



**EVALUATING THE EFFECTIVENESS OF
DEMONSTRATION-CUM-DISCUSSION TEACHING
STRATEGY ON STUDENTS' ACADEMIC ACHIEVEMENT
IN SOME ECOLOGICAL CONCEPTS**

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Abstract:

This study investigated the effectiveness of Demonstration-cum-Discussion teaching strategy on students' academic achievement in ecological concepts at Navrongo Senior High School, using quasi-experimental design (pretest, posttest non-equivalent approach). The sample comprised of 75 Form Two General Science Gold Track (control group of 29 males and 10 females) and Green Track (experimental group of 21 males and 15 females) students. The experimental group and control groups were taught using Demonstration-cum-Discussion teaching strategy and Conventional Teaching Method respectively. The test-retest reliability coefficient of the instrument was found to be 0.78. The pretest scores revealed that the students were homogeneous in terms of academic achievement (Mean = (22.19, 21.46) t-value = 0.87, p-value = 0.39, $p > 0.05$). The posttest results of the experimental group were significantly higher than the control group (Mean = (48.19, 38.71) t-value = 12.43, p-value = 0.000, $p < 0.05$). There was no significant difference in the achievement of male and female students in the experimental group for both pretest (Mean = (23.24, 21.33) t-value = 1.43, p-value = 0.20, $p > 0.05$) and posttest (Mean = (48.52, 47.73) t-value = 0.53, p-value = 0.59, $p > 0.05$). This study recommended that Biology teachers at Navrongo Senior High School should be encouraged to teach the concept of Ecology using demonstration-cum-discussion in order to enhance the conceptual understanding and academic achievement of students.

Keywords: ecology, demonstration-cum-discussion, conventional teaching method

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1. Introduction

Biology is one of the science subjects offered at the senior high school to tertiary level in Ghana for science students. The instructional strategy adopted by Biology tutors in Ghana specifically in the Kassena Nankana Municipality of the Upper East Region of Ghana in teaching the subject does not help to improve the conceptual understanding and academic achievement of students. The most common instructional strategies used by Biology teachers are the lecture method and note-taking. According to Alaagib, Musa and Saeed (2019) these methods stress on naming, memorizing and recalling which do not lead to the development of critical thinking and inquiry skills of learners. The traditional and note-taking method makes the learner passive in the teaching and learning process. One of the main factors facilitating meaningful learning of biological concepts is the use of effective and efficient instructional methods (Ogunkola & Samuel, 2011). SMASSE report (2010) recommended that instructors should come up with new teaching strategies that will place more emphasis on practical activities. Biology teachers should adopt instructional strategies that are capable of helping students to develop critical thinking, innovative and inquiry skills. This can be attained by shifting from the teacher-centred to student-centred teaching approach (Wafula & Odhiambo, 2016).

There are many current instructional strategies that would promote better understanding of biological concepts. These methods are; computer assisted instruction, multimedia instructional strategy, project-based method, demonstration method, concept mapping method, laboratory method, inquiry method, cooperative learning and field trip method (Achor, Wude, & Duguryil, 2013). These instructional methods give learners the opportunity to participate fully in the teaching and learning process (Namale & Buku, 2011). Modern instructional strategies also enable learners to develop problem solving skills.

Demonstration method of teaching is an instructional teaching strategy in which a teacher demonstrates an activity with explanations where necessary and students watch and also practice (Olufunmiyi, 2015). According to Akinbobola and Ikidite (2011) demonstration method involves teaching concepts, principles of real things by combining explanation with handling or manipulation of real things, materials or equipment. This instructional strategy utilizes several senses; students can see, hear and possibly experience an actual event which stimulates interest and reinforces learning (Umar, Dauda, & Mutah, 2016). Demonstration method is useful for facilitating learning since it promotes students' concentration and interest in the lesson (Basheer, Hugerat, Kortam, & Hofstein, 2017). The purpose of using demonstration method in teaching and learning process is to show a process and the occurrence of an event (Ramadhan & Surya, 2017). Demonstration instructional strategy promotes hand-on exposure to students and makes learners active in the teaching and learning process (Giridharan & Raju, 2016).

