mpohor Senior High School in the Western region of Ghana. The reliability of the students' questionnaire was determined using the Split Half Method (S.H.M.). Using odd-even items, the questionnaire was split into two halves and given to some non-research subject teachers to respond. The two set of scores were correlated. This yielded an internal consistency of 0.83 based on Pearson's Product Moment Correlation Formula. This was then compared with the tabulated coefficient of the reliability which according to Bryman and Cramer (2001) is acceptable at 0.8. Thus, the internal consistency (reliability) of the instrument was calculated.

Data Collection Procedure

The researcher sought permission from the Assistant Headmaster (Academic) of all the secondary schools to carry out a research using science students of the school which was granted.

The questionnaire was administered by the researcher personally. This enabled the researcher to get to the respondent directly and to enable her establish rapport with the respondents. It also enabled her to explain further parts of the questionnaire items that posed some problems to the respondents. After the questionnaire was issued out to the respondents, a time frame or interval of one week was allowed so that the respondents could respond to them not only as appropriate as possible but also at their own convenience.

The researcher also had the opportunity to observe some science practical lessons in some of the selected schools.

Data Analysis

The data obtained from the questionnaires, document analysis and informal observation were converted into frequency counts and simple percentages, and used to answer the research questions addressed in the study.

This study, in keeping with current or recent trends in the learning environment with regards to the classroom, employed quantitative method in analyzing the data that was collected (Fisher & Frazer, 1990; Fraser & Tobin, 1991; Fraser1994). This was done, using Microsoft excel spreadsheet.



CHAPTER FOUR

RESULTS AND DATA ANALYSIS

Overview

This chapter presents the results gathered from the respondents (teacher and students) on the questionnaire items. It also contains the analysis of various responses from the respondents.

Presentation of data analysis by research questions

Research Question 1

What are the difficulties associated with the organization of science practical lesson?

In finding the difficulties associated with the organization of science practical lesson, the researcher used the following items 1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 16, 17, 17, 18, 19 and 21 of the teacher's questionnaire and items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 17, 18, 19, 20, 21, 25 and 28 of the student's questionnaire as presented in the Tables and Figures below.

In the tables, identification of laboratories for science practical lessons, number of times for practical lessons, availability of equipment and the personnel responsible for the organization of practical lessons were investigated.

Organization of Science Practical Lessons

The researcher wanted to know if the selected schools in the Metropolis do have Biology, Chemistry, and Physics laboratories in terms of science subjects being taught.

Table 1: Science Laboratories for Practical Works in Biology, Physics, and Chemistry.

Response	Frequency	Percentage (%)
Yes	215	100
No	0	0
Total	215	100

According to Table 1, the entire respondents (representing 100%) said that they have separate laboratories for science practical in Biology, Physics and Chemistry. This means that science practical lessons organized in the selected schools were being done in separate laboratories.

Again, the researcher attempted to investigate the frequency at which students undertake science practical lessons.

Table 2: Number of times practical lessons are organized in the laboratories of the selected Schools.

Response	Frequency	Percentage (%)
Not at all	68	31.6
Frequent	50	23.3
Quite frequent	56	26.0
Very frequent	12	5.6
Not frequent	29	13.5
Total	215	100

From Table 2, 31.6% of the respondents do not have access to science practical lessons, 26.0% quite frequently have science practical lessons, 23.3% frequently have access to science practical lessons, 13.5% not frequent and 5.6% of the respondents indicated that they have science practical lessons very frequently.

From the statistics, the investigator can confidently say that most of the selected schools in the Sekondi-Takoradi Metropolis do not have science practical lessons often and this hinders the students' understanding of science concepts. According to Freeman (1997), the motivation to learn science does not only depend on interests that the students bring to school. It can also be the result of certain learning situations, among which we find laboratory work.

Again, the researcher attempted to find out who actually conducts science practical lessons in the selected school's laboratories.

Table 3: Organization of practical lessons in the laboratories.

Response	Frequency	Percentage (%)
The science teacher	95	44.2
Lab. Technician	95	30.2
Lab. Assistant	65	30.2
Class Prefect	55	25.6
Total	215	100

According to Table 3, 44.2% of respondents indicated that science practical lessons are normally organized by their teachers, 30.2% of them indicated that laboratory technicians do organize science practical lessons for them and 25.6% also indicated that laboratory assistants, normally organized the practical lessons.

This is an indication that, most of the science practical lessons in the selected schools were organized by experience teachers, laboratory technicians and laboratory assistants to improve upon the teaching and learning of science.

To further understand the problems associated with the organization of science practical lessons, the researcher probed further to know if the time allocated for science practical lessons is adequate for effective practical work in a week.

Table 4: Number of periods for Science Practical Lessons within a week

Response	Frequency	Percentage (%)
One	96	44.7
Two	119	53.3
Three	0	0
Four	0	0
Total	215	100

From Table 4, 53.3% of the respondents have two periods of science practical lessons in a week, whilst 44.7% indicated that they have one period of practical work a week. From the statistics, one can say that though majority of the students from the selected schools have two periods of practical section a week, yet, a sizable number of students from the selected school also have just one period for practical work a week. That is inadequate for a practical lesson since more time is needed for practical activities to enable students get the requisite practical skills to enhance their performance.

Again, to understand the problems associated with the organization of science practical lessons, the researcher probed further to know if the perceived time is

adequate for the student to undertake effective practical section. The following responses were generated:

Table 5: Perception of time allocated for practical lessons in the selected schools

Response	Frequency	Percentage (%)
Not sufficient	83	38.6
Sufficient	60	27.9
Quite sufficient	40	18.6
Very sufficient	32	14.9
Total	215	100

From the inference in Table 5, 38.6% of the respondents indicated that the time allocated for practical lessons is not sufficient whereas 27.9% of them perceived that the time allocated for practical lesson is sufficient. 18.6% of the respondents think the time allocated for practical lessons is quite sufficient and 14.9% of the respondents also indicated that, the time allotted to practical work is very sufficient.

