International Journal of Educational Research and Technology, Vol 1 [1] June 2010: 19 - 29

http://www.soeagra.com
ISSN 0976-4089

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Effect of Project-Based, Demonstration and Lecture Teaching Strategies on Senior Secondary Students' Achievement in an Aspect of Agricultural Science

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ABSTRACT
This study investigated the effect of three teaching strategies; project-based, demonstration and lecture strategies of teaching on students' achievement in pasture and forage crops which is an aspect of agricultural science. Lecture strategy served both as a teaching strategy as well as control since it is assumed to be a conventional strategy of teaching. A 3X2X2 pre-test, post–test experimental design with a control group was used in which a hundred and fifty randomly selected Senior Secondary School II (SSS II) Agricultural science students were drawn from three schools. The data was analyzed using ANCOVA and Scheffe post–hoc test analysis. There is significant main effect of treatment on students' achievement in an aspect of agricultural science that is, pasture and forage crops [$F_{2,137}$ = 20.860; p<0.05]. Also, students performed significantly at different levels in the three groups. There is no significant interaction effect of treatment and gender on students' achievement in an aspect of agricultural science that is, pasture and forage crops [$F_{2,137}$ =0.494; p>0.05]. Project-based and demonstration strategies of teaching are potent in raising students' achievement. Thus, in-service training in form of workshops, seminars and symposia should be organized for teachers regularly to update their knowledge and enhance their adoption of appropriate teaching strategies.
Key Words: *Project-based, demonstration, lecture, agricultural achievement test, teaching of pasture and forage crops.*

INTRODUCTION

It is now being recognized that there are better ways to learn than through the traditional methods (Wood & Gentile, 2003). Educators are beginning to show an increased awareness of the importance of the way students learn. Many of the standard methods of conveying knowledge have been shown to be relatively ineffective on the students' ability to master and then retain important concepts. Learning through some methods of teaching is passive rather than active. The traditional methods (lecture, laboratory, recitation) do not tend to foster critical thinking, creative thinking, and collaborative problem-solving (Blair, Schwartz, Biswas, & Leelawong, 2007). No one can deny that schools are becoming diverse in terms of students' backgrounds and abilities, and teachers are being ever more challenged to find effective ways to meet diverse needs of their students. Educators confront classrooms in which different students exhibit assorted academic and behavioural characteristics and they are increasingly looking for successful instructional and classroom management techniques (Tournaki & Cricitielo, 2003, Carrier, 2005). Project Based Learning (PBL) has emerged to become an instructional approach that is gaining growing interest within the engineering education community (Hadim & Esche, 2002). Duch (2002) described PBL as an instructional method that challenges students to 'learn how to learn,' working cooperatively in groups to seek solutions to real world problems". Prpic and Hadgraft (2009) addressed the key ingredients of PBL and postulate that it should not be confused with design projects or case studies where the focus is predominantly on the application of existing knowledge and integration of what is already known. PBL goes beyond this, students will encounter some concepts for the first time and therefore they need strategies for acquiring this new knowledge (Prpic & Hadgraft, 2009).

The project-centered learning approach (or more commonly, "Project-Based Learning", PBL) has been extensively applied and found effective in science, legal and medical education as well as engineering. A substantial body of literature supports the view that PBL substantially improves long-term retention, "deep understanding" and the ability to extrapolate scientific knowledge to subsequent learning experiences and new situations (Barron, *et al,* 1998, Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Williams 1992 & Bransford, & Schwartz,1999) The application of this approach to the study of certain concept is motivated by several factors derived both from the research literature and teaching experience. Binnie (2002) concluded in paper:

> *"The use of projects was very helpful in assisting the learning of the students. Their active involvement in the tasks forced them to think and enhanced their learning. The use of real data of their own choice motivated them because they wanted to know what conclusions they might come to. Without the projects their understanding of the process of problem-solving using the statistical thinking strategy outlined would have been very theoretical."(p.5).*

Project work approach seems to have the components to motivate teachers and students to develop a cooperative work mainly aiming at the students to perceive and understand all the necessary stages required to arrive at logical conclusion (Biajone, 2006).