Discussion is a method of instruction whereby two or more people express, clarify, and pool their knowledge, experiences, opinions and feelings (Rahman, et al., 2011). Discussion method provides opportunity for dialogue between teacher and students in

teaching and learning process. Discussion method of instruction is considered as active teaching strategy because it enables students to explore issues of interest, opinions and ideas (Hackathorn, Solomon, Blankmeyer, Tennial, & Garczynski, 2011). The learner is the owner of his/her own knowledge in this instructional strategy. The principal role of the instructor is to facilitate the learning process and act as a catalyst and tilt the students' minds into thinking and reflecting on the topic or concept (Azure, 2018). Discussion instructional strategy does not consider the learner to be an empty vessel prepared to receive information from the instructor but the learner has knowledge which may be wrong or correct about a given concept and the main duty of the teacher is to help polish the students' prior knowledge. Discussion method of teaching assists in fostering intellectual growth, individual expression and character development (Abdulbaki, Suhaimi, Alsaqqaf, & Jawad, 2018).

Demonstration-cum-discussion method of instruction is a teaching strategy in which the instructor demonstrates aspects of the concept that needs demonstration with the involvement of the students and also initiates discussion in aspects of the topic that need to be discussed (Omotayo & Taiwo, 2018). This instructional strategy engages students fully in the teaching and learning process and also helps learners to develop critical thinking, analytical, inquiry, observation and communication skills (Azure, 2018). Demonstration-cum-discussion instructional approach helps to cater for different learning needs of students in the class.

2. Statement of the Problem

In this study effectiveness of demonstration-cum-discussion instructional strategy on students' academic achievement in some ecological concepts was investigated. Ecology is considered as one of the difficult topics in Biology by General Science students at Navrongo Senior High School in Ghana. The 2021 final year students were asked to list Biology topics which they considered to be difficult. Out of a total population of 100 students, 85 listed Genetics, Anatomy and Physiology of mammals, Ecology, Classification of living organisms, Cell Biology and Plant Anatomy and physiology. They indicated that these topics are very broad and also have a lot of technical terms hence making them difficult to understand. The West African Examination Council Chief Examiner Report (2013-2018) outlined the weaknesses of Biology candidates in the area of poor spelling of technical terms and poor grasps of ecological concepts. Etobro and Fabinu (2017) studied the topics that Senior Secondary School students had difficulties in learning in Lagos State, Nigeria and reported that the students often have difficulties learning five main topics in Biology. These topics are; ecological concepts, conservation of natural resources, reproduction in plants, pests and diseases of plants and genetics. The researchers concluded that the students attributed their sources of difficulties in learning these Biology topics to abstractness, complexity, and misconception of concepts. They also noted that teachers' methods of teaching and lack of practical activities militated against students' understanding of concepts. It is against this background that

the current study sought to explore the effectiveness of demonstration-cum-discussion instructional strategy on students' academic achievement in some concepts in Ecology at Navrongo Senior High School in the Kassena Nankana Municipality of the Upper East Region of Ghana.

2.1 Purpose of the Study

This study was conducted to determine the effectiveness of demonstration-cum-discussion teaching strategy on students' academic achievement of form two general science students in some ecological concepts at Navrongo Senior High School.

2.3 Specific Objectives of the Study

The objectives of the study were to:

- 1) Determine the difference between the pretest mean scores of students in the experimental and control groups.
- 2) Determine the difference between the posttest mean scores of students in the experimental and control groups.
- 3) Examine the difference between the pretest and posttest mean scores of male and female students in the experimental group.

2.4 Research Questions

The following research questions were addressed in the study:

1. What is the difference between the pretest mean scores of students in the experimental group and the control group?
2. What is the difference between the posttest mean scores of students in the experimental and control groups?
3. What are the differences between the pretest and posttest mean scores of male and female students in the experimental group?

2.5 Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

HO₁. There is no significant difference between the pretest mean scores of students in the experimental group and the control group.

HO₂. There is no significant difference between the posttest mean scores of students in the experimental group and those in the control group.

HO₃. There is no significant difference between the pretest and posttest mean scores of male and female students in the experimental group.

