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Assessing Biology Practical Lessons in Some Selected Colleges of Education In Ashanti Region Of Ghana

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Abstract
The study investigated how biology practical lessons are conducted in some selected Colleges of Education in Ashanti Region of Ghana. The sample population was made up of 60 students and 12 biology tutors from six selected Colleges of Education. The main instrument used for the study was questionnaire. Data collected were analyzed using frequency counts and percentages. The research findings showed that both tutors and students from the selected science colleges considered practical lessons as one of the effective means of teaching and learning biology. It also came out that, the tutors' pre-activities and teaching strategies in selected science and non-science colleges of education were not different. Again, students from the science colleges tend to have a greater advantage over their counterparts from the non-science colleges, because they were exposed to some other additional strategies.

Background to the Study

The upgrading of the teacher education certificate programme to diploma advocated the conventional approach to science practical activities and suggested that science practical work should be laboratory based. To achieve this goal, all Colleges of Education had to be provided with laboratories well-resourced with adequate equipment and apparatus. Unfortunately, however, a close observation made about some Colleges of Education in Ghana, revealed that they do not have standard laboratory stocked with adequate equipment and apparatus. Even those having standard laboratories for science teaching, such laboratories were ill-equipped. Other series of observations made about some Colleges of Education also showed that the approach currently being used to teach biology is most often based on classroom work which is intended only to meet examination requirements. Meanwhile, practical work is known to be an essential component of studying the natural environment. It is often defined as a typical laboratory work where students encounter ideas and principles at first hand. 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 attitude. It is also done to develop specific manipulative skills and to elucidate theoretical work as an aid to comprehension (Beatty & Woolnough, 1982). All these benefits are lost if biology lessons follow literary approaches only.

Though practical lessons are to be used by tutors to help their students to achieve better results in biology, it was sad to find that in most of the colleges, 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 (Serwaa, 2007). Although, some studies have been conducted in the past years to investigate the issue in the study area, still there seemed to be a growing concern about the deficiency in biology practical lessons in some Colleges of Education. It is for these reasons that this study investigates and compares how biology practical activities are done in some selected Colleges of Education in Ashanti region.

Review of Related Literature

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 acquisition of knowledge, and also 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. 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, suggest 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; NRC, 2000; Posner, Strike, Hewson & Gertzog, 1982; Roth, 1995; Wandersee, Mintzes, & Novak, 1994; West & Pine, 1985). Secondly, research suggests that real-life application may be a way to engage students' interest in learning science (McComas, 1996; Simon, 2000). 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; Posner *et al*., 1982).

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; Hallinger, Leithwood & Murphy, 1993; Krajcik *et al*., 1998; Siegal & Ranney, 2003).

Carrying out hands-on practical activities can also be engaging to students (Freedman, 1997). Although studies suggest that many students lose interest in science class after age 11 because they find school science boring (Doherty & Dawe, 1988; Hadden & Johnstone, 1983 ; Simon, 2000; Yager & Penick, 1986), the aspect of science that students consistently report as most appealing is hands-on laboratory work (Molyneux-Hodgson, Sutherland & Butterfields,1999). Biology among the science 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 experimentation and interrelationship with other career sciences. It is found to be the leading way to profession 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 at the Senior High School 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 biology data. 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 Area (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 strands and other strands of science education for personal development and for contributing towards building a scientific and technological world.

Teaching and Learning

The biology 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 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.

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 biology teaching in most colleges of education is most often based on classroom and laboratory work which are intended to meet examination requirements.

Unfortunately, the examination- driven mode of biology teaching has limited the biological (science) and technological scope and perspectives of the students. Not only does the approach tend to make the study of biology uninteresting, boring and not enjoyable. 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 biology career opportunities. 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, hypotheses testing, identifying and controlling variables, interpreting data and constructing instruments (Agboala, 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 biology lessons.

