EFFECT OF PRACTICAL ACTIVITY APPROACH AND GENDER ON STUDENTS' ACHIEVEMENT IN BIOLOGY: IMPLICATIONS FOR SECONDARY EDUCATION

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Abstract
This study used a quasi-experimental pretest-posttest design. 120 participants were drawn from a population of 2,405 SS1 students in Nsukka LGA using simple random and selective sampling techniques. The validated Achievement Test in Biology was the data collection tool with an internal consistency reliability value of 0.75 obtained using the K-R20 formula. Data were analyzed using mean and standard deviation as well as ANCOVA. Results demonstrated that students in the experimental group taught using the practical activity approach (PAA) outperformed those in the control group taught using the conventional method. The adoption of the PAA did not significantly affect students' achievement in Biology, gender-wise, even though male students achieved better than female students. The school location had no substantial influence on students' achievement in Biology when the PAA was adopted. Among the suggestions made was that the government should set up well-equipped Biology laboratory in every secondary school regardless of location to make Biology teaching and learning more thorough and practical.

Keywords: *Practical Activity Approach, Conventional Teaching Method, Gender, School Location.*

Introduction

Science is the study of the world around us through observation and inquiry. Science, which is derived from the Latin word Scientia, simply means to be aware of the reality or truth (Chukwunta, 2016). Additionally, it involves the methodical, evidence-based search for and application of knowledge and understanding of the natural world (Science Council, 2009). In addition to

observation, hypothesis, and experimentation, these systematic approaches also involve result analysis and the formulation of new hypotheses. As a result, science investigates the natural world and all of its elements, including humans, plants, animals, ecosystems, atoms, and even societies, as well as the natural forces that influence each of these. Amazing facts and other ground-breaking technologies that have impacted human life have been found thanks to the study of science. These innovations, which may be found in the fields of health, transportation, agriculture, and communication among others, benefit both individuals and society as a whole. Therefore, science serves as the foundation for progress and aids in the growth of every country. The integration of science into the educational system was prompted by its importance to societal growth and economic advancement. At the senior secondary level, there are different science subjects, including Physics, Chemistry, and Biology.

The study of living things or life is known as Biology. It focuses on the investigation of the development, structures, function and distribution of living things as well as their interactions with their surroundings. The study of Biology covers the anatomy, physiology, and evolution of all living organisms (Basson, 2012). Additionally, it is the scientific study of how plants and animals live and are structured (Hornby, 2010). Biology has a significant impact on both the individual and society. For instance, Biology instruction prepares students for jobs in Medicine, Pharmacy, Biochemistry, and even Agriculture, as well as aids in the control of communicable illnesses and the preservation of the environment (Okereke & Nzewi, 2021). It helps in improving the quality and quantity of food and livestock production among other things. Because of its importance to both individual and societal growth, Biology is taught in senior secondary schools in Nigeria under the direction of a formalized Biology curriculum.

The delivery of Biology contents is influenced by the Biology curriculum. The National Policy on Education (Nigeria Educational Research and Development Council [NERDC], 2008) established the following goals for secondary school Biology curricula:

- to prepare students to acquire sufficient laboratory and field skills in Biology;
- to acquire meaningful and relevant knowledge in Biology;
- the ability to apply scientific knowledge to daily life in matters of individual and community health and agriculture;

- to exhibit reasonable and functional scientific reasoning.

The West African Examination Council (WAEC) Syllabus (1998–2003) specified the aims and objectives of teaching Biology in secondary schools thereby further broadening the goals. Among the aims and objectives are:

- to enjoy nature and to comprehend the composition and operation of living things;
- to develop the necessary laboratory and field abilities to conduct and assess biological studies and projects;
- to develop the necessary scientific abilities, such as making observations, classifying, and interpreting biological facts;
- to develop a scientific mindset for problem-solving;
- and to be able to apply biological concepts to real-world issues affecting economic, social, environmental, and public health issues.

It takes competent as well as application-focused Biology teaching and learning for the aforementioned lofty objectives to be met. The Biology curriculum is spirally organized with enough content included. Due to the way most teachers teach Biology, the vast content may seem abstract to the students. As a result, the objectives of teaching Biology to students become a phantom. In an effort to stop this terrible scenario in its tracks, the curriculum recommended teaching Biology concepts utilizing specimens and other teaching resources. Therefore, practical activities need to be used in the teaching and learning of Biology.