2. Literature Review

2.1 Theoretical Review: Constructivism Teaching and Learning Theory

The teaching and learning theory that underpinned this study is the constructivism teaching and learning theory proposed by John Dewey (1933) and other constructivists such as Jean Piaget (1972), Lev Vygotsky (1978) and Jerome Bruner (1990). Constructivism is a learning theory that describes how learners construct knowledge based upon previous experiences which are unique to each student (Singh & Yaduvanshi, 2015). Constructivism is a learner-centred approach rather than teacher-centred where the instructor acts as a facilitator. According to Sherma and Poonam (2015), this learning theory engages students in a manner that they can construct their own knowledge by correlating it with their past experiences. Constructivism is basically a learning theory which is based on observation and scientific study of how people learn (Olusegun, 2015). When students come into contact with something new, they try to connect it with their previous knowledge by modifying what they believe without necessarily ignoring the totality of the new information. In a constructivism classroom setting, the task is shifted from the teacher to the learner. Constructivism classroom is not a place where a knowledgeable person pours a well-organized body of knowledge to learners who are considered as empty vessels ready to be filled. Learners in such classrooms are encouraged to actively participate in the teaching and learning process while the teacher functions as a coach, motivator and facilitator.

Constructivism theory of learning has four key concepts. These are; schema, assimilation, accommodation and equilibration. Schema refers to the learner's ability to classify and organize new experiences in the mind. Schemas are developed based on information provided by life experiences and are stored in memory. Assimilation is the process of interpreting new information, concepts and ideas or concepts based on existing knowledge and understanding (Alkhaldeh, 2013). Accommodation is the ability to restructure the learner's mind or mental organization such that new information may be included. Equilibration is a concept that deals with the ability of the learner to balance new information with old knowledge. Equilibration helps explain the procedures through which children move from one level of thought to another (Sharma & Poonam, 2016).

Merill (1991) outlined the following assumptions of Constructivists theory: 1) Learning is a personal interpretation of the world. 2) Learning is an active process in which meaning is developed on the basis of experience. 3) Conceptual growth comes from the negotiation of meaning, the sharing of multiple perspectives and the changing of our internal representation through collaborative learning. 4) Learning should be situated in realistic setting; testing should be integrated with the task and not a separate activity.

Constructivism teaching and learning theory which is also known as Genetic Epistemology helps learners to transfer their skills to real life situation. It helps learners to learn more on their own since it is learner-centred where students are actively engaged

in the teaching and learning process (Singh & Yaduvanshi, 2015). The theory also helps learners to ask meaningful questions and apply their curiosity to solve problems in their daily lives. Constructivism promotes the sense of personal agency as learners have ownership of their learning and assessment (McLeod, 2019). Constructivism also creates new understanding through moderation, coaching and suggestions (Christie, 2005).

2.2 Empirical Review

Ekeyi (2013) explored the effect of demonstration method of teaching on students' achievement in agricultural science. A total of 480 students from 12 intact classes were sampled for the study. The results of the study proved that students who were taught through demonstration method performed significantly higher than the cohort who was taught through traditional teaching method. Basila and Jajua (2019) investigated the effects of demonstration and discussion instructional strategies on secondary school students' achievement and retention in Biology. A total of 240 students constituted the sample of the study. The results of the study showed that students who were taught using demonstration and discussion methods performed significantly higher than their counterparts who were taught using lecture method. Adegbola (2012) also explored the effects of discussion and demonstration methods of teaching on students' retention and achievement in basic science in Ekiti State. Seventy-six students participated in the study. Based on the results, the researcher concluded that discussion and demonstration methods were effective for teaching basic science since the students' performed significantly higher than the cohort who was taught using lecture method.

2.3 Research Gaps

Few research studies have been carried out on the effect of demonstration and discussion methods of instruction. Most of these studies were done in Nigeria. Example include; "Effects of demonstration teaching method on senior secondary school students' academic performance in Biology in Ekiti State, Nigeria" by Omotayo and Taiwo (2018), "Effect of demonstration and lecture teaching methods on academic performance of secondary school students' in financial accounting in Adamawu State, Nigeria" by Umoru & Haruna (2018), "A mixed-method study of the effect of demonstration method on students' academic achievement in financial accounting" by Inuwa, Abdullah and Hassan (2018), "Effect of demonstration method of teaching on academic performance of students' in motor vehicle in Yobe State" by Aliyu (2020). No study has investigated the effectiveness of demonstration-cum-discussion on students' academic achievement in ecological concepts. In order to address this research gap, the researchers investigated the effectiveness of demonstration-cum-discussion teaching strategy on students' academic achievement in some concepts in Ecology at Navrongo Senior High School in the Upper Region of Ghana.