Attitudinal domain such as values, human feelings and decision making skills is also important enough to be addressed at the colleges of education. Practical work done in groups, enables students to develop attitudes such as positive attitudes towards themselves, positive attitudes towards biology and science in general and science tutors. 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 biology lessons enable them to develop scientific concepts in everyday life experience and to apply learned biology concept 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 Biology

There are many methods of teaching employed in the teaching of biology at the diploma level at colleges of education. No simple method can be said to be sufficient to be used in the teaching and learning of biology at the colleges of education. There is, therefore, the need to search for more effective strategies that are likely to improve achievement in biology at the colleges of education.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 benefit of co- operative learning for science students are well documented (National Institute for Science Education College level one, 1997; 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 tutor, although the tutor 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 biology lessons are done in groups, students is 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 biology in our 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 biology 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, it means 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 student's outcomes, motivations, and attitudes, but also teachers' motivation. Frasers study on learning environments are focus on student's outcomes, students' and teachers' perceptions, 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 biology students in Nigeria, approach biology laboratory activities with mixed emotions. For some, these activities are windows on the world of biology, allowing them to gain experience with the techniques, concepts and emotions that go with real research. For some others, practical lessons in biology 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 biology teacher in the secondary school biology laboratory, is that, teachers feel that demonstrating or carrying out activities in the laboratory amount to inviting trouble, and tedious. Often this turns out to be major cause of their indifference to practical work. Moreover, the topics are so restricted to examination scheduled curriculum that teachers must comply to if their students are to pass their external examination.

However, on the part of biology tutors, it is rather disturbing to note the apathy or indifference, with which biology practical activities are conducted in the biology laboratory. Practical biology 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 colleges of education in Ghana. The

classroom, laboratory and the school environment can be made conducive to teaching and learning of biology through improvisation of materials by teachers when standard laboratory equipment are not available.

Materials for Biology Practical Work

Availability of teaching and learning materials for biology Practical work plays an important role in the learning of biology. 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 endeavor. 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 different 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.

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 however, 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.

Time Allocated for Biology Lessons

Time, is a resources which is not renewable, non- interchangeable and finite. Most biology teachers overlook the practical aspect of the subjects perhaps because of time allocated for the teaching and learning of biology 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 biology practical work. The biology 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 colleges of education could only have four(4) periods of sixty minutes per week allotted for science. This inadequacy of lesson time for biology (science) perhaps has forced tutors 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 biology. Krafts 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 will result in a limited coverage of the designed curricula, which will finally have negative effect on the student's performance.

It is of the reason that Hurd (2002) suggested increasing the amount of time allotted for active experimentation in biology as a way of increasing participation by students who are poorly motivated. He cautioned that often teachers use teacher centered instructional techniques and assigned time that the seat work to unmotivated students while more motivated students perform laboratory activities and are given assessment involving problem solving. Instructional time intended for science varies across countries participating in the latest Trends in Mathematics and Science Study (TIMSS). Some countries spend up to 32% of instructional time on science (Martin, Mullis, & Chrostowski, 2004). Lynn (1989) 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 the benchmarking state 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 biology, more time should be devoted to it in the classroom. Curricular time in biology in Ghana like many other countries has not matched the significant increase in the number of biology topics to be taught at the colleges of education.

Research Design

The research design that is used in the study is a descriptive survey. It describes what existed with respect to how biology practical work is done in Colleges of Education. According to Gay (1987), the descriptive sample survey involves collecting data in order to test hypothesis or to answer questions concerning the current status 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. Since, it is the purpose of the research to survey and compare how biology practical work is conducted in the two types of Colleges of Education in the Ashanti region of Ghana, the descriptive sample survey is considered the most appropriate.

Population

Johnson and Christensen (2008) defined population as the set of all elements. They continue that, ''It is the large total group to which a researcher wants to generate his or her sample results'' (p. 224). In other words, it is the total group the researcher is interested in learning more about. This group is sometimes referred to as the target population. The target population of this study was all the science students of the Colleges of Education in the Ashanti region of Ghana. However, the sample frame forming the student' population from which the sample was drawn was the DBE 2 students and their tutors. DBE 2 (Diploma of basic education) students were selected because they had just completed a course which involved more biological drawings works in DBE 1.

Sample and sampling technique

Purposive sampling and simple random techniques was employed in this study. Purposive sampling technique was used because the participants needed to be of certain characteristics. In this case, students

who had just completed a course involving more practical work in DBE 1 science were the people had these needed characteristic. The sample size of 60 students and 12 tutors were selected from the 6 Colleges of Education. These selected population under study comprised a group of (30) students each from science and non- science colleges, while a group (6) tutors each from science and non-science colleges. The selection as regards the number of students and tutors in each of the College of Education was done through simple random sampling, irrespective of the students' and tutors' population in each of the selected College of Education, since the study is a comparative one. In this, 10 students were selected from each of the College of Education in question while 2 biology tutors were selected from each of the Colleges selected.