Project-based Learning is a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks. Research shows that learners not only respond by giving useful information, but they also actively use what they know to explore, negotiate, interpret and create. Education has benefited from this teaching strategy, as teachers have learned how to effectively select content and activities to amplify and extend the skills and capabilities of students.

Many countries in the world want all their citizens to be educated, also, education professionals are seeking research-supported practices that are applicable in classrooms and can facilitate students' access to the mastering of concepts in agricultural science, hence, the need to introduce modern instructional strategies – demonstration strategy - that do not only create cooperative pleasant atmosphere but enhance peer relations and also increase academic achievement of students.

Demonstration method has been shown to be effective with both large and small groups. The greater the degree of participation and sensory involvement by the learner, the more effective learning will be. Newby, Stepich, Lehman and Russel (1996) identified ways teacher can improve the use of demonstration method in the classroom. They suggest that teacher should allow students to use several senses by allowing them to see, hear and possibly experience. Also, ideas should be presented to stimulate interest. If these precautionary measures are not taken, demonstration can limit student participation.

Uhumuavbi and Mamudu (2009) found that demonstration method of teaching is sensitive to gender. They reported that exposing students to demonstration method yielded a better performance for male students than their female counterparts. It is therefore necessary to verify such claim. In this study gender is one of the moderating variables because it is important to find out if the treatments are sensitive to gender. Gender has remained a burning issue and has also remained relevant in education because it has been linked to achievement and participation in certain professions (Sotonade, 2004). Certain cultures restrict particular gender to certain professions like farming, engineering and trading (Erinosho, 1997; Olatoye & Afuwape, 2004). Therefore, using gender as a moderating variable in an experimental study can yield useful practical information. However, there have been conflict findings on how gender influences academic achievement. It seems the influence of gender varies according to school subjects. For example, while Olatoye (2008) reported there is no significant difference between male and female achievement in science. Tamir (1990) reported there is no significance difference between male and female achievement in biology and chemistry but reported a significant difference in physics (boys scoring higher).Kumar and Morris (2005) advocated for consideration of gender in studies involving achievement and scientific understanding in the biological and physical sciences. Lee (1998) observed that educators perhaps unknowingly had for many decades considered reading and literature as female domains and mathematics and science as male domains. While understanding the need to address gender difference represents a vital step, making education gender-responsive will require a genuine commitment to provide teaching-learning experiences that reflect female and male difference. Lee further noted that males tended to do much better in the physical sciences (like physics), while females held a modest advantage in the life science (like biology and agricultural science). Johnson, Wardlow and Franklin (1998) found that student achievement in Agricultural science is not influenced by gender. Sanhez and Roda (2006) defined self-concept as the set of knowledge and attributes, that a person has about himself or herself; the perception an individual assigns to herself/himself, the characteristics or attributes that a person uses to describes himself or herself. In experimental studies, there is normally social interaction among the students themselves and between the students and their teacher. It is therefore important to also consider a moderating variable like self-concept which may influence student interaction and possibly achievement in the class. Self-concept is a strong predictor of student academic achievement (Olatoye, 2008; Lang, 2006). Also, self-concept can be developed or constructed by individuals through interaction within the environment and reflecting on that interaction (Huitt, 2004). Thus self-concept is a variable that can be enhanced in students through conscious efforts of the teacher and counsellor. Including a moderating variable like this is this in the study will enable teachers and experts in the field know if the treatment is sensitive to self-concept or not and enhance precautionary measures they should take in adopting the teaching strategies. Olatoye (2008) asserted that any student characteristics that can change because of training and exposure to counselling can be very important in enhancing students' academic achievement. The importance of science and technology in the growth and development of any nation cannot be over emphasized and it is apparent that technology cannot thrive without using appropriate instructional teaching strategies to teach the students. This is because future development of any nation in the fields of sciences depends on how well the science subjects are taught. Instructional methods are tools for reaching the set goals and objectives. The effective teacher has many teaching methods at his or her disposal and can select the ones that will be most effective for leading the learner to desired behaviours. The level of students' performance in the internal and external examinations cannot improve until teachers are able to employ appropriate strategies to impact desired knowledge and skills on the learners.Thus, teachers have begun to take a closer look at project-based and demonstration teaching strategies as tools in their array of teaching techniques. It is against this backdrop that experimental investigation into influence of project-based and demonstration teaching strategies on senior secondary school students' achievement in an aspect of Agricultural science specifically, pasture and forage crops becomes imperative.