When teaching Biology, the practical activity approach uses real objects, specimens, and other instructional resources to make the subject more relevant and increase students' engagement. Sam (2009) maintained that using a practical activity technique could make lessons more at home with students than simply presenting them as abstract ideas. Instead of giving students extensive notes to write down, the practical activity approach in Biology incorporates the study of plants and animals with their habitats in a way that is participatory using instructional and laboratory materials (Opuh, Ezeh & Ezemagu, 2008). Accordingly, practical activity approach is expected to help students study Biology with hands-on activities and aid students in understanding Biology ideas more than when they are taught without them. Students are expected to get the necessary knowledge, scientific aptitude, and attitude through the use of practical activity strategy in Biology instruction.

Through improved retention, practical activities motivate students and increase their interest in Biology in a way that teaching the theoretical aspects of the subject alone cannot (Allan, & Jonathan, 2000). Again, if given the chance, students can learn more in any science session that includes hands-on activities as they do scientific procedures like manipulating and classifying among others. This is supported by the social constructivist learning theory developed by Lev Vygotsky in 1962 since when students actively participate in practical activities, they work together in groups and gain knowledge from an adult, an instructor, or a peer who is more knowledgeable than they are. Additionally, the practical activity approach to teaching and learning Biology is expected to help students learn scientific theories and concepts firsthand, make teaching and learning meaningful, expose students to the methods used by scientists, and generally appear to improve students' performance in science. To sum up, students may have opportunities to put what they have learned in theory into reality through practical exercises in disciplines like Biology. Students moreover get opportunities to develop their interpersonal skills, creative thinking, and practical Biology learning abilities.

The stated importance of practical activities notwithstanding, a cursory glance at Nigeria's public secondary schools would make one appalled at the way Biology is taught. Most teachers teach Biology without including practical exercises to quickly cover the curriculum. They frequently employ teacher-centred methods to teach Biology lessons, such as conventional teaching methods like lectures and teacher-led demonstrations, which seldom ever allow for active students' participation in the teaching and learning processes. The appalling situation is that most Biology teachers only remember to incorporate practical exercises when their students are about to take examinations in SS3 (Senior Secondary 3) classes. As evidenced by the one-shot approach to science practical activities that science teachers only carry out as external examinations draw near, Orji and Ike (2020) found that the teaching of science in Nigeria is more focused on regurgitating facts and concepts. Because of this, students cannot demonstrate the necessary practical skills before taking Biology examinations. In essence, this seems to have an impact on their performance in Biology.

Achievement is defined as the successful completion of a task. It is also the accomplishment of learning goals during instruction. According to Anakwe (2006), an achievement is a test designed to help determine whether the goals of an academic study have been met. The level of Biology achievement among students in Nigeria has not been improving steadily over time. In other words,

it sometimes gets poor and other times fair. For instance, the WAEC Chief Examiner's report from 2015 and 2018 noted low levels of students' achievement in Biology. In the previous years, 2016 and 2017, it seemed fair. For students to gain maximally from Biology and achieve their desired goals, low performance in Biology classes must be eliminated. Numerous factors, including how Biology is taught by teachers, contribute to students' low performance in the subject (Cimer, 2012). Studies have been done on the effectiveness of cutting-edge teaching techniques to raise students' achievement in Biology instructional processes, including instructional scaffolding (Vandepol, Volman, & Beishuizen, 2010), concept mapping (Vandana, 2017), and peer tutoring (Yashvinder & Suyatha, 2016). The Biology students' achievement, however, has not been consistently improved over time. Additionally, Nwagbo (2009) advocated for the use of practical activities in Biology instruction, but a few Biology teachers are hesitant to implement the strategy.

Reviewing certain studies on the application of practical activity strategy is crucial.