Based on the responses generated, majority of the selected schools do not have enough time for practical lessons hence, having adequate time for hands-on activities is minimal. This is an indication that, there is the need to allot more time to practical activities to help students get the requisite practical skills to enhance their performance.

The researcher again, sought to find out how class size affects the effective organization of science practical lessons and the following responses were generated:

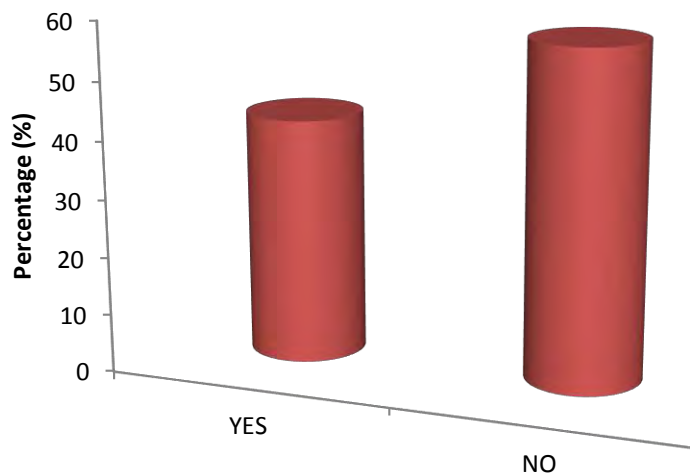
Table 6: Promotion of effective teaching and learning based on the number of students in class.

Response	Frequency	Percentage (%)
No	125	58.1
Yes	90	41.9
Total	215	100

Statistics from Table 6 indicates that, 58.1% of the respondents believe that, class size per practical lesson hinders effective teaching and learning of science, whilst 41.9% of the respondents disagreed to large number of student per practical section posing a problem to effective learning.

From the statistics above, the researcher concludes that large number of students per practical section may affect effective teaching and learning of science in the selected schools in Sekondi-Takoradi Metropolis.

It was also important to establish if the science laboratories in the selected schools were well -equipped for effective teaching, so the respondents were asked whether equipment and apparatus for practical lessons were available for use and the following responses were generated:



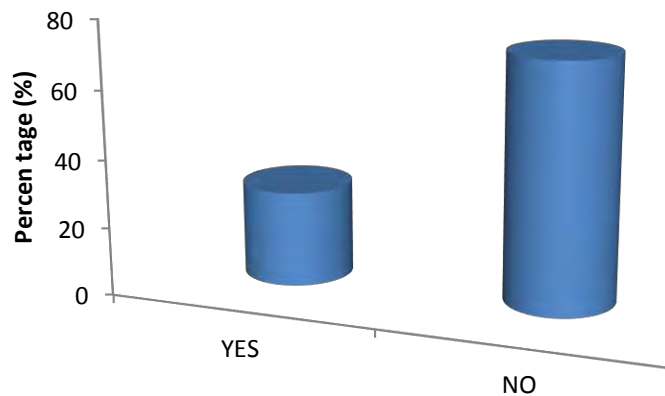
Availability of equipment

Figure 1: Views on the availability of equipment

Figure 1, indicates that whilst 42.3% of the respondents agree that the equipment in the laboratories is readily available for their use, during practical lessons, majority of the respondents, representing 57.7% disagree to this assertion.

From Figure 1, the researcher can conclude that, equipment and materials are not readily available for students to use during practical lessons in the selected schools.

Respondents' view on the availability of equipment above, elicited further enquiry to ascertain the adequacy of the science equipment for effective teaching and learning.



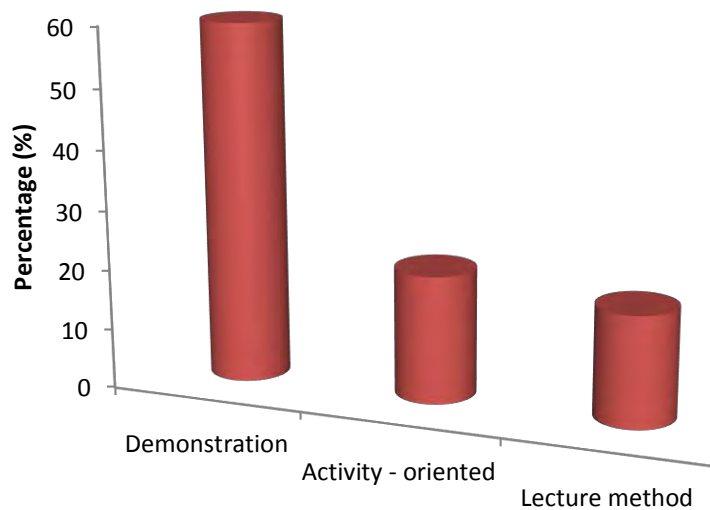
Adequacy of Science Equipment

Figure 2: Views on adequacy of Science Equipment

From Figure 2, it is evident that though the various laboratories were equipped with the necessary equipment, they are woefully inadequate for each and every student to have access for effective practical work. Majority of the respondents, representing 72.1% responded negatively to the question of whether the equipment are adequate for effective practical work, while 27.9% of the respondents were of the view that the equipment for practical work were adequate.

So it can be inferred that, it is because the equipment are not adequate that was why they were not made available for students to use in the selected schools.

Since Science practical lessons should involve the active participation of students, the researcher wanted to know the participation of the students in this learning process by soliciting for the methods used by teachers during practical work.



