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A COMPARATIVE STUDY OF BIOLOGY PRACTICAL LESSONS IN SELECTED WELL-ENDOWED AND LESS-ENDOWED SENIOR HIGH SCHOOLS IN GHANA

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Abstract:
The teaching and learning of biology in the Senior High Schools 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 and compare how biology practical lessons were conducted in some well-endowed and less-endowed Senior High Schools in Ghana. The main instruments used for gathering the data for the study were questionnaires, document analysis and informal observation of some biology lessons. This enabled the Researchers to capture as closely as possible, the real picture of what happened during the observed lessons. The sampled population for the study consisted of 408 students and 24 biology teachers from twelve selected Senior High Schools in the Eastern and Central Regions of Ghana. Data collected were analyzed using frequency counts and percentages. The research findings showed that the time allotted to practical lessons in biology varied from one school to another, as 35.8% of students from well-endowed schools complained of insufficiency of time as against 78.9% of students from less-endowed schools. The study also found that the teaching strategies employed in the two categories of Senior High Schools were not different. However, students from the selected well-endowed schools tend to have a greater advantage than their counterparts from the less-endowed schools, as they were exposed to less lecture method 7.4% compared to 27.9% from the low-endowment schools**.** To ensure efficiency in the teaching of the practical aspect of biology in the Senior High Schools, the study recommends that the government and all other stakeholders in education must supply laboratories in all Senior High Schools with the necessary equipment, materials and chemicals to enable students to develop the necessary skills, attitudes, and interest in science.

Keywords: well-endowed, less-endowed, practical, equipment, laboratory

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1. Introduction

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 best for acquiring scientific skills. The "hands-on" approach has the potential to stimulate students' interests in the subject matter, teach laboratory skills, enhance the acquisition of knowledge, and give insight into the scientific attitudes and skills development. According to Freedman (1997), the motivation to learn biology does not only depend on the interests that the students bring to school. It can also be the result of certain learning situations, among which we find laboratory work.

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. To achieve this goal, all Senior High Schools have to be provided with laboratories well-stocked with adequate equipment and apparatus. Unfortunately, however, a close observation made about some Senior High Schools in Ghana, revealed that such schools do not have science laboratories. Even those having laboratories for science teaching, such laboratories were ill-equipped (Angell, Guttersrud, Henriksen & Isnes, 2004; Schreiner, & Sjoberg, 2004). Other series of observations made about some Senior High Schools also revealed that the approach currently being used to teach biology is most often based on classroom and laboratory work which are intended only to meet examination requirements.

Meanwhile, practical work as known is an essential component of studying the natural sciences. The "hand- 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 certain critical and disciplined attitudes. It is also done to develop specific manipulative skills and to elucidate theoretical work as an aid to comprehension (Beatty & Woolnough, 1982; Ghana Government, 2006). All these benefits are lost if biology lessons follow literary approaches only.

Though practical lessons are to be used by teachers to help their students to achieve better results in biology, it was sad to find that in most of the schools, the biology 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 (McCombs, 1996; Serwaa, 2007). Although some studies have been conducted in the 80's and 90's to investigate the issue in the study area, still there seemed to be a growing concern about the lack/deficiency in biology practical lessons in some Senior High Schools.

In spite of the numerous policy provisions and other efforts by the Government of Ghana to lay emphasis on science education as the engine for growth and

development of the country, its advancement has not been up to expectation (Anamuah-Mensah, 1995; Banahene, 2008).

The teaching and learning of biology as a branch of science have standards to be followed by teachers if effective learning by students is to be achieved. One very important aspect of biology teaching is its practical lessons. Literature in this area appears very scanty and as a result, our knowledge of what biology teachers do in the classrooms or laboratories is very limited. Literature in this area also indicates that only few research efforts were directed at comparing the standard of biology practical teaching in well-endowed Senior High Schools with standards in less-endowed Senior High Schools. This therefore calls for more research efforts directed towards this very important aspect of science teaching. It is for these reasons that this study investigated and compared how biology practical activities are done in some selected well-endowed and less-endowed Senior High Schools in Ghana.