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

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 by Johnson (1978) and Smith (1982), this method does not require the use of a check list; instead a free-form procedure of recording data is used. The 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 used such as text books and syllabuses. Two types of questionnaires were designed, one for the tutors and one also for the students. Both set of questionnaires were designed in such a way that they contained open ended and closed ended type of questions. For the close ended type of question, options were given and the respondents were asked to tick the answer which was applicable. With the open ended type of questionnaires, respondents were asked to express their own kind of responses in the spaces provided on the questionnaire.

Validity

Joppe (2000), validity determines whether the research instruments 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 were also 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 with twenty (20) students at Wesley College in the Ashanti region of Ghana. The college was selected because it shares similar characteristics with the colleges in the selected region. The pilot testing enables the researcher to determine whether the instrument items posses the desired qualities of measurement. This is emphasized by Johnson and Christensen (2008) who state that a pilot-testing of instrument can reveal ambiguities, poorly worded questions, questions that are not understood, and to check how long it takes participants to complete the test under circumstances similar to those of the actual research study.

Reliability

A pilot test of the instrument was carried out with twenty (20) students offering elective science in Wesley College in the Ashanti region of Ghana. These students used for the pilot test did not form part of the sample for the study. The reliability of the student's questionnaire were 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 subjects to respond to. 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 Vice Principals (Academic) of all the colleges to carry out a research using science students of the colleges which was granted.

The questionnaire was administrated by the researcher personally. This enabled the researcher to get to the respondent directly and to enable him establish rapport with the respondents. It also enabled him 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 biology practical lessons in some of the selected colleges.

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 study, in keeping with current or recent trends in the learning environment with regards to the classroom, employed both qualitative and quantitative methods in analyzing the data that was collected (Fisher & Frazer, 1990; Frazer & Tobin, 1991; Frazer, 1994), This was done, using Statistical Package for Social Science (SPSS) version 16 and Microsoft excel spreadsheet.

According to Tobin and Fraser (1998), combining qualitative and quantitative methods of research provides multiple theoretical perspectives (observation and interpretive methods) into education in general and the classroom in particular. The practice whereby a combination of both qualitative and quantitative measures is included in a research study is generally accepted as enhancing the study (Fraser & Tobin, 1991; Tobin & Fraser, (1998).

Research Question 1

Is there any difference in the time allocated for biology practical work in the colleges of education and if so, to what extent did this affect practical work*?*

In an attempt to answer the above question, the Researcher used item 7 of the students' questionnaire as well as 20 of the tutors' questionnaire. Table1 represents the responses of students from the two categories of schools in line with the question. In this table, the schools were codified as categories X and Y; with the X1-X3 and Y1-Y3 representing the three science and three non science colleges of education respectively. The responses of the respondent also shown on the Table 1. below.

Table 1: Number of times Tutors had Practical Lesson in Biology per Week

Science colleges	**Once**	**Twice**	**Some times**	**Non-science colleges**	**Once**	**Twice**	**Some times**
X1	4	6	0	Y1	2	4	4
X2	2	8	0	Y2	1	3	6
X3	4	6	0	Y3	2	3	5
Total	10	20	0	Total	5	10	15
Percentage	33.3%	66.7%	0%	Percentage	16.7%	33.3%	50%

Source: field 2018

As indicated in the Table 1, in terms of having practical work "once a week", was

recorded as 33.3% for the students in the science colleges as against 16.7% for those

from non-science Colleges of Education. Having practical work "twice a week" was weighed in favour of the students from science colleges, who had 66.7%, as against 33.3%, from those in the non-science Colleges. The uncertainty of 'sometimes' having practical work went in favour of the students from non-science colleges, who recorded 50%, as against none of the respondents from the science Colleges. On the question of the extent to which time allotted to biology lessons in the two categories of colleges of education affected practical work, responses from the respondents in line with this were coded as the following: Not sufficient; Quite sufficient and very sufficient.