For instance, Ude (2019) found that using practical Biology activities to teach senior secondary school students increased their academic performance more than using the traditional teaching approach. When teaching with practicals, Ude also noted that gender had a substantial impact on students' achievement. The study used ANCOVA to analyse the administered pretest that acted as a covariate, while Ude's method of evaluating the null hypothesis was the t-test. Additionally, the current study took into account factors that the reviewed study did not, such as the influence of school location on students' Biology achievement while using a practical activity approach. In addition, Bajon (2012) investigated how different types of practical activities affected students' Biology achievement and found that students who were taught the subject through group laboratory activities outperformed those who were taught the subject through solo-laboratory activities. Additionally, there was no discernible relationship between the form of the practical exercise and the gender of the students' mean achievement scores, and male students had higher mean achievement scores than their female counterparts. While the current study did not take into account the form of practical activities, Bajon's study focused on the impact of practical activity mode on students' achievement. The evaluated study did not take into account how school location affected learning, as did the current study. More research is needed to determine how the practical activity approach improves students' poor achievement in

Biology because of the limitations in the aforementioned review. Gender may have an impact on students' performance in Biology and in other disciplines.

Gender is a social construct. It differs from the biological traits of males and females that are typically referred to as someone's sex. Additionally, contrary to what some believe, it is not just for women. The roles, responsibilities, and tasks that are ascribed to men and women in society are what define a person's gender. Gender was characterized by Okeke (2007) as a social variable that was not universal because it differed culturally depending on the locale. According to Macionis and Genber (2005), gender is determined by human emotions, beliefs, and roles. This describes how gender influences how people perceive themselves and behave in ways that are consistent with the roles that society has assigned to each sex. Experience has shown that curriculum materials like scientific textbooks tend to favour men over women in the educational sector, for example. The majority of the photographs that were used in them might be considered as being gender biased. Because it has an impact on the courses that male and female students in schools offer. The gender divide has reached frightening proportions. To demonstrate this, it is known that male students are more likely to enroll in courses in Mathematics, Science, and Technology, while female students are more likely to choose non-scientific courses (Cottes, 2003). The study of Science and Technology should be permitted and supported equally for male and female students (Nwosu, 2001). Recent years have seen the advancement of numerous studies on gender concerns in science education.

For instance, studies have shown that gender influences scientific achievement in fields like Biology (Okwo & Otubar, 2007; Chikelu, 2009). Contrarily, some studies indicated that gender has little bearing on scientific achievement (Nzewi, 2010; Ogunleye & Babajide, 2011). It is obvious that the influence of gender on students' achievement is still controversial and of concern when taking into account the various perspectives on gender influence in the studies mentioned above. Thus, it is necessary for this study to determine how gender influences students' achievement in Biology while using a practical activity approach. Apart from gender, school location may also influence students' achievement in Biology.

School location is the actual place in the physical environment (that is, whether rural or urban place), where the school is sited. The rich cultural diversity of rural life in Nigeria is distinct from that of urban centres, and this is thought to frequently have an impact on students' academic performance. This is due

to lack of social amenities in the rural areas such as pipe-borne water, electricity, and healthcare facilities (Obodo & Onoh, 2001). The distribution of educational facilities and teachers may also reflect this. Due to these common circumstances, learning possibilities in schools in Nigeria may vary depending on the location of the school. Consequently, students in urban schools in Nigeria have greater educational chances than those in rural schools. While some studies indicated that school location influenced students' learning outcomes, others indicated the contrary (Bosede, 2010; Ezechi & Adakwu, 2018). This study therefore experimented on the effect of practical activity approach on students' achievement in Biology with gender.

The study specifically determined the:

1. effect of practical activity approach on students' achievement in Biology.
2. influence of gender on Biology students' achievement.
3. interplay effect of gender and instructional approach on Biology students' achievement.
4. influence of school location on Biology students' achievement.

The study was guided by three research questions:

1. What are the average achievement scores of Biology students taught using a practical activity approach and those taught using a conventional teaching method?
2. How does gender influence students' mean Biology achievement scores?
3. What influence does school location have on students' mean Biology achievement scores?

The following null hypotheses (Ho) were formulated at the $p \leq 0.05$ level of significance.

H_{O1} The mean achievement scores of students taught Biology using the practical activity approach and those taught using the conventional teaching method do not differ significantly.

H_{O2} The mean achievement scores of students in Biology are not significantly influenced by gender.

H_{O3} Gender and instructional approach had no interaction effect on students' achievement in Biology.

H_{O4} There is no influence between the school location and students' mean achievement scores in Biology.

Method

A quasi-experimental design, specifically the pretest-posttest non-equivalent control group design, was used in this study. In a quasi-experimental design, the assignment of individuals to groups is not entirely random (Ali, 2006). The study's quasi-experimental method is deemed adequate because intact classes were employed to prevent interfering with regular class lessons.

