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Assessing Teacher Factor and Second Year Home Economics Students' Performance in Biology Practicals in Two Districts of Oti Region, Ghana

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Abstract: ***The purpose of this paper is to assess the level of performance of Home Economics Second Year students in Biology practicals and also explore teacher factors that contributed to this level of performance ascertained. Four schools from two districts within Oti region were selected for the study. The selection of schools for this study was mainly based on the performance of Home Economics students in WASSCE biology within the years 2015-2018 and the school's availability for the study. In all, 76 Home Economics students were sampled randomly whereas 4 teachers who teach them were sampled purposively. The research design employed was descriptive survey. A 30-item Home Economics Students Performance Test (HESPBPT) with reliability estimated value of 0.84 by Cronbach's alpha method in SPSS version 16 was administered on the students to generate data for analysis. Also, Biology Teachers Questionnaire (BTQ) and Practical Observation Checklist (BPOC) were administered on teachers to generate relevant data for analysis. The study revealed that there is a statistically significant difference in the performance level of Home Economics Second Year students selected randomly from the four schools. Again, the study established that the practical performance levels of these students are poor and teacher characteristics such as Practical Content Knowledge and Practical Pedagogical Knowledge which affects teacher practical content coverage, practical content exposure and practical content emphasis are the main factors that negatively contributed to it.***

Keywords: Opportunity-to-learn (OTL), Student Practical Performance Determinant Framework (SPPDF), Home Economics Students Performance Test (HESPBPT), Biology Teachers Questionnaire (BTQ), Biology Practical Observation Checklist (BPOC), Practical Pedagogical Skills (PPSs).

1. Introduction

Education in general, and science education in particular is important for developing methods and standards of living. The development of a society without science education is unimaginable. According to Lewin (1992), over the last two decades many developing countries in an attempt to build vibrant economies, have invested heavily in improving access to, and enhancing the quality of, science education.

To this, Ghana on the drive to sustainability was the first independent sub-Saharan African country to embark on comprehensive drive to promote science education as well as the application of science in industrial and social development (Anamuah-Mensah, 1999).

Biology as a branch of natural science is devoted to the study of life and the activities of all living things from bacteria to higher plants and animals. The survival of humans, nevertheless, depends greatly on the knowledge and understanding of the structure and function of organisms and how they interact with one another and the environment. The knowledge, skills and attitudes acquired through the study of biology provides the learner with necessary basic tools for employment in laboratory, industry, agriculture, horticulture, forestry, healthcare, work with animals, marine and freshwater biology, information science, administration, finance, management and teaching. It further equips the learner for further studies and research into pure and applied sciences and technology that are vital areas for the advancement of society. Teaching elective biology in totality guides the learner and makes him or her capable of critical thinking, making meaningful decisions and solving problems (Curriculum Research and Development Division [CRDD], 2010).

The advantages of studying biology as outlined by the biology syllabus for Senior High School, makes it important for everyone to be concerned about students' performance in it. Over the years, experts have continued to draw attention to the grave consequences of constant decline in the performance of students in biology (Abdullahi, 1982; WAEC, 2015). Since, worldwide biology has been recognized as indispensable tool in the development of a vibrant economy, assessing students' performance and developing new and innovative approaches to help improve their performance in biology has become the focal point of most researches.

According to Ndioho (2005) and Chukwuneke (2006), the use of traditional instructional approach without practicals to teach biology to secondary school students results in poor understanding of biological concepts and consequently poor performance.

Hofstein (1988) revealed that biology practical work is worthwhile in helping to develop favourable scientific attitudes of students. To Millar (2004) the real purpose of practical work is to encourage students to make links between

things they can see and handle, and ideas they may entertain which might account for their observations.

The West African Examinations Council in an attempt to encourage practical work in biology, have outlined skills that biology students must acquire before their final biology examinations. These skills are categorized into laboratory and field skills and are generally referred to as Science Process Skills (SPS). The SPS as stated by WAEC align itself to the biology teaching syllabus which guides the choice of the biology teachers' instruction in the classroom.