The purpose of the study was to find out and compare the various strategies employed by both teachers and students from the selected well-endowed and less-endowed Senior High Schools in teaching and learning during practical lessons in biology.

In line with the purpose, the following research questions guided the study:

a. Determine the difference in the time allocated for biology practical work in the selected well-endowed and less-endowed Senior High Schools.
b. Examine the strategies employed by teachers and students from the selected well-endowed Senior High Schools during biology practical lessons and their counterparts in the selected less-endowed Senior High Schools.

2. Review of Related Literature

2.1 Teaching and Learning

The biology curriculum has an in-built flexibility to cater for the interests, 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, such as investigations, discussions, demonstrations, practical work, projects, field studies, model-making, case-studies, oral reports, assignments, debates, information search and role-play. Practical work and investigations are essential components of the biology curriculum. They enable students to gain personal experience of biological 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.

The process skills or approaches 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, hypothesis testing, identifying and controlling variables,

interpreting data and constructing instruments (Agboala, 2011). According to him all these processes can be achieved through group work during practical activities.

In application and connections domain, Adedapo (2010) observed that science is related to everything, especially subjects such as mathematics, social sciences, vocational subjects and the humanities. Practical work done by students during biology lessons enables them to develop scientific concepts in everyday life experiences and to apply learned biology concepts and skills to everyday social problems. Not only that, practical work also enables students to understand scientific and technological principles involved in household technological devices and to evaluate the mass media report of scientific development.

2.2 Overview of Examination Reports on Biology in Ghana

Biology among the sciences have been given a special recognition by most educators not only because of its educational values, but also its close relation to humans as living organisms, the peculiar field of experimentations and interrelationship with other career sciences. It is found to be the leading way to professions such as Medicine, Pharmacy, Agriculture, Dentistry and many others.

In Ghana, it is a common knowledge that biology as a subject usually has a relatively higher number of students' enrolment than chemistry and physics in recent years in the Senior High Schools. However, these high numbers do not match with students' achievement in biology. There is also enough evidence that most students fail in biology because they do not perform well in paper 2, which is a practical paper. This paper tests skills in drawing, identification and classification, analysis of some processes and interpretation of biological data.

For instance, the West African Examinations Council (WAEC) Chief Examiners over the years (2010 - 2015) have been identifying some weaknesses on the part of biology students, some of which include the following:

a. Candidates' answers show that they have not been taken through adequate practical lessons.
b. Students' answers indicate that they have not done any practical along the lines of the tested questions.
c. Candidates wrote unobservable features. Thus, they answered the practical questions from the theory they have learnt.
d. Standard of students' drawing were poor which indicates they do not practice biological drawing as required by practical examination.

This seems to give the impression that, students were either not taken through enough practical work or were not serious with the practical work. Biology is a unique discipline where experiments with living organisms do take place both in the laboratory and in the field. However, increasing use of virtual environments instead of practical investigations in biology has recently been documented (Partridge, 2003; Tranter, 2004). Biology is one of the elective subjects in the Key Learning Areas (KLA) of Science Education. Its curriculum provides a range of balanced learning experiences through which students are expected to develop the necessary scientific skills and processes,

values and attitudes as well as knowledge and understanding embedded in the 'Life and Living' strand and other strands of science education for personal development and for contributing towards building a scientific and technological world.

2.3 Methods Used in Teaching Biology

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

Such strategies include co-operative learning/instructional strategies (activity-based) which have been found to improve biology learning outcomes (Okebukonla, 1984; Iroegbu, 1998; Slavin, 1990). The benefits of Cooperative Learning for science students are well documented (National Institute for Science Education- College Level One, 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).