3. Methodology

3.1 Research Design

This study adopted a pretest, posttest non-equivalent control group quasi-experimental design. This is because there was non-random sampling of students into groups. Navrongo Senior High School classes exist as intact groups and the school authorities and Ghana Education Service kicked against the dissolution and reconstitution of classes for research activities due to the outbreak of the novel Coronavirus popularly called Covid-19 pandemic. The school authorities and the Head of Science Department also kicked against the dismantling of classes and reconstitution for the purpose of research since it disrupts the time table of the school. The adopted design made use of two groups, control group (X) and experimental group (Y). The conceptual understanding and academic achievement of students in both groups were similar before treatment was administered to them. The control group was taught using Conventional Teaching Method and the experimental group was taught using Demonstration-cum-Discussion Instructional Strategy. The layout for the study is as follows:

Control Group X;	O ₁	X	O ₂
Experimental Group Y;	O ₃	Y	O ₄

Where;

X: represents Conventional Teaching Method;

Y: signifies Demonstration-cum-Discussion instructional strategy;

O₁, O₃; represents Pretest Achievement of students in the control and experimental groups; and

O₂, O₄; signifies Posttest Achievement of students in the control and experimental groups;

3.2 Population and Sample

The study was conducted at Navrongo Senior High School in the Kassena Nankana Municipality in the Upper East Region of Ghana. The population for the study included all Form Two General Science students of Gold and Green Tracks. Purposive sampling technique was used to select two intact classes for the study, one class from Form Two Gold Track science classes and another class from Form Two Green Track science classes. The two classes were randomly assigned into experimental group and control group. The sample size was 75, comprised of 21 males and 15 females of the Green Track class, designated as the experimental group. The control group comprised of 29 males and 10 females of the Gold Track class.

3.3 Data Collection Instruments

The instruments used for data collection were pretest and posttest which were developed by the teachers/researchers from the content that was covered in the study. The data were collected by the researchers before and after the treatment for a period of eight weeks.

The pretest was tagged Students' Basic Knowledge in Ecology Test (SBKET) and was given to both groups before the treatment. The experimental group was taught using Demonstration-cum-Discussion Instructional Strategy and the control group was taught using Conventional Teaching Method. The control and experimental groups were taught by one of the researchers. All lesson plans were prepared on the aspects of ecology using Ghana Education Service Teaching Syllabus and West African Senior Secondary School Biology Syllabus for Biology. The aspects of ecology covered included: Terminologies used in Ecology; habitats (terrestrial and aquatic habitats); feeding relationships (food chain, food web and ecological pyramid); Biological associations; population dynamics; biological control of pests; ecological succession and soil. After the intervention, posttest, tagged Students' Academic Achievement in Ecology Test (SAAET) was administered to both groups to determine the effectiveness of the intervention.

The pretest and posttest were made up of forty test items each. Each test was divided into two sections; A and B. Section A was made up of thirty multiple choice questions. Each multiple choice item had one key and three distractors that reflected on students' misconceptions in ecology. Section B was made up of ten short answers essay type questions. The pretest which was given to the participants before the intervention was different from the posttest which was also administered to both groups after the treatment.

The instruments for data collection were given to three of tutors who are West African Examination Council Biology Examiners to help establish the content and face validity. The test items were piloted and the reliability of the items was determined using test-retest reliability coefficient. The reliability coefficient was found to be 0.78 which showed that the instrument was highly reliable. The data collected from the students' scores were analysed using descriptive statistics (mean and standard deviation) and inferential statistics (independent student t-test) to test the null hypotheses at the significant level of 0.05, using Microsoft Excel version 2019.

4. Findings and Presentation

The data collected from the students' scores were analysed using descriptive statistics of mean, standard deviation and inferential statistics of t-test using Microsoft Office Excel version 2019.

4.1 Research Question 1: What is the difference between the pretest mean scores of student in the experimental group and control group?