Method(s) used in teaching

Figure 3: Students' view on the method(s) used in teaching

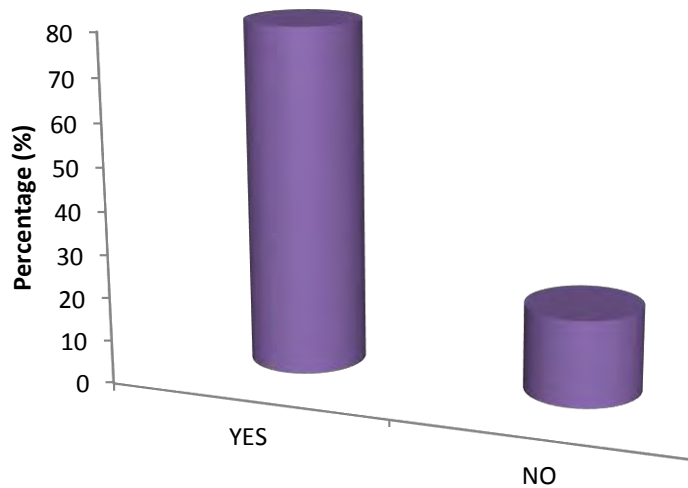
According to Figure 3, 60.0% of the respondents indicated that, they had science practical lessons through demonstration whilst 21.4% of the respondents said science practical lessons were taught through activity-oriented method and 18.6% of the respondents also indicated that practical lessons were taught through the lecture method. From the statistics, it can be concluded that students' participation in practical lessons in the selected schools is through demonstration rather than activity-oriented method which improve students understanding and retention.

Research Question 2

What are students' attitudes towards science practical lesson?

In an attempt to answer the above question, the researcher used items 27 and 28 of the student's questionnaire and items 30 and 32 of the teacher's questionnaire to generate the results shown in Figures 4 and 5 below.

The Figures 4 and 5 shows, students' regularity and punctuality to practical lessons as well as their perception of time allocated to practical lessons to promote effective teaching and learning.

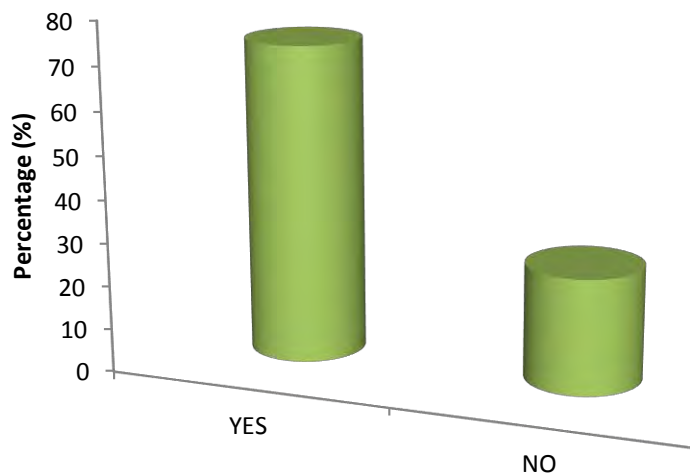


Attendance to practical session

Figure 4: Views on attendance to practical session

According to Figure 4, 80% of the respondents like attending practical sessions, only 20% of the respondents indicated that they do not like going for science practical sessions. Most of the students from the selected schools believed that, regular attendance to practical sessions would help them to analyze science problems and understand how to come up with scientific solutions.

The researcher decided to find out if the students find science practical lessons a waste of time and the following responses were generated:



Perception of science practical lessons as a waste of time

Figure 5: Views on perception of science practical lessons as a waste of time

Figure 5, depicts students' perceptions of practical lessons. Whilst majority of the respondents representing 73.3% do not perceive practical science lesson as a waste of time, 26.7% see it as a waste of time.

The researcher can conclude fairly that, most of the students have positive attitudes toward science practical lessons. Students who indicated that practical lessons were a waste of time gave some reasons. One major reason cited by these students was that their science laboratories lack almost all the necessary basic equipment for effective practical work.

Research Question 3

To what extent do these difficulties affect the performance of students?

In addressing the above question, the researcher used item 31 of student's questionnaire and items 27, 34, 35 and 36 of teacher's questionnaire as presented in figures 6, 7, and 8 below.

In these figures, students' concentration during practical lesson, students' performing practical after their colleagues had finished and students' performance in test of practical skills were dealt with.



Students' concentration during practical lessons

Figure 6: Views on students' concentration during practical lessons

The researcher wanted to find out if students concentrate during practical lessons.

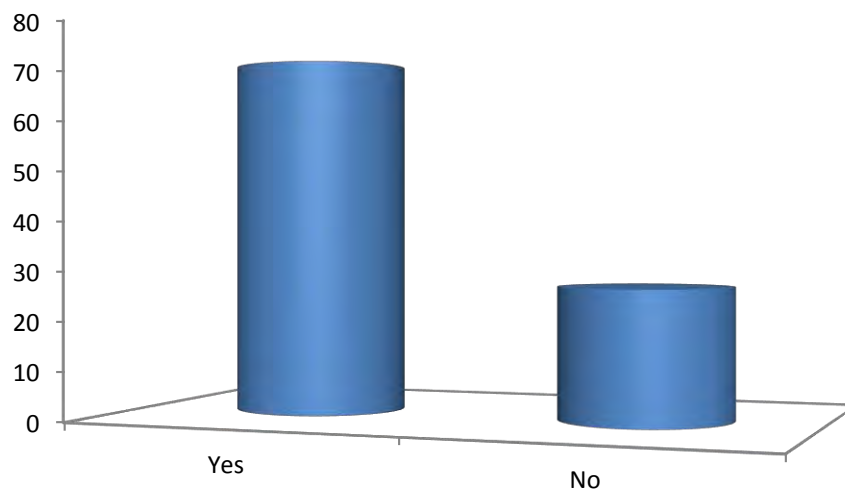
According to Figure 6, 79% of the respondents hold the view that, their concentration during practical lessons was minimal, whilst 21% of the respondents indicated that they do concentrate during practical less.

From the results generated, the researcher can conclude that, majority of the student in the selected schools lose concentration during practical lessons.

Students who indicated that they do not concentrate during practical sessions gave some reasons. One major reason cited by these students was that their science laboratories lack almost all the necessary basic equipment and so they have to take turns to perform their practical work.