Research Hypotheses

The following research hypotheses were generated for the study:

$H0_1$: There is no significant main effect of treatment on students' achievement in an aspect of agricultural science (pasture and forage crops)

$H0_2$: There is no significant main effect of gender on students' achievement in an aspect of agricultural science (pasture and forage crops)

$H0_3$: There is no significant main effect of self-concept on students' achievement in an aspect of agricultural science (pasture and forage crops)

$H0_4$: There is no significant interaction effect of treatment and gender on students' achievement in an aspect of agricultural science (pasture and forage crops)

$H0_5$: There is no significant interaction effect of treatment and self-concept on students' achievement in an aspect of agricultural science (pasture and forage crops)

$H0_6$: There is no significant interaction effect of gender and self-concept on students' achievement in an aspect of agricultural science (pasture and forage crops)

$H0_7$: There is no significant interaction effect of treatments (demonstration and peer-tutoring teaching strategies), gender and self-concept on students' achievement in an aspect of agricultural science (pasture and forage crops)

MATERIALS AND METHOD

Research Design

The research design used for this study was a 3X2X2 pre-test, post-test experimental design with two experimental groups and one control group. Self-concept and gender were used as moderating variables. The same pre-test was initially administered to the agricultural science students in the three groups before the treatment. Project-based strategy was used in the first group; demonstration strategy was used in the second group while the lecture strategy was adopted in the third group which served as control. At the end of the six-week treatment, a post-test was conducted in these three groups.

Table 1: Randomized control-Group Pre-test Post-test Design

Group	Pre-test	Treatment	Post-test
1 st experimental Group	O_{1Pr}	X_{Pr}	O_{2Pr}
2nd experimental Group	O_{1D}	X_D	O_{2D}
Control Group	O_{1L}		O_{2L}

Where:
O_{1Pr} represents the pre-test scores for project-based teaching strategy group (1st experimental group)
O_{2Pr} represents the post-test scores for project-based teaching strategy group (1st experimental group)
X_{Pr} represents the treatment for project-based teaching strategy group (1st experimental group)
O_{1D} represents the pre-test scores for demonstration teaching strategy group (2nd experimental group)
O_{2D} represents the post-test scores for demonstration teaching strategy group (2nd experimental group)
X_D represents the treatment for demonstration teaching strategy group (2nd experimental group)
O_{1L} represents the pre-test scores for control group strategy
O_{2L} represents the post-test scores for control group strategy

Table 2: Randomized control-Group Pre-test-Post-test Design

	Male		Female		Total
	High Self-concept	Low Self-concept	High Self-concept	Low Self-concept	
Project-based	13	13	13	13	52
Demonstration	13	13	13	13	52
Control	13	13	13	13	52
Total	39	39	39	39	156

Target Population and Sample

The population for this study comprised of all Senior Secondary School two (SS II) agricultural science students in Ijebu-Ode Local Government Area of Ogun State. A total of one hundred and fifty senior secondary school two (SSS II) students purposively selected from the three schools constituted the sample for the study. Fifty two students (representing the number in a group) were selected from each school. The schools were purposively selected so that they would be far apart enough not to allow interference.

Research Instruments

The instruments used for the study were: teaching manual on pasture and forage crops, common grasses and legumes samples, grasses and legumes album, self-concept questionnaire as well as a twenty-item select response questions used for the pretest, post–test tagged Agricultural Achievement Test (AAT).