Table 1: T-test summary of pretest scores of students in the control and experimental groups

Group	N	Mean	SD	Df	t-value	p-value
Experimental	36	22.19	4.04	73	0.83	0.39
Control	39	21.46	3.16			
Level of significance = 0.05; p>0.05; Not significant						

Table 1 is a summary of the pretest results of participants in the experimental and control groups. The pretest mean score of students in the experimental group was 22.19 with a standard deviation of 4.04. The pretest mean score of students in the control group was 21.46 with a standard deviation of 3.16. To see if there was a significant difference between the pretest mean scores of the experimental and control groups, a null hypothesis was established.

4.1.1 Analysis of Research Hypothesis One

Research Hypothesis One: There is no significant difference between the pretest mean scores of students in the experimental and control groups.

From Table 1, the t-value and p-value are; $t = 0.87$ and $p = 0.39$. The p-value is greater than 0.05 and this showed that there was no significant difference between the pretest mean scores of students in the experimental and control groups. In the light of this result, it was hard to reject the null hypothesis. This also proved that the two intact classes selected for the study were similar in conceptual understanding and academic achievement in the concept of ecology before the treatment.

4.2 Research Question 2: What is the difference between the posttest mean scores of students in the experimental and control groups?

Table 2: T-test summary of posttest scores of students in the experimental and control groups

Group	N	Mean	SD	Df	t-value	p-value
Experimental	36	48.19	4.26	73	12.43	0.000
Control	39	38.71	2.94			
Level of significance = 0.05; $p < 0.05$; Highly significant						

Table 2 presents a summary of the posttest results of participants in the experimental and control groups. From Table 2, the posttest mean score of participants in the experimental group was 48.19 with a standard deviation of 4.26 whilst participants in the control group had a mean score, 38.71 with a standard deviation of 2.94. The mean difference between participants in the experimental and control groups was 9.48. A null hypothesis was formulated to test for significant difference between the posttest mean scores students in the experimental and control groups.

4.2.1 Analysis of Research Hypothesis Two

Research Hypothesis Two: There is no significant difference between the posttest mean scores of students in the experimental and control groups.

From Table 2, the t-value was 12.43 and the p-value was 0.000. The p-value, $0.000 < 0.05$. This showed that the posttest mean score of participants in the experimental group differed significantly from their counterparts in the control group. Based on this result, it was hard to accept the null hypothesis. This clearly indicated that there was statistically significant difference between the posttest mean score of students in the experimental group and their counterparts in the control group. It also proved that the intervention

given was very effective which led to significant difference in academic achievement of participants in the experimental and control groups.

4.3 Research Question 3: What are the differences between the pretest and posttest mean scores of male and female students in the experimental group?

Table 3i: T-test summary of the pretest results of male and female students in the experimental group

Group	N	Mean	SD	Df	t-value	p-value
Male	21	23.24	4.88	34	1.43	0.20
Female	15	21.33	3.24			
Level of significance = 0.05; p>0.05; Not significant						

Table 3i is a summary of the pretest results of male and female participants in the experimental group. From table 3i, the pretest mean score of male students in the experimental group was 23.24 with a standard deviation of 4.88. The female students had a mean score of 21.33 with a standard deviation 3.24. A null hypothesis was therefore formulated to test for significant difference between the pretest mean scores of male and female participants in the experimental group.

4.3.1 Analysis of Research Hypothesis 3

Research Hypothesis 3i: There is no significant difference between the pretest mean scores of the male and female students in the experimental group.

From Table 3i, $t = 1.43$, $p = 0.20$, and $p\text{-value } 0.20 > 0.05$. In the light of the p-value, the null hypothesis was accepted. This proved that there was statistically no significant difference between the pretest mean scores of male and female students in the experimental group. This indicated that male and female students in the experimental group were similar in conceptual understanding and academic achievement in ecological concepts before the treatment.

Table 3ii: T-test summary of the posttest of male and female students in the experimental group

Group	N	Mean	SD	Df	t-value	p-value
Male	21	48.52	3.72	34	0.52	0.59
Female	15	47.73	5.02			
Level of significance = 0.05; p>0.05; Not significant						

Table 3ii is a t-test summary of the posttest results of male and female students taught through Demonstration-cum-Discussion Instructional Strategy. From Table 3ii, the posttest mean score of the male students in the experimental group was 48.52 with a standard deviation of 3.72. The female students in the experimental group had a mean of 47.73 with a standard deviation of 5.02. The mean difference between the two groups was 1.30. A null hypothesis was used to determine if there was a significant difference

between the posttest mean scores of male and female students taught using Demonstration-cum-Discussion Teaching Strategy.