As a result, they become just passive observers rather than active participants in the lesson.

Since the students' concentration is minimal during practical lessons, the researcher wanted to find out if the students' are able to perform their practical work when it comes to their turn.

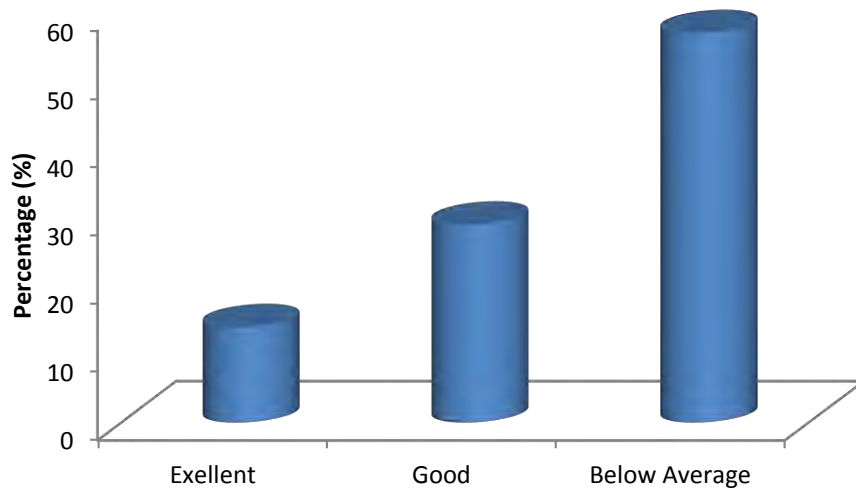


The ability of students to perform during practical sessions.

Figure 7: Views on the ability of students to perform during practical sessions

From Figure 7, 73% of the respondents indicated that, they are not able to perform their practical work, whilst 27% of the respondents hold the view that they are able to perform their practical work. It is evident from the results that some students from the selected schools were not able to perform their practical work when it comes to their turn.

The researcher wanted to find out the performance of students when it comes to test of practical skills. This was necessitated because of lack of students' participation during practical lessons.



Students' performance in test of practical skills

Figure 8: Views on students' performance in test of practical skills

According to Figure 8, 60% of the respondents indicated that, students performance during test of practical skills was below average, 40% were of the view that the performance of students were good, whilst 20% of the respondents indicated that students' performance during test of practical skills was excellent.

From the results, it is evident that, the performance of majority of the students from the selected schools is below average when it comes to test of practical skills.

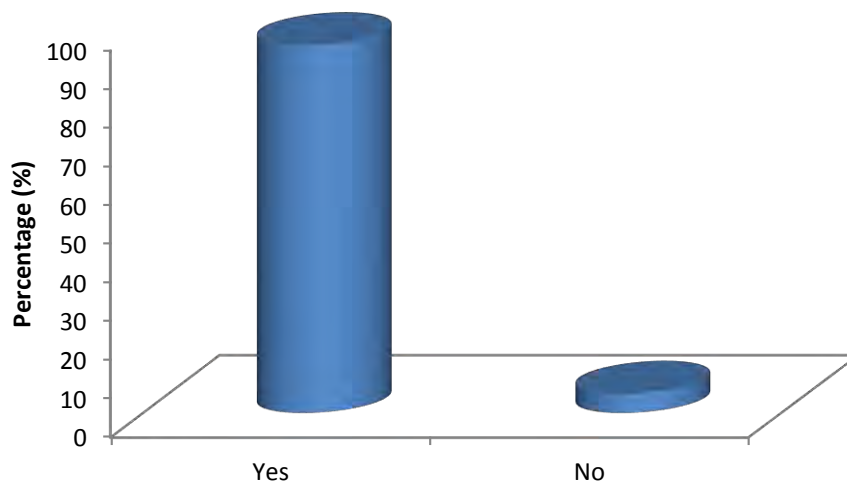
This could be attributed to students not concentrating during practical lessons coupled with students not being able to perform practical work after their colleagues had finished theirs.

Research Question 4

What are the appropriate solutions to the problems?

In an attempt to answer this question, the researcher used items 32, 33 and 34 of the student's questionnaire and 28 and 33 of teacher's questionnaire and the results generated is presented in Figures 10 -12 below.

In these figures, allotting enough time to practical lessons, provision of more science equipment and reducing the number of students' per practical lesson were dealt with.

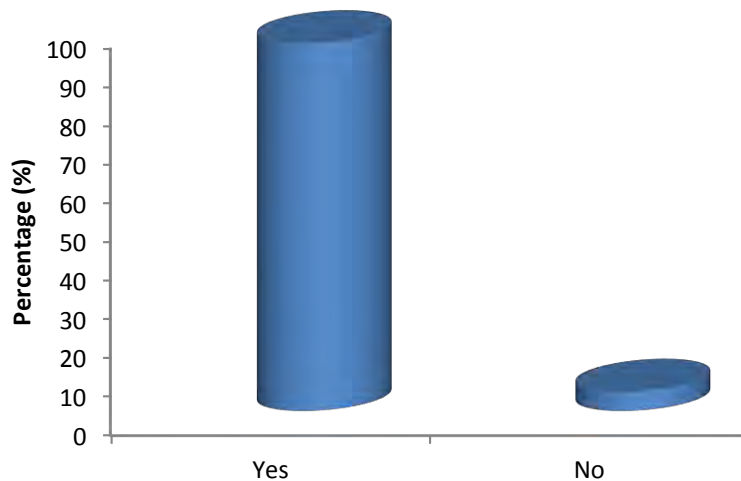


Allotting enough time for practical session

Figure 9: Views on allotting more time to practical work.

From figure 9, 95% of the respondents are of the view that more time needs to be allotted to practical lessons to help improve students' performance, whilst 5% of the respondents hold a different opinion.