3. Methodology

3.1 Research Design

The research design that is used in the study is a descriptive sample survey. It describes what existed with respect to how biology practical work is done in Senior High Schools. The descriptive sample survey has 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 behaviour of the population. Since, it is the purpose of the research to survey and compare how biology practical work is conducted in the two types of Senior High Schools in the Eastern and Central Regions of Ghana, the descriptive sample survey is considered.

3.2 Population

The targeted population consisted of all science teachers and students in 12 selected Senior High Schools in the Eastern and Central Regions of Ghana. The accessible population however comprised all biology teachers and students in the selected schools. In all, four hundred and thirty-two individuals comprising 408 students and 24 teachers were used.

3.3 Sample and Sampling Technique

A sample size of 408 students and 24 teachers were selected from the 12 Senior High Schools. The selection as regards the number of students and teachers in each of the senior high schools was done equally irrespective of the students' and teachers' population in each of the selected Senior High Schools, since the study is a comparative

one. In this, 34 students were selected from each of the Senior High Schools in question while two (2) biology teachers were selected from each of the schools selected.

The selected schools were put into two categories; six well-endowed schools (schools with better and adequate infrastructure and equipment) and six less-endowed schools (schools deficient in the basic infrastructure and equipment). In the sampling of the schools, numbers were counted from a list of schools at sample intervals using a table of random numbers. The students and teachers were also selected through the use of a table of random numbers.

3.4 Instrumentation

The major instruments used in the study to gather views, opinions and suggestions were informal observation of some biology practical lessons, document analysis and questionnaires.

In agreement with Barnes (1985), the Researcher undertook unscheduled observations of some biology 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, a free-form procedure of recording data is 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 curriculum and materials such as text books and syllabuses. Other documents used were the West Africa Examination Council (WAEC) Chief Examiners' Reports from 2010 to 2015.

Two types of questionnaires were designed; one for the teachers and the other for the students. Both sets of questionnaires were designed in such a way that they contained open-ended and close-ended type of questions.

3.5 Validity

According to Joppe (2000), validity determines whether the research instrument truly measures that which it was intended to measure. To ensure the validity of the questionnaire it was given to the expertise of some Senior Science Education and English Education lecturers from the departments of Science Education and English Education respectively, of the University of Education, Winneba was also drawn on to validate the questionnaires and to ascertain the content and face validity of the items.

3.6 Pilot-test

A pilot test of the instrument was carried out with forty (40) students offering elective biology in Mpraeso Senior High School in the Eastern Region of Ghana. These students used for the pilot test did not form part of the sample for the study. The school was selected because it shares similar characteristics with Senior High Schools in the selected Regions. The pilot study enabled the researcher to restructure the questionnaire to help elicit the right responses.

3.7 Reliability

The reliability of the students' questionnaire was determined using the split half method. The two sets 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 reliability which according to Bryman and Cramer (2001) is acceptable at 0.8.

3.8 Data Collection Procedure

The questionnaire was administrated by the researchers personally. After the questionnaire was issued out to the respondents, a time frame or interval of one week was allowed so that respondents could respond to them not only as appropriate as possible but also at their own convenience. The Researchers also had the opportunity to observe some biology practical lessons in each of the selected senior high schools.

3.9 Method of Data Analysis

Coding schemes were developed to organize the data into meaningful and manageable categories. This involved the data obtained from the questionnaires, document analysis and informal observations. The categorized data were later converted into frequency counts and simple percentages and used to answer the research questions addressed in the study. This was done, using Statistical Package for Social Sciences (SPSS) version 22.0.

4. Results

The questionnaires were aimed at finding out how frequent practical work was organised during the teaching and learning of biology. The questions for the students were designed based on their perception on how often practical work is organized, time allocated, and the availability of teaching and learning materials for the subject.

4.1 Research Question 1: Is there any difference in the time allocated for biology practical work in the selected well-endowed and less-endowed senior high schools and if so, to what extent did this affect practical work?