According to Hinneh (2017), students develop certain undesirable attitudes that hinder their interest and consequently affect their performance when they are not exposed to practicals or are made confuse in the midst of practical work. Since the inception of the Senior Secondary School Programme (SSSP) in 1987, the West African Examinations Council (WAEC) Chief Examiners' Reports indicate that more students fail in Biology because they do not perform creditably in the practical paper (Biology 3) which contributes 40% to the total assessment mark and tests:

- Students' scientific inquiry skills in drawing;
- Identification and classification;
- Students' ability to relate structure to function;
- Analyses of some processes; and
- Interpretation of biological phenomena.

Home Economics students in Jasikan and Kadjebi Districts of the Oti Region have over the years performed poorly in WASSCE Biology as indicated by their school results analysis. From 2015 to 2017, a total of 487 Home Economics students were graduated from four senior high schools in the two districts. Out of the 487 students, 176 representing 36.14% scored grades A1- C6 while 139 representing 28.54% obtained grades D7-E8 and 172 representing 35.32% scored F9.

These results imply that only 176 Home Economics students qualify to enter any tertiary institution in Ghana for biology related programmes or otherwise while 311 students representing 63.86% did not qualify because the basic requirement is C6 and therefore would have to resit biology to be able to qualify for any tertiary biology programme. Also, performance in WASSCE biology 2018 and 2019 followed a similar trend as observed in previous years.

To this, since biology practicals play a major role in students conceptual understanding and consequently their performance in biology, this study sought to assess the level of performance of Home Economics SHS2 students in biology practicals.

1.1 Purpose of the Study

The purpose of the study was to determine the level of performance of Home Economics students in biology. Specifically, the study explored:

1) The performance level of Second Year Home Economics students in biology practicals in two districts of Oti Region.
2) The teacher factors that account for Second Year Home Economics students' level of performance in biology practicals in the two districts of Oti Region.

1.2 Scope of the Study

The study focused on biology teachers and Second Year Home Economics students from four schools located in two districts of the Oti Region in Ghana. These schools were considered because their biology teachers and Home Economics students were accessible for the study.

1.3 Research Question

The following research questions guided the study:

1) What is the level of performance of Second Year Home Economics students in biology practicals?
2) What teacher factors account for Second Year Home Economics students' level of performance in biology practicals?

1.4 Hypothesis

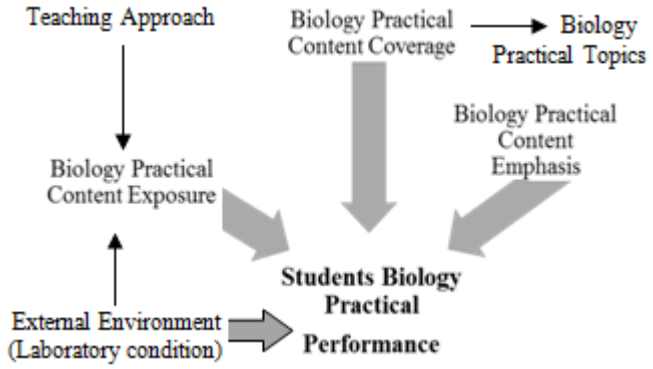
Ho: There is no statistically significant difference among the mean scores of Second Year Home Economics students in biology practicals from the four schools selected for the study.

2. Conceptual Framework

The study whose focus was to determine the performance level of SHS2 Home Economics students in biology practicals and teacher factors that account for their level of performance, adapted the opportunity-to-learn (OTL) conceptual framework which was first developed by Stevens (1993). This framework by Stevens (1993) identified four variables that have positive influence on students learning outcomes (performances). They are: Content Coverage variable; Content Exposure variable; Content Emphasis variable; and Quality of Instructional Delivery variable.

This study however focused on Content Coverage variable, Content Exposure variable and Content Emphasis variable. In addition to these variables, it also considered the environment (laboratory) where biology practicals occur as a variable that greatly influence students' performance (outcome).

Based on all these variables, the study developed a conceptual framework which was titled "Students Practical Performance Determinant Framework (SPPDF)" to determine holistically the teacher factors vis-à-vis the conditions of biology laboratories and how they have contributed to students' performance particularly in biology practicals.