4.3.2 Analysis of Research Hypothesis 3ii

Hypothesis 3ii: There is no significant difference between the posttest mean scores of male and female students in the experimental group.

From Table 3ii, the t-value was 0.52 and the p-value was 0.59. The p-value, $0.59 > 0.05$ hence the null hypothesis was accepted. This indicated that there was statistically no significant difference between the posttest mean score of male and female participants taught using demonstration-cum-discussion teaching strategy. This implies that the treatment given to the experimental group was effective to both male and female students since there was no significant difference in their academic achievement in ecological concepts.

5. Discussion, Conclusions and Recommendations

5.1 Discussion

This study investigated the effectiveness of demonstration-cum-discussion teaching strategy on students' academic achievement in some concepts in Ecology. There was no significant difference between the pretest mean scores of participants in the experimental and their cohorts in the control groups. This is an indication that the two intact classes used for the study were similar in conceptual understanding and academic achievement in Ecology concepts before the treatment.

There was significant difference between the posttest mean scores of students in the experimental and control groups. Students who were taught, using Demonstration-cum-Discussion teaching strategy performed significantly higher than their counterparts who were taught using Conventional Teaching Method. This proved that Demonstration-cum-Discussion teaching strategy was an effective instructional approach for teaching Ecology concepts. This finding agrees with earlier finding by Basila and Jajua (2019) who investigated the effects of demonstration and discussion teaching strategies on secondary school students' achievement and retention and confirmed that students exposed to demonstration and discussion instructional strategies performed significantly better than their cohorts exposed to conventional teaching method. The finding also agrees with the finding by Omotayo and Taiwo (2019) who explored the effects of demonstration teaching method on senior secondary school students' academic performance in Biology and found out that students taught, using demonstration method performed significantly higher than those taught through conventional method of teaching. In a related study, Bisht (2012) who investigated the effects of demonstration-cum-lecture method on academic achievement of students in biological science, confirmed that students taught using demonstration-cum-lecture method performed significantly far above their counterparts taught through traditional teaching method.

The current study which did not find significant difference between the pretest and posttest mean scores of male and female students in the experimental group, which means that both male and female students in the experimental group were similar in academic achievement in the concept of ecology before and after intervention corroborates the finding of Ogwu, Jatua and Gwamna (2020) who investigated the impact of discussion method on performance and retention in Biology among secondary school students and observed that no significant difference existed between male and female students exposed to discussion method of teaching. This finding is in line with the finding of Basila and Jajua (2019) who evaluated the effects of demonstration and discussion strategies on secondary school students' achievement and retention in Biology and affirmed that no significant difference exists between male and female students exposed to demonstration and discussion teaching methods.

5.2 Conclusion

This study explored the effectiveness of Demonstration-cum-Discussion Teaching Strategy on students' academic achievement in some ecology concepts at Navrongo Senior High School in the Kassena Nankana Municipality of the Upper East Region of Ghana. The study found out that there was no significant difference between the pretest mean scores the control and experimental groups. This showed that the two intact classes selected for the study were similar in conceptual understanding and academic achievement in the concept of ecology before the treatment was administered. The study also found out that Demonstration-cum-Discussion teaching strategy was effective teaching methodology for teaching ecological concepts since students who were exposed to demonstration-cum-discussion teaching method performed significantly higher than their cohorts who were exposed to conventional teaching method. It is also established that demonstration-cum-discussion teaching strategy is more effective in enhancing the conceptual understanding and academic achievement of both male female students equally since there was no significant difference in their academic achievement after being exposed to the treatment. The Demonstration-cum-Discussion teaching strategy significantly improved the conceptual understanding and academic achievement of students in Ecology concepts.

5.3 Recommendations/ Contribution to Practice, Theory and Policy

Based on the results of the study, the following recommendations were put forward by the researchers;

- 1) Science teachers should be encouraged to use demonstration-cum-discussion teaching strategy as a teaching method when teaching ecology in order to improve the academic achievement of students since the topic has both practical and theoretical components.
- 2) The Government, Ghana Education Service (GES), Ministry of Education (MOE) and other Non-Governmental Organizations (NGOs) should organize workshops, seminars and conferences for science teachers on current or modern teaching

methodologies that are capable of improving the conceptual understanding and academic achievements of learners.