The responses are represented in Table 2.From Table 2, 36.7% of students from science colleges indicated that the time slot for practical work in biology was "not sufficient" and this was strongly confirmed by 80% of their counterpart from non-science colleges. In terms of the time being "sufficient", 33.3% of students from science colleges in their opinion responded in the affirmative as against 13.3% of those from non-science colleges. The responses of students from science colleges in line with the time being "quite sufficient" were 23.3% as against only 6.7% of their counterparts from non-science colleges. Again, 6.7% with regards to the population of students from science college were also of the view that the time was "very sufficient" for practical activities, an opinion supported by none of those from non-science colleges. This is an indication that there is the need to allocate more time for practical activities to help students get the requisite practical skills to enhance performance.

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

Quantum of time	**Students in science colleges**		**Students in non- science Colleges**	
	frequency	Percentage%	Frequency	Percentage%
Not sufficient	11	36.7	24	80.0
Sufficient	10	33.3	4	13.3
Quite sufficient	7	23.3	2	6.7
Very sufficient	2	6.7	0	0

Research Question 2

Are *the strategies employed by tutors and students from the selected science colleges during biology practical lessons different from their counterparts in the non-science colleges?*

Items 5 of the tutors' questionnaire, 5 and 6 of that of students' were used to answer the above question. Multiple responses were given by both teachers and students on the above question. The responses provided were coded under the following: Preparing the laboratory (PL); Reviewing the laboratory rules and regulations (RLRR); Gathering of specimen (GS); Provision of related theory (PRT); Pilot-testing of equipment (PTE); and "others" These are represented in the Table 3.

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

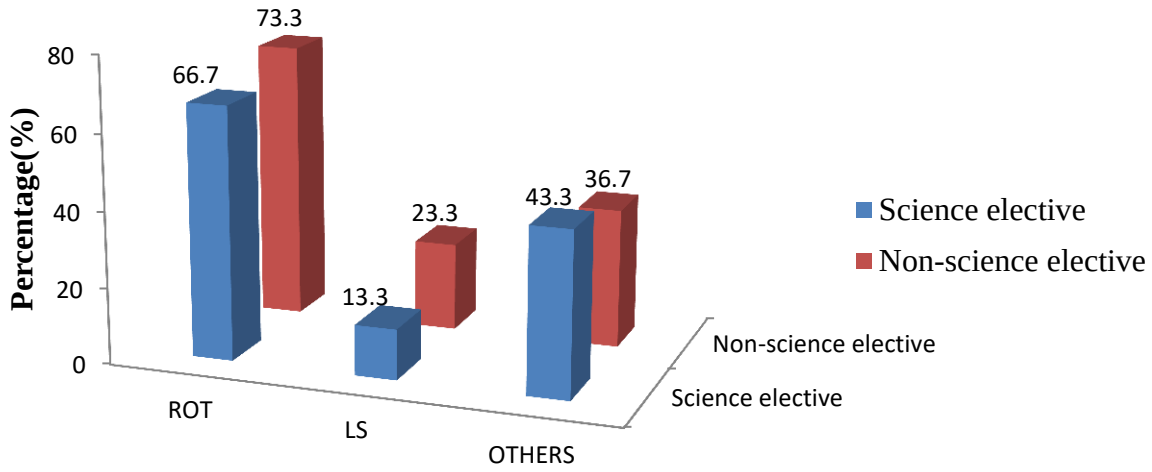
Teacher's pre-activities		**Students in science colleges**				**Students in non- science colleges**			
		Frequency		Percentage %		Frequency		Percentage %	
PL		15		50.0		13		43.3	
RLRR		13		43.3		13		43.3	
GS		8		26.7		9		30.0	
PRT		11		36.7		9		30.0	
PTE		8		26.7		3		10.0	
Others		3		10.0		4		13.3	

Source: Field 2018

According to Table 3, 50% of students from science colleges indicated that their tutors always prepare the laboratory (PL) before having biology practical lessons as against 43.3% of those from non-science colleges. A population representing 43.3% of students from science colleges indicated that their

tutors review laboratory rules and regulation (RLRR) before the commencement of any practical lesson in biology, a view supported and confirmed by 43.3%of their counterparts from non- science colleges. Beside 26.7% of students from science colleges said their tutors gathered specimen (GS) before having practical lessons in biology as against 30.3% of their compatriots from non-science colleges. A 36.7% representation of students from science colleges again indicated that their tutors always provide the relevant theory (PRT) before having practical lessons and this was confirmed by 30.3% of students from non-science colleges in the Table 3.