3. Research Methodology

Research Design

The study employed descriptive survey design. According to Cohen, Manion and Morrison (2007), the descriptive survey design aims at obtaining information about the present condition or position of an organization, institution or a school. Since it was the purpose of the study to carefully assess the performance of Home Economics students in biology practicals and teacher factors that affect their performance level, this design was considered the best.

Sample Size

The sample size was 76 Home Economics students selected randomly from four schools with pseudonyms A, B, C and D (as indicated in Table 1). Also, one (1) biology teacher who teaches SHS2 Home Economics students biology was purposively sampled from each of the four schools. The minimum sample size of students (76) was calculated using:

$n = \frac{4pq}{d^2}$ as proposed by Rose, Spinks and Canhoto (2015).

According to Rose, Spinks and Canhoto (2015), by definition, n = minimum sample size, p = proportion of the population having the characteristics observed at 95% confidence level (the worst scenario = 0.95), q = 1- p and d= degree of precision (accepted margin of error $\pm$5% = 0.05).

Hence, $n = \frac{4(0.95)(0.05)}{(0.05)(0.05)} =$ **76**

Table 1: Sample frame for the study

School	No. of Intact Classes	No. of students in H/E1	No. of students in H/E2	Total No. of students	No. of students selected per Class	Total students selected for Study
A	2	32	31	63	13	26
B	2	30	28	58	12	24
C	1	24	-	24	10	10
D	2	20	18	38	8	16
Total	7	106	77	183	43	76

Source: Field data, 2019.

In all, the sample size for the study was 80.

4. Data Collecting Instruments

a) Home Economics Students Performance in Biology Practical Test (HESPBPT)

This instrument which comprised 30-items was used to collect data on students' performance level in biology practicals. The test covered the following Year 1 topics: body symmetry, sections and orientation of specimens; preparation of wet-mount slide; identification of the parts of the microscope and its operation; and biological drawing. These topics were selected because it is believed that students had already treated them and that their responses on these topics would give a better picture of their true performance.

b) Biology Teachers Questionnaire (BTQ)

This instrument assessed biology teachers' characteristics (factors) particularly their beliefs and experiences which has great impact on their practical content coverage, content emphasis, content exposure and consequently students' biology practical performance level.

c) Biology Practical Observation Checklist (BPOC)

This instrument assessed the availability of practical equipment/materials and the environment (laboratory) where practical occurs. The HESPBPT produced internal consistency reliability estimated value of 0.84 by Cronbach's Alpha method in SPSS version 16.

5. Results and Discussion

Research Question 1

What is the level of performance of Second Year Home Economics students in biology practicals?

The test which focused on Year 1 biology practical topics which included body symmetry, sections and orientation of specimens, preparation of wet-mount slide, identification of the parts and operation of the microscope, and biological drawing was scored over 50 marks. To however calculate the percentage score for each student who participated in this test, individual students scores were multiplied by the factor 2. This implies that the highest score for HESPBPT which is 50 marks would produce a percentage score of 50 x 2 = 100%. Hence, the data collected from the four schools with pseudonyms A, B, C and D produced the highest individual percentage scores to be 42%, 46%, 34% and 34% respectively. Again, the corresponding lowest individual percentage scores were 10%, 14%, 10% and 12% respectively.

Table 2 shows the details of students' level of performance in biology practicals.

Table 2: Analysis of students scores in HESPBPT

School	N	Sum of score	Total sum of score (N x 50)	% score (sum of score divided by total sum of score multiplied by 100)	Remark
A	26	347	1300	26.69	Fail
B	24	337	1200	28.08	Fail
C	10	110	500	22.0	Fail
D	16	193	800	24.13	Fail

Note: Remarks was based on WAEC recommendation [80-100% (Excellent), 70-79% (Very good), 60-69% (Good), 50-59% (Credit), 40-49% (Pass) and 0-39% (Fail)]

Based on the data collected as indicated in Table 2, the level of performance of randomly selected Second Year Home Economics students in biology practicals was low. This implies that the students need immediate remediation (intervention) in biology practicals, which forms the foundation of a solid conceptual understanding of biology.