From the statistics, it is evident that more time should be given to practical sessions, since that will give the students enough time for more hands –on activities which student from the selected schools do not have enough time for.



Provision of more science equipment

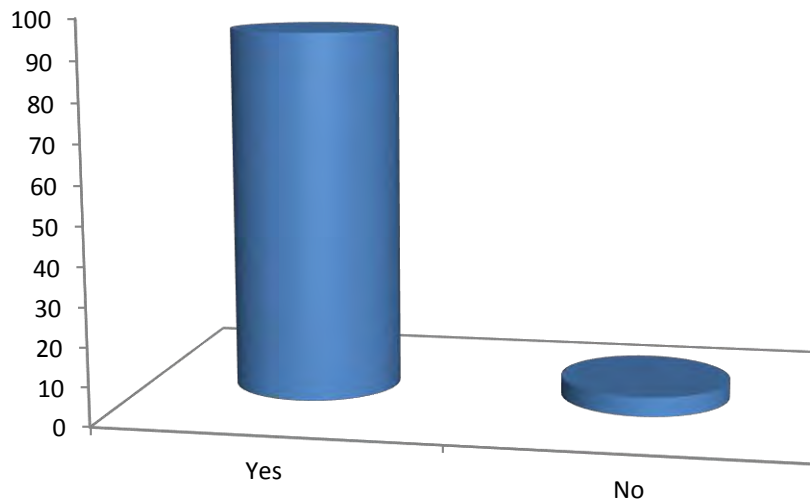
Figure 10: Views on provision of science equipment.

Practical lessons are carried out with the help of apparatus. The researcher sought to find out if provision of more science apparatus could help improve upon students' performance.

From Figure 10, 95% of the respondents are of the view that, their laboratories should be equipped with more modern equipment and materials whilst 5% of the respondents do not agree to this assertion.

The researcher can conclude that, laboratories in the selected schools should be equipped with the requisite equipment and materials in order to make them available for the students to use.

The researcher again wanted to find out if reduction in class size will help improve students' performance.



Reducing number of students per class session

Figure 11: Views on reduction in class size per class session

According to Figure 11, 95% of the respondents indicated that, reduction in class size will help to improve upon the difficulties large class size pose to practical lessons, whilst 5% of the respondents think otherwise.

From the results generated, the researcher can conclude that reduction in class size per practical lesson will in no doubt improve upon the effective monitoring of the teaching and learning of science in the selected schools.

CHAPTER FIVE

DISCUSSIONS, SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

Overview

This chapter discussed the findings of the study in relation to the statement of the problem and the literature review. Recommendations and suggestions were also offered to improve upon the effective organization of science practical lessons at the Senior High School level.

Discussion

The research findings showed that both tutors and students from the selected Senior High Schools consider practical lessons as one of the effective means of teaching and learning of science. However, there were some challenges associated with the organization of science practical lessons.

It was observed that, time allotted to practical lessons varied from one school to another and was seen as one of the challenges facing the organization of science practical lessons.

Whilst some of the schools had more time for practical lessons other do not. Observation also showed that the time allocated for practical lessons is inadequate to enable the teachers organize effective practical lessons. As a result of these practical lessons become ineffective and hence profited the students less than was intended.

This observation is in line with that of Kraft (1994). In his submission, Kraft indicated

that Ghanaian school children spent less time in learning in school and that the learning time was less by two or three hours every day.

This reduction in time allocated for the subject will certainly cause most of the teachers to overlook important aspects of the science subject and this in the long run, will affect the students' performance.

Also some teachers seemed to ignore the practical aspect of science teaching owing to non-availability of the basic equipment, inadequately equipped science laboratory coupled with their perception that the science syllabus was broad; a perception which in the opinion of the researcher actually influence how these teachers taught the subject. This behaviour on the part of teachers with regard to the approach use in the teaching of science does not give room for students to develop their creative abilities as opined by Adepaju (1991). Young (1990), emphasized that teachers in science education, should guide the students to fish out for information on their own through activities rather than feeding them with information. He explained that when students are involved in most of the activities during lessons not only do they learn to be inquisitive and creative but they also acquire knowledge more meaningfully. Practical lessons should therefore be used by teachers to help their students achieve better results in science.

One other major finding from the study was that most schools have science laboratories, but these laboratories were in most cases used for theory lessons rather than practical lessons. This is because such laboratories were ill-equipped with materials and equipment necessary for practical lessons. According to Ogunyemi (1990), when materials are provided to meet the needs of a school system, students will not only have access to reference materials but the individual students will learn at their own pace to increase their academic performance.

Again, another finding from the study was that large class size per practical lesson hinders effective teaching and learning of science, since most of the schools, though, had laboratories for science practical lessons, they were not well-equipped and so students did not have access to adequate materials for hands-on activities.

This situation therefore prevented students' from engaging in self-initiated explorations.

The large numbers of students in most of the science classes coupled with inadequacy of equipment and materials, did not promote effective teaching and learning during science practical lessons.

Again, it was observed that some of the schools did not have good laboratories for practical work in science. Also, there were only few laboratory assistants in some of the schools. In most of the schools where even there were laboratory assistants, students were not allowed to practice or manipulate equipment in the laboratory at their free times. Some of the reasons cited by the authorities for not allowing the students to practice and manipulate equipment in the absence of the teachers and the laboratory technicians/assistants were that students might either steal some of the materials, misuse or damage them.

Consequently, the students were not able to do further explorations during practical lessons. Lack of materials and equipment as well as non-accessibility to practical equipment during students' free time therefore were part of the problems identified. Students learn faster when they are allowed to interact with materials and equipment during their free time with their peers. These situations therefore prevented students from engaging in self-initiated explorations.