In terms of Pilot-testing of equipment (PTE) before allowing students to have the practical lessons, 26.7% of students from science colleges responded in the affirmative that their tutors have been doing that. Only 10.0% of students from non-science colleges however supported this view.A part from all the things that have been mentioned as the teachers' pre-activities, 10.0% of students from science colleges and 13.3% of their counterparts from non-science colleges indicated some other activities being carried out by their teachers. Some of the other things mentioned include; borrowing non-available equipment and apparatus from other sources such as sister schools and nearby science resource centers, giving of advice, taking students through the entire practical process, and putting them into groups. All these pieces of information are represented in Table 3. With respect to what the students do on their own before going for biology lessons, opinions have been captured in Fig.1 with varied responses from the students on the above question. The responses provided were coded under the following; Reading over the topics (ROT); Collection / looking for specimen (LS); and others.



Students pre-practical activities

Fig. 1: Things students do before attending Biology Practical Lessons

1, 66.7% of students were science colleges as against 73.3% of those from non-science colleges said they usually read over the notes on a relating practical topic before attending lessons in the laboratory. A 13.3% of the population of students from science colleges as against 23.3% of their counterparts from non-science indicated that they looked for specimen.

Apart from all the things they have been mentioned as the role they played, 43.3% of the student from science and 36.7% of their counterparts from non-science colleges indicated some other activities they carried out. Some other things mentioned included; receiving instructions from their tutors putting on their laboratory coats, discussing the relevant topics, tanning up minds toward lesson and looking for the necessary practical kits.

To address the question of whether the strategies employed by the tutors from the two categories of schools during practical lessons in biology differ, items 28 and 29 of the tutors' questionnaire as well as items 25 and 26 of the questionnaire for the students were used. The responses given by the respondents were coded as Activity- oriented; Lectures; Demonstration; and others as indicated in Table 4 and depicted in fig. 2 From Table 4, it was indicated that the majority of the students from the science colleges representing 93.3% as against 73.3 % of those from non-science colleges indicated that their tutors have been using the activity- oriented methods during biology practical lessons. When it comes to the issue of their tutors using the lecture methods to teach during practical lessons in biology, only 10.0% of the students from science colleges as against 30.0% of their counterparts from non-science colleges responded in affirmative.

A 53.3% of students from science colleges on the contrary indicated that their tutors use the demonstration method in teaching during practical lessons biology and this opinion was supported and confirmed by 50.0% of those from non-science colleges. Although 3.3% of the students from science colleges mentioned any other strategy besides those already mentioned, but none of their counterparts from non-science colleges said their tutors sometimes used strategies such as description, and computer software on science which involve playing and learning at the same time. This means that though the strategies identified by students from the two categories of schools were very close, students from the science colleges had access to some other activity-oriented methods as compared to their counterparts from non-science colleges.

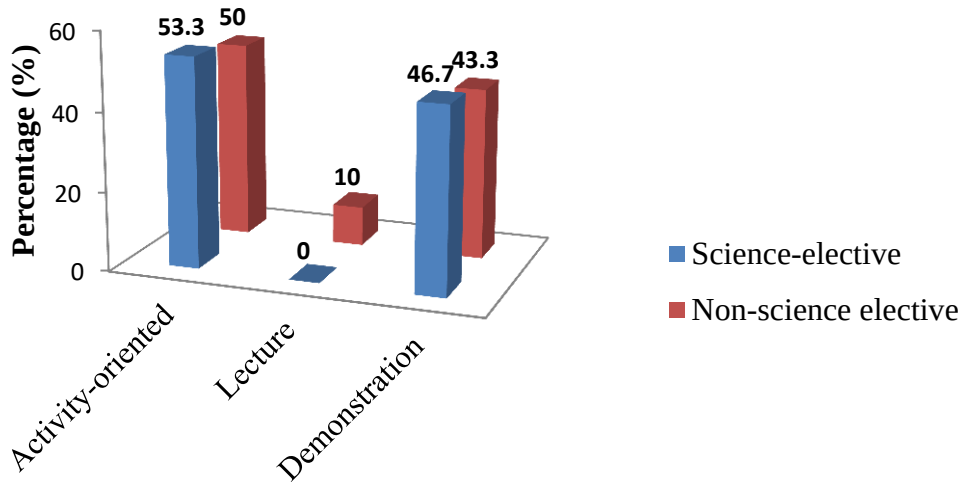
Table 4: Students' Responses on Teaching Strategies Used by Their Tutors

during Biology Practical Lessons.