According to the Curriculum Research and Development Division (2010), teaching biology practicals help students not only to acquire knowledge but also to understand what they have learnt and apply them practically. To this, three profile dimensions which are knowledge and comprehension (30%); application of knowledge (40%); and practical and experimental skills (30%) for teaching, learning and testing processes in biology was advocated by the teaching syllabus.

Practical work in biology is very important because scientific phenomenon is not fully understood by only theory. The fact that the empirical and theoretical are intertwined and cannot be separated, the biology teaching syllabus advocated three (3) periods of forty (40) minutes per week for theory and three (3) continuous periods of forty (40) minutes per week for practicals.

Hypothesis:

Ho: There is no statistically significant difference among the mean scores of Second Year Home Economics students in biology practicals from the four schools selected for the study.

Table 3: Analysis of variance of Schools (students score in HESPBPT)

School	N	Sum of score	Mean score	Mean Deviation	Standard Deviation	Variance
A	26	347	13.35	3.55	4.24	18.00
B	24	337	14.04	3.54	4.24	17.95
C	10	110	11	3.0	3.61	14.44
D	16	193	12.06	2.56	3.11	9.66

Source of Variation (score of the student)	Sum of Squares	Degree of freedom	Mean Score	F	P-value	F crit
Between Groups	83.20639	3	27.73546446	1.75513074	0.163453	2.731807
Within Groups	1137.78	72	15.80250623			
Total	1220.987	75				

Table 3 reveals that the four groups of students from the four schools showed significant statistical difference (F value =1.755, p-value = 0.163) in their performance level. To this, the null hypothesis "*There is no statistically significant difference among the mean scores of Second Year Home Economics students in biology practicals from the four schools selected for the study*" was not supported.

Also, the SD score for schools A and B (4.24) implies that Home Economics students in those schools have mixed ability as compared to their counterparts in schools C and D with SD scores of 3.61 and 3.11 respectively.

What teacher factors account for Second Year Home Economics students' level of performance in biology practicals?

Table 4: Analysis of teachers' beliefs and experiences about biology practicals

S/N	Statement	n	SD	M
1	Students need incessant practicals to perform creditably in biology	4	1.29099	2.5
2	Biology theory needs more time than biology practicals	4	0.57735	3.5
3	I like teaching Biology theory to practicals	4	0.5	3.75
4	It is difficult to get materials for biology practicals	4	0.5	3.75
5	Biology practicals is time consuming	4	0	4
6	I have more knowledge in biology theory than practicals	4	0.57735	3.5
7	My experience in teaching practicals is limited	4	0.57735	3.5
8	Biology practicals should be organize by experience biology teachers	4	0.5	3.75
9	I get exhausted after organizing biology practicals	4	0.57735	3.5
10	Biology practicals have very little impact on students WASSCE performance	4	0.57735	2.5
11	Biology practicals improves the understanding of theory	4	0	3
12	The best time to teach practicals is when students are in Form 3	4	0.95743	3.25
13	Biology practicals is not as important as biology theory	4	0.5	2.25
14	I need in-service training to teach biology practicals	4	0.5	3.25
15	I need to be supported by other teachers to teach practicals	4	0.5	3.25
16	I like biology practicals	4	0.5	2.25
17	Practicals can only be taught in the laboratory when equipments are available	4	0.5	3.75
18	Teaching practicals is as important as teaching theory	4	0.5	2.75

From the above data as indicated in Table 4, Biology Teachers Questionnaire (BTQ) was used in the assessment of teachers' beliefs and experiences, it came to the fore that all the

respondents had varied opinions (SD=1.29, M=2.5) on the statement, "students need incessant practicals to perform creditably in biology". However, their opinion as expressed on the statement, "The best time to teach practicals is when students are in Form 3", which yielded Standard Deviation of .957 and Mean value of 3.25. It implies that the best time to teach practicals is not when students are in the first year nor second year, but rather when they are in the third year. This contravenes with what the syllabus proposed, and perhaps that largely accounted for the abysmal performance of Home Economics Second Year students' performance in the HESPBPT as indicated in Table 2.

According to Motlhabane and Dichaba (2013), although practical work plays a pivotal role in the teaching of biology, many teachers ignore it and focus on teaching only the theory. This phenomenon has contributed negatively to the development of basic biology practical skills among students. Also, if teachers introduce biology practicals in form three, it makes it difficult for students to fully understand biological concepts, and also, grasp manipulation and experimental skills as tested by WAEC in biology paper 3.