From the study, it came to light that most teachers organize science practical lessons through demonstration rather than activity-oriented strategy to enhance students understanding, retention and experience. Von Secker and Lissitz (1999) are of the opinion that “Teacher-centered instructions are negatively associated with achievement. On the other hand, mean science achievement is expected to increase with the amount of emphasis on laboratory inquiry” (p.1194). The authors concluded that de-emphasizing traditional, teacher-centered instruction is expected to increase average science achievement and minimize gaps in achievement between individuals of different socio-economic status.

Once more, it was also noted that most students generally had positive attitude towards practical work in science. Students who even indicated that they have negative attitudes towards the subject in question said, their poor attitudes were developed as a result of the frustrations they had to endure due to the non-availability or inadequacy of appropriate equipment, materials and specimen in their science laboratories.

There were host of problems that confronted both the teachers and students in the course of having practical lessons in science. Some of the identified problems include; lack of proper laboratory, lack of laboratory assistant or technician, lack / inadequacy of practical equipment and materials, large class size, insufficient time for practical work, non- availability of some specimen in the locality; lack of funds, and malfunctioning of equipment and expired chemicals.

Respondents also mentioned some of the things that could be done to address the identified problems. These includes; provision of more/ necessary equipment and materials by stakeholders, recruitment of well-educated lab technicians / assistants, adjustment in time allocated for practical work, provision of proper and well-equipped

laboratory, making class size more manageable and refurbishing the existing science resource centres.

Summary of the Main Findings of the Study

From the analysis, the following were the major findings:

1. Both students and teachers in the selected schools that is, St. Mary's Boys' SHS, Archbishop Porter Girls' SHS, Bompeh SHS, Takoradi SHS and Baidoo Bonsoe SHS in Sekondi-Takoradi Metropolis consider the activity methods as the most effective method of teaching and learning science.
2. Though most of the selected Senior High Schools in the Sekondi-Takoradi Metropolis had laboratories, many of such laboratories are inadequately equipped.
3. Time allocated for practical lessons was woefully inadequate or insufficient in most of the selected schools in the Sekondi-Takoradi Metropolis.
4. Few teaching and learning materials available were used in groups in the selected schools in the Sekondi-Takoradi Metropolis.
5. There were no laboratory assistants/technicians in most of the selected schools in the Sekondi-Takoradi Metropolis.
6. Most students from the selected schools in the Sekondi-Takoradi Metropolis were also found to possess positive attitudes toward practical work in science. This was confirmed by their teachers.
7. Most of the selected schools in the Sekondi-Takoradi Metropolis were found to have too large class sizes.
8. Some of the heads of the selected school in the Sekondi-Takoradi Metropolis perceived the provision of materials and equipment as waste of money, and

did not take science practical lessons serious because it involved money.

From the survey findings the respondents proposed the following solutions which if adopted by Ministry of Education and Ministry of Environment Science And Technology will help promote effective teaching of science practical lessons in the Sekondi-Takoradi Metropolis and the Nation as a whole.

1. Provision of adequate science equipment and apparatus.
2. Resourcing and refurbishing of existing Science laboratories
3. Regular provision of in-service training for science teachers, Lab technicians and assistants.
4. Increase practical lesson times for students, at least Thrice a week
5. Reduction of class size for effective monitoring.

These measures if effectively put in place will enhance the organization of science practical lessons.

Conclusions

From the findings, it can be concluded that the most effective method of teaching and learning of science is through practical work as students learn better by doing.

It could be inferred from the study that, the inadequate supply of equipment and materials by the stakeholders in education to meet the standard required by West African Examination Council (WAEC) has had adverse effects on the organization of science practical activities in the surveyed schools.

The inadequate time allotted to practical lessons in most schools, did not promote frequent use of practical activity in science lessons. Teachers are, however, expected to do more to stimulate and sustain students' interest in science practical lessons. For

them to be able to whip up the interest of students in this direction there is the need to adjust the time slots to favour more practical work.

It also appears that most schools authorities did not have interest in the provision of science materials and equipment. The excuse they gave was that there were no funds for such purchases. According to the respondents, school authorities only procure science materials during WAEC designated examinations, a situation which is not helping both teachers and students at all.

Also, the large sizes of science classes in most of the selected schools visited had been a major drawback towards the effective use of practical activities in the teaching and learning of science. This therefore has become a major cause for concern, which must seriously be looked at by all the heads of the selected Senior High Schools. Much success could be attained, if such, large classes are split into more manageable units.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

1. Teachers from the selected schools in the Sekondi-Takoradi Metropolis should make conscious efforts to organize more practical work in science irrespective of the fact that there are inadequate supply of science equipment and materials.
2. A point worth considering is the time slot for science on the school time table and that the Curriculum developers, Educational Directors and headmasters in Senior High Schools should adjust or extend the time allocated for the sciences, so that teachers will have enough time for practical lessons with their students.

3. Headmasters and educational authorities should provide adequate and relevant teaching and learning materials in the science laboratories for tutors and students to use during practical lessons.
4. Schools with inadequate materials for teaching and learning science are advised to make good use of the various science resource centres nearby for practical activities.
5. Headmasters and Headmistresses should try as much as possible to motivate their tutors and students intermittently to reinforce their interest in practical work.
6. School authorities should as much as possible, recruit well-educated laboratory technicians and assistants to enhance the practical work of teachers and students in science at the senior high school level.
7. Teachers should introduce field trips and excursions as part of their science teaching and learning programmes.
8. Directors and other stakeholders in education, National Association of Graduate Teachers (NAGRAT), Ghana National Association Of Teachers (GNAT), Ghana Association of Science Teachers (GAST) and GES should continue to organize frequent in -service professional training workshops and course for science teachers to up-grade and up-date their knowledge in the organization of practical lessons.
9. Science teachers should be given incentives such as risk allowances, and regular provision of funds for the purchase of essential materials without going through the usual bureaucratic process of applying for funds for such purposes.
10. School authorities should as a matter of urgency split large science classes into

more manageable units for teachers to have a more effective and meaningful practical lessons. This calls for the training and recruitment of more teachers; no matter the cost involved.