- 3) The Government, Ghana Education Service and Ministry of Education should extend study leave with pay to senior high school level to enable science teachers upgrade professionally and also improve on their teaching styles since most teachers are not well verse with modern teaching methods.

Conflict of Interest Statement

The authors declare no conflicts of interests.

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References

- Abdulbaki, K., Suhaimi, M., Alsaqqaf, A., & Jawad, W. (2018). The Use of Discussion Method at University: Enhancement of Teaching and Learning. *International Journal of Higher Education*, 7(6), 118-127.
- Achor, E. E., Wude, M. H., & Duguryil, Z. P. (2013). Do Cooperative Learning Strategies have the Potentials to Eliminate Gender Difference in Students' Achievement in Biology? The Effect of STAD and Jigsaw Cooperative Strategies. *Journal of Science, Technology, Mathematics and Education (JOSTMED)*, 10(1), 136-146.
- Adegbola, F. F. (2010). The Effects of Demonstration and Discussion Methods on Junior Secondary Schhol Students' Retention and Achievement in Basic Science. *Journal of Research in Science Education*, 1(1), 257-265.

- Akinbobola, A. O., & Ikidite, G. A. (2011). Strategies for Teaching Mineral Resources to Nigeria Secondary School Science Students. *African Journal of Social Research and Development*, 3(2), 130-133.
- Alaagib, N. A., Musa, O. A., & Saeed, A. M. (2019). Comparison of the Effectiveness of Lectures Based on Problems and Traditional lectures in Physiology Teaching in Sudan. *BMC Medical Education*, 1-8.
- Aliyu, M. (2020). Effect of Demonstration Method of Teaching on the Academic Performance of Students' in Motor Vehicle Mechanic in Yobe State. *International journal of Innovative Scientific & Engineering Technologies Research*, 8(2), 59-65. Retrieved from <http://www.seachipaj.org>
- Alkhalwaldeh, S. A. (2013). Enhancing Ninth Grade Students' Understanding of Human Circulatory System Concepts Through Conceptual Change Approach. *The European Journal of Social and Behavioural Sciences*, 2(7), 202-223.
- Azure, J. A. (2018). *Teaching and Learning of Integrated Science: A Model for Teacher Trainees in Universities and Colleges of Education*. Accra: Emmpong Press.
- Basheer, A., Hugerat, M., Kortam, N., & Hofstein, A. (2017). The Effectiveness of Teachers' Use of Demonstrations for Enhancing Students' Understanding and Attitudes to Learning Oxidation-Reduction Concept. *EURASIA Journal of Mathematics, Science and Technology Education*, 13(3), 555-570. Retrieved from <http://iserjournals.com/journals/eurasia>
- Basila, D., & Jajua, M. A. (2019). Effects of Demonstration and Discussion Strategies on Secondary School Students' Achievement and Retention in Biology in Mubi Educational Zone, Adamawa State. *International Journal of Research and Scientific Innovation (IJRSI)*, 6(12), 234-246. Retrieved from <http://www.rsisinternational.org>
- Bisht, D. (2012). A Comparative Study of Effect of Lecture Method and Lecture-Cum-Demonstration Method on Achievement of IX Class Students' in Biological Science. *Journal of Educational Chronicle*, 3(2), 44-48.
- Christie, A. (2005). Constructivism and its implications for educators. Retrieved from <http://alicechristie.com/edtech/learning/constructivism/index.htm>
- Ekeyi, D. N. (2013). Effect of Demonstration Method of Teaching on Students' Achievement in Agriculture Science. *World Journal of Education*, 3(6), 1-7. Retrieved from <http://dx.doi.org/10.5430/wje>
- Etobro, A. B., & Fabinu, O. E. (2017). Students Perceptions of Difficult Concepts in Biology in Senior High Schools in Lagos State. *Global Journal of Educational Research*, 16, 139-147.
- Giridharan, K., & Raju, R. (2016). Impact of Teaching Strategies: Demonstration and Lecture Strategies and Impact of Teachers Effect on Academic Achievement in Engineering Education. *International Journal of Educational Science*, 14(3), 174-186.
- Hackathorn, J., Solomon, E. D., Blankmeyer, K. L., Tennial, R. E., & Garczynski, A. M. (2011). Learning by Doing: An Empirical Study of Active Teaching Techniques. *The Journal of Effective Teaching*, 11(2), 40-54.