The study was conducted at Nsukka Local Government Area (L.G.A.), Enugu state. There are a total of thirty-one (31) public secondary schools, twelve (12) in found in urban, while nineteen (19) were in the rural areas.

The population of this study consisted of 2,405 senior secondary one (SS1) Biology students made up of 1,107 males and 1,298 females. The study included a sample of one hundred and twenty (120) SS1 Biology students, consisting of 42 males and 78 females. Purposive and simple random sampling techniques were used in sampling. Co-educational public secondary schools were purposively sampled to accommodate gender variable. Two urban and rural public secondary schools were randomly sampled. The experimental group consisted of one urban and one rural public secondary school, while the control group consisted of the remaining urban and rural public secondary schools. The sample size was one hundred and twenty (120) students.

Biology Achievement Test (BAT), was constructed by the researchers, and used to collect data. The BAT is a 40-item, multiple-choice test with five lettered options (A–E). The instrument was created using contents from the SS1 Biology curriculum on Nutrition in Animals, to which the students were exposed (Nigerian Educational Research and Development Council Ministry of Education, [NERDC], 2008). A test blueprint was used to build the items in the test and for content validation. Each correctly answered question was scored one, while any incorrect answer scored zero. The BAT was face and content validated. The face validation was done by giving the instrument to three experts from the Department of Science Education, University of Nigeria, Nsukka. Trial testing of the Achievement Test in Biology was done by administering thirty copies of the instrument to 30 SS1 Biology students in a secondary school at Obollo-Afor, in Udenu Local Government Area. Thereafter, they were scored and used for determining the instrument reliability using Kudder-Richardson ($K\text{-}R_{20}$) formula which yielded an internal consistency reliability value of 0.75.

As research assistants for the study, Biology teachers from the sampled schools were used for treatment and data collection. Both teachers in the control and experimental groups were provided with a lesson plan to use in their regular classroom instruction; and four days of training on how to apply the strategy was given to teachers in the experimental group. Also, the teachers received training on how to divide the students into groups. Before the researchers asked the trained research assistants to begin teaching in their schools, they had successfully demonstrated what they had learned before the researchers.

At the beginning of the research, a pretest was given to the students in both groups. Lessons that lasted for six weeks came thereafter. While students in the experimental group were taught using the practical activity approach, those in the control group were taught using the conventional teaching method. The posttest was then administered to the students in both groups after the six-week instruction.

By guaranteeing that students were instructed in their regular Biology classes by their regular Biology teachers, utilizing their regular school schedule, the researchers were able to control the extraneous variable such as the Hawthorne effect. Also, before conducting this study, the researchers obtained ethical approval from their university's research ethics committee. Additionally, the sample or study participants voluntarily gave their consent. Research questions were answered using mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at a 0.05 level of significance.

Results

Table 1: Mean and Standard Deviation of the achievement scores of students taught Biology using a practical activity approach and those taught Biology using a conventional teaching method

Group		Pretest		Posttest		
	N	$\overline{X}$	Std. Dev.	$\overline{X}$	Std. Dev.	Mean Gain
Experimental (EG)	60	15.90	3.87	25.82	4.31	9.92
Control (CG)	60	16.88	5.06	24.57	3.64	7.69

From the data in Table 1, the EG had a mean gain achievement score of 9.92 while the CG had a mean gain achievement score of 7.69. The mean gain was in favour of the EG.

Table 2: Analysis of Covariance (ANCOVA) of the mean achievement scores of students taught Biology using a practical activity approach and those taught Biology using a conventional teaching method

Tests of Between-Subjects Effects

Dependent Variable: Posttest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	234.813[a]	8	29.352	1.926	.063
Intercept	3261.110	1	3261.110	213.966	.000
Pretest	87.879	1	87.879	5.766	.018
Group	80.266	1	80.266	5.266	.024
Gender	3.535	1	3.535	.232	.631
School Location	15.963	1	15.963	1.047	.308
Group * Gender	12.505	1	12.505	.820	.367
Group * School Location	4.088	1	4.088	.268	.606
Gender * School Location	1.034	1	1.034	.068	.795
Group * Gender * School Location	.151	1	.151	.010	.921
Error	1691.779	111	15.241		
Total	**78081.000**	**120**			
Corrected Total	**1926.592**	**119**			

R Squared = .122 (Adjusted R Squared = .059)

The results presented in Table 2 reveal that an F-ratio of 5.266 was obtained with an associated probability (p) value of 0.024. As the probability value of 0.024 is less than 0.05 set as the benchmark, the null hypothesis (H_{O1}) is rejected.