In an attempt to answer the above question, the responses of students from the two categories of schools were codified as categories A and B; with the A1-A6 and B1-B6 representing the six well-endowed and six less-endowed schools respectively. The responses from the participants are presented in Tables 1.

4.1.1 Time allocated for biology practical work

Table 1: Number of Times Teachers had Practical Lessons in Biology per Week

Category A Schools (Students)	Number of times per week			Category B Schools (Students)	Number of times per week		
	Once	Twice	Some-times		Once	Twice	Sometimes
A1	0	34	0	B1	0	0	34
A2	34	0	0	B2	0	0	34
A3	34	0	0	B3	34	0	0
A4	0	34	0	B4	0	34	0
A5	0	34	0	B5	0	34	0
A6	0	34	0	B6	0	0	34
Total	68	136	0	Total	34	68	102
Percentage	33.3	66.7	0	Percentage	16.7	33.3	50

Source: Field Survey, 2017

A1- A6 = well-endowed schools B1-B6 = less-endowed schools

As indicated in Table 1, in terms of having practical work "once a week", it was 33.3% representing (68 students-2 schools) of the students from well-endowed schools as against 16.7% representing (34 students-1 school) for students from the less-endowed schools.

Having practical work "twice a week" was still weighed in favour of the students from well-endowed schools, who had 66.7%, representing (136 students-4 schools) as against 33.3%, representing (68 students-2 schools) for students from less-endowed schools.

The uncertainty of "sometimes" having practical work this time was in favour of students from less-endowed schools, as the percentage was 50, representing (102 students-3 schools) as against none for respondents from well-endowed schools.

On the question of the extent to which time allotted to biology lessons in the two categories of senior high schools affected practical work, responses from the respondents in line with this were coded as the following as depicted in Table 2: Not sufficient; Sufficient; Quite sufficient and Very sufficient.

Table 2: Students' Responses on Sufficiency of Time Allocated for Biology Practical work

Quantum of time	Students in Well-Endowed Schools		Students in Less-Endowed Schools	
	Frequency	Percentage %	Frequency	Percentage %
Not sufficient	73	35.8	161	78,9
Sufficient	70	34	25	12.3
Quite sufficient	50	245	13	6.4
Very sufficient	11	5.4	5	2.5

Source: Field Survey, 2017

The results from Table 2, shows that 35.8% of students from well-endowed schools indicated that the time slot for practical work in biology was "not sufficient" and this was strongly confirmed by 78.9% of their counterpart from less-endowed schools. In terms of the time being "sufficient", 34.3% of students from well-endowed schools in

their opinion responded in the affirmative as against 12.3% of those from less-endowed schools.

The responses of students from well-endowed schools in line with the time being "quite sufficient" were 24.5% as against only 6.4% of their counterparts from less-endowed schools. A 5.4% with regards to the population of students from well-endowed schools were also of the view that the time was "very sufficient" for practical activities, an opinion supported by only 2.5% of those from less-endowed schools.

4.2 Research Question 2: Are the strategies employed by teachers and students from the selected well-endowed senior high schools during biology practical lessons different from their counterparts in the selected less-endowed senior high schools?

With regards to this research question, multiple responses were given by both teachers and students on the above question. The responses provided were coded under the following: Setting up the laboratory (SUL); Provision of instructions (PI); Collection of specimen (CS); Teaches related theory (TRT); pre-testing of equipment (PE); setting related questions to specimen (SRQS) and 'Others'. These are represented in Table 3

4.2.1 Strategies employed by teachers and students during biology practical

Table 3: Things Students say Their Teachers do Before Organizing Biology Practical Lessons

Teachers' pre-activities	Students in Well-Endowed Schools		Students in Less-Endowed Schools	
	Frequency	Percentage %	Frequency	Percentage %
SUL	100	49.0	82	40.2
PI	83	40.7	85	41.7
CS	48	23.5	60	29.4
TRT	72	35.3	61	29.9
PE	50	25.0	15	7.4
SRQS	45	22.1	20	10.0
Others	15	7.4	24	11.8