- Inuwa, U., Abdullah, Z., & Hassan, H. (2018). A Mixed-Method Study of the Effect of Demonstration Method on Students' Achievement in Financial Accounting. *international Journal of Instruction*, 11(4), 577-592.
- McLeod, S. A. (2019). Constructivism as a Theory of Teaching and Learning. *Simply Psychology*. Retrieved from <http://www.simplypsychology.org/constructivism.html>.
- Merrill, M. D. (1991). Constructivism and Instructional Design. *Educational Technology*, pp 45-53
- Namale, M. K., & Buku, D. K. (2011). *The Professional Teacher Preparation and Practice*. Accra: Richblank Publication.
- Ogunkola, B. J., & Samuel, D. (2011). Science Teachers' and Students' Perceived Difficult Topics in Integrated Science Curriculum of Lower Secondary Schools in Barbados. *World Journal of Education*, 1(2), 17-28.
- Olufunmiyi, A. A. (2015). Effects of Learning Styles and Instructional Strategies on Students' Achievement in Nigerian Senior Secondary School Physics. *Advances in Physics Theories and Applications*, 41, 20-29.
- Olusegun, S. B. (2015). Constructivism Learning Theory: A Paradigm Shift for Teaching and Learning. *IOSR Journal of Research and Methods in Education (IOSR-JRME)*, 5(6), 66-70.
- Omotayo, A. K., & Taiwo, A. F. (2018). Effect of Demonstration Teaching Method on Senior Secondary Students' Academic Performance in Biology in Ekiti State, Nigeria. *Social Science Education Journal (SOSCED-J)*, 4(2), 15-21.
- Rahman, F., Khalil, K. J., Jumani, B. N., Ajmal, M., Malik, S., & Sharif, M. (2011). Impact of Discussion Method on Students' Performance. *International Journal of Business and Social Science*, 2(7), 84-89.
- Ramadhan, N., & Surya, E. (2017). The Implementation of Demonstration Method to Increase Students' Ability in Operating Multiple Numbers by Concrete Object. *International Journal of Sciences: Basic and Applied Research (IJBAR)*, 34(2), 62-68.
- Sharma, H. L., & Poonam, G. (2016). Constructivist Approach for Teaching English: Making sense of Paradigm shift from the Traditional Approach. *International Journal of science and Research*, 5(10), 788-791.
- Singh, S., & Yaduvanshi, S. (2015). Constructivism in Science Classroom: Why and How. *International Journal of Scientific and Research Publications*, 5(3), 1-4.
- SMASSE report (2010). *Manuel for National In-service Education and Training for Biology Teachers*. SMASSE INSET.
- Ugwu, L., Jatua, A., & Gwamna, S. K. (2020). Impact of Discussion Method on Performance and Retention in Biology Among Senior Secondary Students in Katsina Education Zone, Katsina State, Nigeria School. *International Journal of Multidisciplinary and Current Educational Research (IJMCER)*, 2(6), 76-83. Retrieved from <http://www.ijmcer.com>

- Umar, A. M., Dauda, B., & Mutah, K. (2016). Effectiveness of Demonstration and Lecture Method in Learning Concepts in Economics among Secondary School Students in Borno State, Nigeria. *Journal of Education and Practice*, 7(12), 51-58.
- Umoru, T. A., & Haruna, B. (2018). Effect of Demonstration and Lecture Teaching Methods on Academic Performance of Secondary School Students' in Financial Accounting in Adamawa State, Nigeria. *Nigeria Journal of Business Education (NIGJBED)*, 5(2), 447-457. Retrieved from <http://www.nigjbed.com.org>
- WAEC (2013-2018). *Chief Examiner Report*, Accra.
- Wafula, N. W., & Odhiambo, O. R. (2016). project Based Learning on Studennts' Performance in the Concept of Classification of Organisms Among Secondary Schools in Kenya. *Journal of Education and Practice*, 7(16), 25-30.

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