Teachers intimated that they have more knowledge in biology theory than practicals. This assertion is so, because adequate attention is not given to Practical Content Knowledge (PCK) and Practical Pedagogical Skills (PPSs) during pre-service teacher professional training. Also, teachers are not given in-service training on biology practicals to supplement the experience they need to teach biology practicals with all the enthusiasm it requires. To this, the findings however established that biology teachers need in-service training to augment their practical teaching skills.

According to Anamuah-Mensah and Asabere-Ameyaw (2011), one of the weaknesses in Ghanaian teacher preparation is that it focuses more on subject matter content than practical application. To them this limitation in effect affects biology teachers' practical content coverage, and it tends to affect students' practical performance.

Again, the BTQ revealed that teachers view on how to support other teachers (experience teachers) as key in the successful organization of biology practicals. The experienced teacher shares his or her experiences with the novice biology teacher, who thereafter develops experiences and confidence to perform incessant practicals on his or her own to the benefit of the student learner.

To Mulkeen (2010), there is an urgent need to prepare novice biology teachers in several domains of teaching, including pedagogic content knowledge, and classroom management knowledge, because majority of biology teachers are degree holders who have deep knowledge in content but lack practical dexterity.

Solomon (1999) reiterated that practical work and theoretical learning support each other: she used an example of a medical student who, when seeing his very first x-ray picture in a lecture, could not first make sense of either the picture or the lecturer's words but when comprehension came both the picture and the theory made sense simultaneously. Her point to make is that neither the one nor the other is primary (representation) and that neither of them alone corresponds to the full internal image of students.

Science (biology) teachers see practical work carried out by students themselves as an essential element of good science (biology) teaching, as one teacher puts it in an interview study (Donnelly, 1995), 'it is what science (biology) is all about … Science (biology) is a practical subject.

Again, data collected by Biology Practical Observation Checklist (BPOC) points to the fact that although the schools have biology laboratories which are not in the best of conditions but could fit its intended purpose with some little innovation, biology teachers have ignored its use to complement their teaching. The absence of time tables for biology practicals as well as practical lesson plans and students drawing books couple with their practical workbook, revealed that teachers have ignored biology practicals and therefore the use of the laboratories. To this, it is believed that the teaching of biology to Home Economics students could encourage rote learning among them since their biology lessons are mostly without practicals.

Also, because teachers do not focus on the biology practicals as they do with the theory, their experiences in the practicals has not improved as much to benefit their students and help improve their performance.

The upshot of all these teacher characteristics (factors) as established by the study, contributed to the negative performance of Home Economics Year Two students within the context of the study.

6. Conclusions

Based on the results of the findings, Home Economics Second Year students have not been engaged in incessant biology practicals as proposed by the subject syllabus (CRDD). This however has negatively affected their level of performance as revealed by the study. Also, biology teachers' characteristics particularly their Practical Content Knowledge (PCK) and Practical Pedagogical Skills (PPSs) which have direct influence on their practical content coverage, practical content exposure and practical content emphasis and consequently students' level of performance in biology practicals need to be enhanced.

To this, biology teachers' professional preparation both at pre-service level and in-service level needs to be practically oriented to make the teachers apt to teach both practicals and theory concurrently as proposed by the subject syllabus (CRDD, 2010).

7. Recommendation

From the results of the findings, the research recommends that the Ghana Education Directorate for Senior High Schools in the Oti Region should do the following:

1) Teachers must take immediate steps to engage their students in practicals. These steps should include the use of novel approaches such as blending traditional laboratory approach with that of multimedia laboratory approach.
2) Teachers should be given in-service training by well experienced biology teacher who are either in active service or might have just retired.
3) There should be a supporting team made of experienced biology teachers allocated to these districts as mentors to help develop practical skills of novice teachers.
4) The institutions that train biology teachers should give attention to the development of students PCK and PPSs and not only subject matter content.
5) Headmasters/mistresses should commit their supervision to making sure that biology teachers are given the necessary support in terms of duty reliefs to enable them have adequate time to teach students practicals.

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