Source: Field Survey, 2017

According to Table 3, 49% of students from well-endowed schools indicated that their teachers always set up the laboratory before having biology practical lessons as against 40.2% of those from less-endowed schools

A population representing 40.7% of students from well-endowed schools indicated that their teachers provided them with instructions before the commencement of any practical lesson in biology, a view supported and confirmed by 41.7% of their counterparts from less-endowed schools.

Besides, 23.5% of students from well-endowed schools said their teachers collected specimen before having practical lessons in biology as against 29.4% of their compatriots from less-endowed schools. A 35.3% representation of students from well-endowed schools again indicated that their teachers always taught the relevant theory

before having practical lessons and this was confirmed by 29.9% of students from less-endowed schools (Fig. 4).

In terms of pre-testing equipment before allowing students to have the practical lessons, 25% of students from well-endowed schools responded in the affirmative that their teachers have been doing that. Only 7.4% of students from less-endowed schools however, supported this view.

A 22.1% response was recorded for students from well-endowed schools as against 10% for those from less-endowed schools when it comes to the setting of questions relating the specimen being used.

Apart from all the things that have been mentioned as the teachers' pre-activities, 7.4% of students from well-endowed schools and 11.8% of their counterparts from less-endowed schools indicated some other activities being carried out by their teachers.
Some of the other things mentioned included; borrowing non-available equipment and apparatus from other sources such as sister schools and nearby science resource centres, giving of advice, taking students through the entire practical process, and putting them into groups.

Table 4: Students' Responses on Teaching Strategies Used by Their Teachers during Biology Practical Lessons

Teaching strategy	Students in Well-Endowed Schools		Students in Less-Endowed Schools	
	Frequency	Percentage %	Frequency	Percentage %
Activity-oriented	189	92.6	147	72.1
Lecture	15	7.4	57	27.9
Demonstration	108	52.9	97	47.5
Others	2	1.0	0	0

Source: Field Survey, 2017

From Table 4, it was indicated that majority of students from well-endowed schools representing 92.6% as against 72.1% of those from less-endowed schools indicated that their teachers have been using the activity-oriented methods during biology practical lessons.

When it comes to the issue of their teachers using the lecture method to teach during practical lessons in biology, only 7.4% of students from well-endowed schools as against 27.9% of their counterparts from less-endowed schools responded in the affirmative.

A 52.9% of students from well-endowed schools on the contrary indicated that their teachers used the demonstration method in teaching during practical lessons in biology and this opinion was supported and confirmed by 47.5% of those from less-endowed schools.

This means that though the strategies identified by students from the two categories of schools were not different, students from the well-endowed schools had access to some other activity-oriented methods as compared to their counterparts from the less-endowed schools.

5. Discussions

The research findings showed that both teachers and students from the selected well-endowed and less-endowed Senior High Schools consider practical lessons as one of the effective means of teaching and learning of biology. However, the time allotted to practical lessons in biology varied from one school to another.

In this, most of the well-endowed schools had more time for biology practical lessons than those that are less-endowed. Observations also showed that the time allocated for biology is inadequate to enable the teachers organize effective biology practical lessons. This caused the practical lessons to be ineffective most especially in the less-endowed schools 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.

Majority of the students from the less-endowed schools were not certain about the number of times their teachers had practical lessons with them. This means that there were some deficiencies in practical activities in majority of the selected less-endowed senior high schools. Biology practical work in the selected well-endowed senior high school was found to be more effective than in the selected less-endowed senior high schools.

It was also found out that though the teachers' pre-activities and teaching strategies employed in the two categories of senior high schools were not different, students from the selected well-endowed schools tend to have a greater advantage than their counterparts from the other part of the divide, as they were exposed to some other strategies beside the commonly known ones.