Strategies	**Students in science colleges**		**Students in non-science colleges**	
	Frequency	Percentage %	Frequency	Percentage %
Activity oriented	28	93.3	22	73.3
Lecture	3	10	9	30
Demonstration	16	53.3	15	50
Others	1	3.3	0	0

When the students were asked to indicate the method they preferred best the following response shown in Fig. 2 overleaf were given. From Fig. 2. 53.3% of the students from science colleges as against 50.0% of those from non-science colleges said their best strategy among the various ones mentioned was the "activity-related'' methods. None of students from science colleges indicated ''lecture'' as their most preferred strategy as against 10% on the part of their counterparts from non-science colleges. .In the case of "demonstration" 46.7% of students from science colleges said they preferred it being used by their teachers

as the best strategy and this choice was supported and confirmed by 43.3% of those from non-science



Most Preferred Teaching Strategy

colleges.

Fig. 2: Students views on the most preferred strategy used by their tutor during biology practical lessons.

Research Question 3

What are the problems encountered by students from the selected science and non-science colleges of education, during biology practical lessons and how could such problems be addressed?

The researcher in answering this question used items 3 of the teachers' questionnaire and 37 of the questionnaire for students. The responses provided were coded under the following: Lack of standard laboratory (LSL); Lack of laboratory technician (LLT); Inadequacy of practical equipment and materials (IPEM); Large class size(LCS); Insufficient time for practical work (ISTPW); Non availability of some specimen in the locality (NAS); and Others. The summary of the students' responses with respect to the problems connected with biology practical lessons is represented in Table 5.

Table 5: Students' Responses on Problems They Encounter During Biology Practical Lesson

Strategies	**Students in science colleges**		**Students in non-science colleges**	
	Frequency	Percentage %	Frequency	Percentage %
LSL	18	60	11	36.7
LLT	2	6.7	7	23.3
IPEM	4	13.3	24	80
LCS	2	6.7	3	10
ISTPW	3	10	14	46.7
Others	14	46.7	8	26..7

From Table 5, 60.0% of students from science colleges as against 36.7% of their

counterparts from non-science colleges stated that one of the problems they encountered was that they lack standard laboratory (LSL) for practical work in biology. With respect to lack of laboratory technicians (LLT), 6.7% of students from science colleges responded in the affirmative. For students from non-science colleges, about a quarter of the population, 23.3% supported this view, which in the opinion of the researcher was not encouraging as the value of those assistants in the laboratory can never be underestimated. When it came to the problem of inadequacy of practical equipment and material (IPEM), 13.3% of students from science responded positively. This was strongly confirmed by 80.0% of their counterparts from non-science colleges.

On the contrary, 6.7% of students from science colleges indicated large class size (LCS) as the problem they've been encountering during biology practical lessons as against 10.0% of those from non-science colleges. In terms of insufficient time for practical work (ISTPW) being one of the problems encountered, 10.0% of students from science colleges responded positively, an opinion confirmed by 46.7% of their counterparts from non-science colleges. Nonetheless, 46.7% of students from science colleges and 26.7% of their counterparts from non-science colleges mentioned other forms of problems they encountered apart from those that have been already cited. These were codified as "Others". Some of the other problems they stated include "bad odor from chemicals" which tend to put them off, "difficulty in drawing directly from microscopic observation," "non-cooperation" of some members of the group during practical lesson, "not having fieldtrips and excursions" as well as " improper supervision by laboratory assistants".

To address the question on things to do solve the identified problems, the Researcher used items 32 of the questionnaire for tutors and 38 of that of students. The responses given by both tutors and students were categorized into the following: Provision of /necessary equipment and materials by stakeholders (PEM); Employing of well-educated laboratory technician/assistant (ELTA); Adjustment in time allocated for practical work (ATPW) Provision of proper /well-equipped laboratory (PWEL); and Others. The responses of students in this regard are represented in Table 6 below.