Table 3: Mean and standard deviation scores as regards gender influence on students' achievement in Biology

			Pretest		**Posttest**		
	Gender	**N**	$\overline{X}$	**Std. Dev.**	$\overline{X}$	**Std. Dev.**	**Mean Gain**
Control	M	20	15.55	4.43	23.50	3.66	7.95
	F	40	17.80	5.16	25.10	3.56	7.30
Experimental	M	22	15.82	3.54	25.95	5.17	10.13
	F	38	15.94	4.09	25.74	3.80	9.80
Total	M	42	15.45	3.96	24.79	4.63	9.34
	F	78	16.89	4.73	25.41	3.67	8.52

Data in Table 3 reveal that male students exposed to contents in Biology using a practical activity approach with reference to the mean and standard deviation scores of their pretest and posttest had a mean gain achievement score of 10.13. Conversely, the female students taught Biology using a practical activity approach had a mean gain achievement score of 9.80. Table 3 also revealed that the male students generally had a mean gain achievement score of 9.34. On the other hand, the female students had a mean gain achievement score of 8.52.

The results presented in Table 2 show the influence of gender on students' achievement in Biology, with an F-ratio of 0.232 with an associated probability (p) value of 0.631 which was greater than 0.05 set as the benchmark was gotten. The null hypothesis (H_{O2}) which stated that there is no significant influence of gender on students' achievement in Biology is not rejected.

The results presented in Table 2 show that an F-ratio of 0.820 with an associated probability (p) value of 0.367 which was greater than 0.05 set as a benchmark was obtained. The null hypothesis (HO_3) which stated that there is no significant interaction effect of teaching strategy and gender on students' achievement in Biology is not rejected. This is further illustrated in the interaction graph shown below where gender (male and female) plotted against teaching strategy did not intercept at any point.

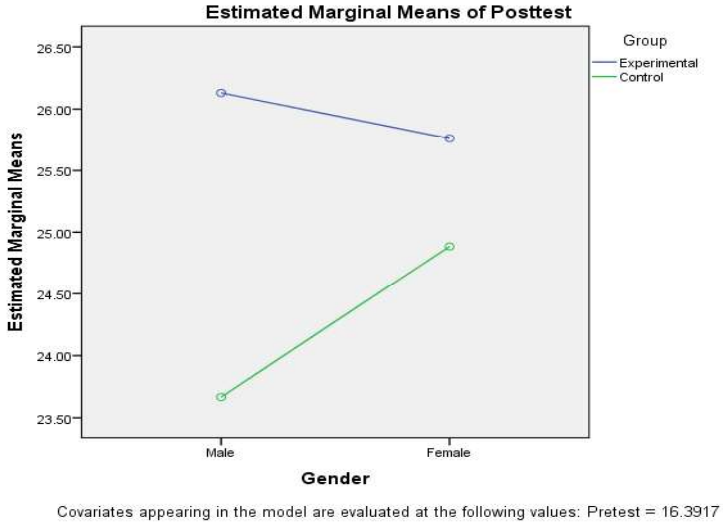

Figure 1: Graph showing interaction effect of teaching strategy and gender on students' achievement in Biology

Table 4: Mean and Standard Deviation Scores as regards to the influence of school location on students' achievement in Biology

			Pretest		Posttest		
	School Location	**N**	$\overline{X}$	**Std. Dev.**	$\overline{X}$	**Std. Dev.**	**Mean Gain**
Control	Urban	32	18.44	5.32	25.41	2.88	6.97
	Rural	28	15.11	4.17	23.61	4.20	8.50
Experimental	Urban	28	17.43	3.93	26.32	4.33	8.89
	Rural	32	14.56	3.34	25.37	4.31	10.81
Total	Urban	60	17.97	4.71	25.83	3.63	7.86
	Rural	60	14.81	3.73	24.55	4.32	9.74

Data in Table 4 show that urban students who were taught Biology using a practical activity approach had a mean gain achievement score of 8.89. On the other hand, rural students had a mean gain achievement score of 10.81. Table 4 also shows that the urban students had a mean gain achievement score of 7.86. Conversely, the rural students had a mean gain achievement score of 9.74.