More so, teachers, especially those from the less-endowed schools in this research, seemed to ignore the practical aspect of biology teaching owing to non-availability of the basic equipment/ill-equipped science laboratory coupled with their perception that the biology syllabus was wide; a perception which in the opinion of the Researcher actually influenced how these teachers taught the subject. This behaviour on the part of teachers with regard to the approach used in the teaching of biology does not give room for students to develop their creative abilities as opined by Adepoju (1991). Young (1990) in his opinion emphasized that teachers in science education, should guide the students to fish out for information on their own through activities rather than by being fed 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 meaning fully. Practical lessons should therefore be used by teachers to help their students achieve better results in biology.

One other major finding from the study was that in some of the schools, most especially the less-endowed ones that have biology laboratories, such laboratories were in most cases used for theory lessons but not 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, it was observed that some of the schools did not have proper laboratories for practical work in biology. More so, there were only few biology laboratory assistants in some of the schools. In most of the schools where even there were laboratory assistants, students were not allowed to practise or manipulate equipment in the laboratory at their free times. Some of the reasons cited by the authorities for not allowing the students to practise and manipulate equipment in the absence of the teacher and the laboratory technicians / assistants were that students might either steal some of the materials or misuse 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.

Besides, it was also noted that most students generally had positive attitudes toward practical work in biology, even though the number of students from the selected well-endowed schools in this regard was more than those from the selected less-endowed schools. Students who even indicated that they have negative attitudes toward the subject in question said that their rather poor attitudes were developed as a result of the frustrations they had to endure due to the non-availability or inadequacy of the appropriate biological equipment, materials and specimen in their science laboratories.

Respondents also mentioned some of the things that could be done to address the identified problems. These include; 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 / well-equipped lab, parents to provide the necessary practical kits for their wards, making class size more manageable and refurbishing the existing science resource centres.

6. Conclusions

From the findings it can be concluded that though the teachers' pre-activities and teaching strategies employed in the two categories of senior high schools were not so different, students from the selected well-endowed schools tend to have a greater advantage than their counterparts from the other part of the divide, as they were exposed to some other strategies beside the commonly known ones. Thus, teachers and

students from the selected well-endowed schools employed better teaching and learning strategies during biology practical lessons.

More so, it could be inferred from the study that the most effective method of teaching and learning of biology is through practical work as students learn better by doing. In the Researcher's opinion, all stakeholders in education need to put in the needed efforts in providing well-equipped laboratories for all the senior high schools. This will enable teachers and students use practical work effectively to teach and learn biology.

7. Recommendations

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

- Headmasters and educational authorities should provide adequate and relevant teaching and learning materials in the science laboratories for teachers and students to use during practical lessons.
- Teachers should make conscious efforts to organize more practical work in science irrespective of the fact that biology topics in the syllabus are numerous.
- A point worth considering is the time slot for biology on the school time table. It is the Researcher's fervent desire that the curriculum developers, educational Directors and headmasters in senior high schools adjusted or extended the time allocated for the sciences, so that teachers will have enough time for practical lessons with their students.
- Schools with inadequate materials for teaching and learning are advised to make good use of the various science resource centres nearer to them for practical activities.

If such schools do not have buses to convey students to the resource centres, their teachers could still go there to borrow the needed apparatus or materials for use.

- Headmasters and headmistresses should try as much as possible to motivate their teachers and students intermittently to reinforce their interest in practical work.
- Teachers should introduce field trips and excursions as part of their biology teaching and learning programmes.
- The Ghana Education Service (GES), government and other stakeholders in education such as National Association of Graduate Teachers (NAGRAT), Ghana National Association of Teachers(GNAT) and Ghana Association of Science Teachers (GAST) should continue to organize frequent in-service professional training workshops and courses for science teachers to up-grade and up-date their knowledge in the organization of practical lessons.

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