Suggestions for Further Studies

Since society continues to be dynamic with continuous changes in societal needs, there is always the need for further research to be conducted into many aspects of education at all levels to meet the aspirations of society. It is therefore recommended that:

1. More studies are conducted to find out the influence of teacher qualification and area of specialization on practical activity in science.
2. Researchers should find out whether the formation of science clubs in the various schools could help improve the teaching and learning of science or not.
3. A study should be conducted to find out whether gender has any influence on the teaching and learning of science at the senior high level.
4. More work need to be done to find out whether student and teacher motivation could have influence on the teaching and learning of science at the Senior High Level.

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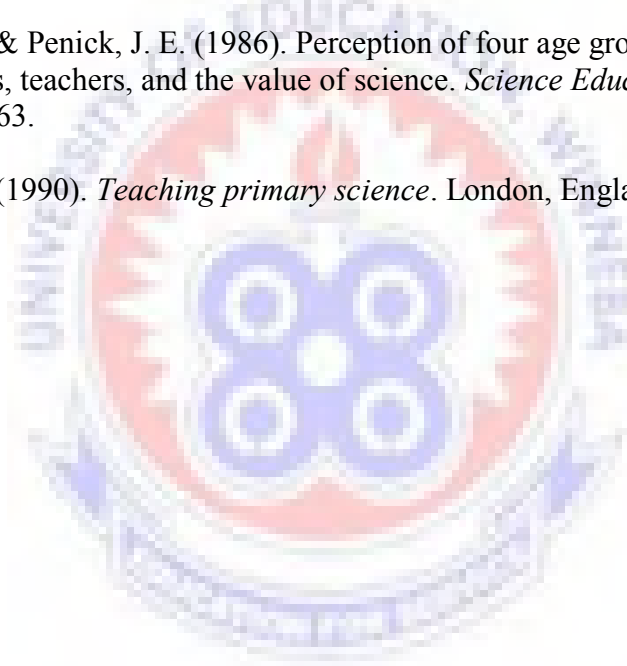
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APPENDIX A

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

QUESTIONNAIRE FOR STUDENTS

Dear Respondent,

This questionnaire is designed purposely to seek information purely meant for academic purpose. May you kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your views on each of the issues raised. Every piece of information you give will highly be accorded the needed confidentiality.

General Instruction

Please indicate your choice by ticking [] in the box to indicate the answer provided.

You are also requested to fill in the blank spaces provided for some of the items.

1. Do you have separate laboratories for Biology, Physics and Chemistry practical work in your school?
(a) Yes [] (b) No []
2. (i). If yes, is the laboratory for Biology practical the same for all the elective sciences?
(a) Yes [] (b) No []
3. (ii). If No, then where do you normally have practical lessons?
(a) Classroom [] (b) Under a tree []
(c) In the open [] (d) Not at all []

4. How often are practical lessons organized in your school laboratory?
(a) Not at all [] (b) Frequent [] (c) Quite frequent []
(d) Very frequent [] (e) Not frequent []
5. Who normally organizes such practical lessons?
(a) The science teacher [] (b) Lab. Technician []
(c) Lab Assistant [] (d) Class Prefect []
6. How many times in a week do you have Chemistry practical lessons?
(a) Once a week [] (b) Twice a week []
(c) Sometimes [] (d) Specify others (if any).....
7. How many times in a week do you have Physics practical lessons?
(a) Once a week [] (b) Twice a week []
(c) Sometimes [] (d) Specify others (if any).....
8. How many times in a week do you have Biology practical lessons?
(a) Once a week [] (b) Twice a week []
(c) Sometimes [] (d) Specify others (if any).....
9. How many times in a week do you have Integrated Science practical lessons?
(a) Once a week [] (b) Twice a week []
(c) Sometimes [] (d) Specify others (if any).....
10. How many period(s) do you have for practical work within a week?
(a) One [] (b) Two [] (c) Three []
(d) Four [] (e) Not at all [] (f) Specify others (if any) []
11. How do you perceive the time allocated for practical lessons in your school??
(a) Not sufficient [] (b) Sufficient []
(c) Quite sufficient [] (d) Very sufficient []

12. How many are you in class? Provide your answer in the space provided below.
.....
13. Does the number of students in your class promote effective teaching and learning during practical lessons?
(a) Yes [] (b) No []
14. In a short sentence give a reason for your answer
.....
.....
15. Is your laboratory equipped with materials necessary for WAEC designated SHS practical work?
(a) Yes [] (b) No []
16. If yes, how well is it equipped?
(a) Very adequate [] (b) Adequate [] (c) Inadequate []
17. Are the equipment and facilities in the laboratory appropriate for practical work?
(a) Yes [] (b) No []
18. Are the equipment and apparatus enough to go round all students during practical lessons?
(a) Yes [] (b) No []
19. If No then, what do you normally do in such situations?
.....
.....
20. How are the available teaching materials used during practical lessons?
(a) Individually [] (b) In Groups [] (c) Whole class demonstration []

21. Do your teachers allow you to practice on your own in the laboratory?
(a) Yes [] (b) No []
22. Do you have a laboratory assistant or technician to assist you during practical lessons?
(a) Yes [] (b) No []
23. Are your teachers always present when having practical lessons?
(a) Yes [] (b) No []
24. If No, what do you do when you are in difficulty?
.....
.....
25. Which method(s) of teaching has/have your teacher(s) been using during practical lessons?
(a) Activity-oriented [] (b) Lecture []
(c) Demonstration [] (d) Specify others if any).....
26. Which of the method(s) would you consider effective for the teaching and learning of science?
(a) Activity-oriented [] (b) Lecture []
(c) Demonstration [] (d) Specify Others (if any).....
27. (i). Do you like going to the laboratory for practical lessons?
(a) Yes [] (b) No []
(ii) Give reason(s) for your answer.....
.....
28. (i). Do you perceive that practical work is a waste of time?
(a) Yes [] (b) No []

(ii). Give reason(s) for your answer in 28(i) above.....