The results in Table 2 show the influence of school location on students' achievement in Biology, with an F-ratio of 1.047 with an associated probability (p) value of 0.308 which was greater than 0.05 set as a benchmark was obtained. The null hypothesis (H_{O4}) which stated that there is no significant influence of school location on students' achievement in Biology is not rejected.

Discussion

The use of the practical activity approach was more effective than the conventional teaching method in helping students succeed in Biology. The students who were taught using a practical activity approach absorbed concepts faster and remember the information better than those who were taught using a conventional method. The instructional processes were marked by active students' involvement, grabbing the students' interest and maximizing comprehension of the subject matter, making the practical activity approach more effective than the conventional method. This result is consistent with Ude (2019), who asserted that students who were exposed to Biology knowledge using a practical activity strategy outperformed those in the control group who were taught using the conventional method. Since Biology involves the study of living entities that are easily found in the environment, its effective teaching and learning inevitably require practical

activity. Therefore, Biology lessons are lacking if only the theoretical aspects are taught without accompanying the relevant practical tasks.

Male students outperformed female students in the practical activity approach, according to the results of the study on the influence of gender on the mean achievement scores of the students in Biology. However, ANCOVA analysis further revealed that this was not significant. This was contrary to the findings of Ude (2019) and Chikelu (2009), who found that gender significantly affected students' performance in Biology. This demonstrated that the practical activity approach is not prejudiced against either gender when employed because it improved learning and gave both male and female Biology students an equal opportunity to learn. The interaction effect of teaching approach and gender, which revealed no appreciable interaction effect on students' achievement in Biology, further supported this.

When taught using practical activity approach, students whose schools were located in rural areas marginally outperformed students whose schools were located in urban areas. This difference in the mean achievement score was not significant. It demonstrated that the practical activity approach is effective for students learning Biology regardless of where a school is located. This contradicts the findings of Ezechi and Adakwu (2018), who found that students' Biology achievement is significantly influenced by their school's location. The amount of students' participation and the cooperation that students experienced when a practical activity approach is applied reinforce Lev Vygotsky's social constructivism theory.

Conclusion

Based on the findings of the study on the influence of gender and the practical activity approach on students' Biology achievement, it can be said that the practical activity approach raises students' Biology achievement more than the conventional teaching method. Additionally, it is gender fair because it provides both male and female Biology students with an equal opportunity to learn. Finally, when using the practical activity approach, location has no impact on students' Biology achievement. As a result, practical experience benefits students in both urban and rural areas, proving that it is not a location-specific activity.

The findings of this study have implications for secondary education. The common application of conventional teaching methods in Biology teaching is not practice-oriented. Thus, the biology students' poor academic achievement

may have been caused by this. This is due to the fact that students are inspired to better understand the biology concepts they are taught through the exposure gained when a practical activity approach is implemented. The findings have implications for science teachers as well. Some science teachers such as Biology teachers might have been teaching students with strategies that are not favourable to the students' understanding of the nature of science. Therefore, they need to move from using teacher-centred to student-centred instructional strategies that are cooperative oriented like the practical activity approach, since it can enhance students' understanding of the subject adequately. Additionally, it is crucial to take gender into account during instructional processes so that all students, regardless of gender, have an equal chance to learn, as is seen when a practical activity approach is implemented. The results of this study also have implications for curriculum designers. To improve the utilization of the practical activity approach, the high school Biology curriculum should incorporate more practical tasks since Biology teachers use the curriculum as a guide.

Recommendations

The following were recommended:

1. The government should equip Biology laboratories in all secondary schools to make Biology teaching and learning more practical.
2. To make the best use of the practical activity approach, Biology teachers should try to improvise some resources that are not readily available.
3. To accommodate students during practical activities, the government and host communities should construct more buildings in schools for Biology laboratories and as well equip them.
4. Science teachers kept abreast of the practical activity approach as the ministry of education periodically organizes seminars for them.
5. Biology teachers and science teachers, in general, should receive more financial incentives such as practical hazard allowance, and their working conditions enhanced. These would motivate them to teach the subject via practical activities.

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