Table 6: Students' Responses on Things to do to solve the identified problems

Solutions	**Students in science colleges**		**Students in non-science colleges**	
	Frequency	Percentage %	Frequency	Percentage %
PEM	18	60	22	73.3
ELTA	2	6.7	8	26.7
ATPW	4	13.3	14	46.7
PWEL	2	6.7	13	43.3
Others	12	40	8	26.6

In Table 6, 60.0% of students from science colleges as against 73.3% of their counterparts from non-science colleges identified the provision of necessary equipment and materials (PEM) by all stakeholders in education as one of the things to do to better their lot with respect to science practical work. In terms of the Employing of well-educated laboratory technician/assistants (ELTA) to help both students and teachers with the practical work, 6.7% of students from science colleges supported that statement as against 26.7% of those from non-science colleges. A population of 13.3% of the students from science colleges agreed with 46.7% of those from non-science colleges on the adjustment in time allocated for practical work" (ATPW) as one the things to do to enhance students' understanding of scientific concepts.

Only 6.7% of students from science colleges as against 43.3% of those from non-science colleges indicated the "provision of proper /well-equipped laboratory" (PWEL) as one of the key areas in solving the identified problems.

As indicated in Table 6. 40.0% of students from science colleges as against 26.7% of those from the non-science colleges, suggested something else (‘others") apart from the enlisted solutions mentioned above. The "Others" include; having more fieldtrips and excursions, motivating both students and tutors especially to give off their maximum best, old students gathering themselves and donating funds to purchase the needed equipment, as well as pleading with tutors to teach wholeheartedly.

Summary of the Main Findings of the Study

From the analysis of the data in the study, the following were the major findings:

1. Both students and tutors consider the activity methods as the most effective method of teaching and learning.
2. Both categories of students indicated that, though most of the colleges had laboratories, many of such laboratories were ill- equipped. Only a few of the colleges (non-science colleges) did not have proper laboratories for practical lessons.
3. Time allocated for biology practical lessons was woefully inadequate or insufficient in most of the schools, though more time was allotted for practical work in the selected science colleges than in the non-science colleges.
4. Few teaching and learning materials available were used in groups in the selected schools.
5. The laboratory assistants/technicians in most colleges were not enough. The worse affected were the non-science colleges.
6. Most students were also found to possess positive attitudes toward practical work in biology. This was confirmed by their tutors.
7. Most of the schools were found to have too large class sizes. Some school heads perceived the provision of materials' and equipment as waste of money, and did not take science serious because it involved money.

Conclusion

From the findings it can be concluded that though tutors' pre-activities and teaching strategies employed in the two categories of colleges were not so different, students from the selected science elective colleges 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, tutors and students from the selected science elective colleges 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 colleges of education. This will enable tutors and students use practical work effectively to teach and learn biology.

It can be said that the inadequate supply of equipment and materials by the stakeholders in education to meet the standard required by Examination authorities at the colleges of education in Ghana has had adverse effects on the organization of biology practical activities in the surveyed colleges. The inadequate time allotted for biology lessons in most colleges too, did not promote frequent use of practical activity in biology lessons. Tutors, are however, expected to do more to stimulate and sustain students' interest in biology practical lessons. For them to be able to whip up the interest of students in this direction there is the need to adjust these time slots to favour more practical work.

It also appears that the 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 tried to procure science materials during UCC designated examinations, a situation which is not helping both tutors and students at all.
More so, the large sizes of science classes in most of the colleges, visited had been a major drawback towards the effective use of practical activities in the teaching and learning of biology. This therefore has become a major cause for concern, which must seriously be looked at by all stakeholders in education. 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. Principals 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.
2. Tutors should make conscious efforts to organize more practical work in science irrespective of the fact that biology topics in the syllabus are numerous.
3. Colleges with inadequate materials for teaching and learning are advised to make good use of the various science resource centres nearby senior high schools for practical activities.
4. Principals should try as much as possible to motivate their tutors and students intermittently to

reinforce their interest in practical work.

5. Colleges authorities should as much as possible, recruit well-educated laboratory technicians and assistants to enhance the practical work of tutors and students in biology at the colleges of education.
6. Teachers should introduce field trips and excursions as part of their biology teaching and learning programmes.
7. Science teachers should be given incentive 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.
8. 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

Suggestions for Further Study

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 colleges could help improve the teaching and learning of science or not.
3. A study be conducted to find out whether gender has any influence on the teaching and learning of science in general and biology in particular 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 colleges of education.

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