.....
.....

29. Are there other facilities and equipment that you feel should be added to what already exist?

(a) Yes [] (b) No []

30. If your answer to (29) is yes, what is/are its/their name(s)?

Specify.....
.....

31. Every human endeavor is bound to meet problems. What problems do you often encounter during practical lessons? Specify such problems in the space provided below.....

32. Do you think allotting enough time for practical sessions will improve upon students' performance.?

(a) Yes [] (b) No []

33. Do you think provision of more science apparatus will curb the inadequacy of equipment for practical lessons?

(a) Yes [] (b) No []

34. Would reduction in class size promote effective practical work?

(a) Yes [] (b) No []

APPENDIX B

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTMENT OF SCIENCE EDUCATION

QUESTIONNAIRE FOR TEACHERS

Dear Respondent,

This study is purely meant for academic purposes. You will be contributing to its success if you answer the items as frankly and honestly as possible. Your responses will be kept confidential. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issues raised.

General Instruction

Please tick [✓] the appropriate bracket or column or fill in the blank spaces provided where applicable.

1. Do you have laboratories in your school for practical work?
(a) Yes [] (b) No []
2. (i). If Yes to (1), is the laboratory the same for all the /elective sciences?
(a) Yes [] (b) No []
(ii). If No to (1) above, where do you normally have your practical lessons?
(a) Classroom [] (b) Under a tree []
(c) In the open [] (d) Not at all []
3. How often are practical lessons for physics, chemistry and biology conducted in yourschool laboratories?
(a) Once a week [] (b) Twice a week []
(c) Thrice a week [] (d) Sometimes []
(e) Not at all [] (f) Specify others (if any).....

4. Who normally organizes such practical lessons? The.....
- (a) The science teacher [] (b) Lab. Technician []
- (c) Lab. Assistant [] (d) Class prefect []
5. Is your school laboratory equipped with materials necessary for WASSCE practical work?
- (a) Yes [] (b) No []
6. If Yes to (5) above how is it equipped?
- (a) Very adequate [] (b) Adequate [] (c) Inadequate []
7. Are these materials enough for effective teaching and learning during practical lessons?
- (a) Yes [] (b) No []
8. Are the equipment and apparatus adequate to go round all students during practical work?
- (a) Yes [] (b) No []
9. If you say No to items 8 above, then what do you normally do in such situations?
-
-
10. How are the available teaching materials used during practical lessons?
- (a) Individually [] (b) In Groups []
- (c) Whole class demonstration []
11. Do you think there are other important equipment and facilities that should have been provided but are not available in the laboratory?
- (a) Yes [] (b) No []

12. If Yes to item (11) above, please list them.....
.....
13. How often does the school authority provide/supply the laboratory with materials?
(a) Very frequent [] (b) Frequent [] (c) Quite frequent []
(d) Not frequent [] (e) Not at all []
14. Do the school authorities perceive the provision of equipment and materials as waste of fund and resources?
(a) Yes [] (b) No []
15. What makes you think so? Give reason(s).....
.....
16. How many period(s) is /are allocated for practical work in your school per class?
SHS 1 0 [] 1 [] 2 [] 3 [] 4 []
SHS 2 0 [] 1 [] 2 [] 3 [] 4 []
SHS 3 0 [] 1 [] 2 [] 3 [] 4 []
17. How do you perceive the time allocated for practical lessons in your school?
(a) Not sufficient [] (b) Sufficient []
(c) Quite sufficient [] (d) Very sufficient []
18. How many students do you have in a class? Provide your answer in the space provided.
19. Does the number of students in your class promote effective teaching and learning during practical lessons?
(a) Yes [] (b) No []

20. In a short sentence give a reason for your answer to (19) above.
.....
.....
21. Do you have laboratory assistant(s)/technician(s) in your school to assist you during practical lessons?
(a) Yes [] (b) No []
22. If Yes to (21) is the laboratory technician or assistant for all the elective sciences?
(a) Yes [] (b) No []
23. What type of practical work do you often perform in your school laboratory? You can tick as many as possible.
(a). Drawing [] (b). Identification and classification []
(c) Food tests [] (d) Analysis/ interpretation []
(e) Specify other (if any).....
24. Which method(s) of teaching have you been using during practical lessons? Tick as many as you've been using.
(a) Activity -oriented [] (b) Lecture []
(c) Demonstration [] (d) Specify other (if any).....
25. Which of the following skills do you often teach during practical lessons? Tick as many as you have been instilling in your students. Skills of
(a) Drawing [] (b) Observing [] (c) Analyzing []
(d) Interpreting [] (e) Recording [] (f) Inquiring []
(g) Manipulating [] (h) Specify others (if any).....

26. Which of the method(s) would you consider effective for the teaching and learning of biology?
(a) Activity-oriented [] (b) Lecture [] (c) Demonstration []
(d) Specify other (if any).....
27. Every human endeavour is bound to meet problems. What problems do you often encounter during biology practical lessons? Specify such problems in the space provided below.....
.....
28. How do you think such problems could be solved to improve upon the learning and teaching of science in the senior high school?
.....
.....
.....
.....
29. Do you think organizing practical lessons are difficult and a mere waste of time?
(a) Yes [] (b) No []
30. Do students punctually and regularly attend practical lessons?
(a) Yes [] (b) No []
31. Would reduction in class size promote effective practical work?
(a) Yes [] (b) No []
32. Do students' see practical lessons as a waste of time?
(a) Yes [] (b) No []

33. Do you think allotting enough time for practical sessions will improve student's performance?
- (a) Yes [] (b) No []
34. Does class size enable students to concentrate during practical lessons?
- (a) Yes [] (b) No []
35. Are students able to perform their practical after their colleagues had finished their work?
- (a) Yes [] (b) No []
36. How do students perform during test of practical skills?
- (a) Excellent [] (b) Good [] (c) Below Average []