Validation of Research Instruments

The research instruments used for the pretest, post–test was tagged Agricultural Achievement Test (AAT) 1 and 2. Items were generated from the West African Examinations Council (WAEC) and National Examinations Council (NECO) agricultural past questions.

Despite using standardized items from these popular national examination bodies, the selected items on pasture and forage crops were still given to experienced teachers critique and suggestions. This led to the modification and rejection of some items. Prior to the commencement of the experiment, the test items were administered to fifty non-participating students but of the same cultural background and also offering agricultural science as a subject. This was done to determine the consistency of the items. The test was administered twice with two weeks interval on these 50 students who did not participate in the major study. Thus, a test re-test reliability co-efficient of 0.78 was obtained for the achievement test. Similarly, a test-retest reliability co-efficient of the self-concept questionnaire is 0.714

Data Collection Procedure

The research involved two main stages, which were the administration of pre-test and post-test that contained the same items arranged in different order. The study was conducted for a period of six weeks during which the topic, pasture and forage crops was covered. The pre-test was administered in the first week of the research exercise to the whole students before the experimental groups were subjected to treatments. All the practical sessions were held on the school farm with the materials provided by the schools. Six students dropped out before the post-test was administered making the sample size to drop from 156 to 150.

After the administration of the pre-test, students in all the groups, they were taught various aspects of the topic; pasture and forage crops. Below are the details of breakdown of topics into weeks:

Teaching Manual

Topic: Pasture and Forage Crops.

Objectives: At the end of the lessons, students should be able to:

- Define pasture and forage crops;
- List and explain the uses of pasture and forage crops;

- Differentiate between the two types of pasture using their characteristics;
- Give the common names of grasses and legumes with their botanical names;
- Discuss the characteristics of some pastures crops;
- Group, state and discuss the factors affecting this distribution of pasture;
- Explain the factors to be considered when establishing the pasture and steps involved;
- State and explain the common management practices in pasture.

WEEK 1: Administration of self-concept questionnaire
-Meaning of pasture and forage crops.
WEEK 2: Uses of forage crops
-Types of pasture
WEEK 3: Characteristics of Natural and Artificial pasture
WEEK 4: Common Grasses and legumes of livestock and their botanical names.
WEEK 5: Characteristics of some pasture crops
-Factors affecting the distribution of pasture
-Factors affecting the productivity of pasture
WEEK 6: Establishment of pasture
-Common pasture management practices
-Revision and conduct of post test

The first group (project method) was exposed to project-based teaching strategy whereby students made album showing pictures of pasture and forage crops. The students in this group also wrote on topics of interest in any aspect pasture and forage crops and also make oral presentation. When the project topics were completed, the teacher provided the students the opportunity to make oral presentation, to compare notes as well as learn from one another. The teacher moderated the oral presentation. Students in this group learned together and search for materials for their project topics outside the classroom. Students in the second group (demonstration method) were given one week to read about the topic and make the list of materials and specimens required for the experiments. The group was divided into eight sizable sub-groups on the school farm to make demonstration by the teacher meaningful. Two practical exercises were carried out in a week. The researcher used samples of grasses and legumes on the school farm, models of different grass vegetations to demonstrate their characteristic features to the students on the farm. Questions were entertained during the practical sessions from the students.

The third group comprised of students in the control group. They were taught the theory and practical using lecture/traditional teaching strategy. The teaching process also lasted for six weeks and a post-test was administered to all the students.

Method of Data Analysis

The data collected were analyzed using ANCOVA to compare the means of the scores of the students and also Scheffe post-hoc analysis to identify the most effective strategy. The analyses of the results were carried out at $p = 0.05$ level of significance.

RESULTS

In table 3 above, there is significant main effect of treatment on students' achievement in an aspect of agricultural science that is, pasture and forage crops [$F_{2, 137} = 20.860$; $p<0.05$] However, there is no significant effect of gender on students' achievement in an aspect of agricultural science that is, pasture and forage crops [$F_{1, 137} = 0.056$; $p>0.05$] Thus, gender (whether students are males or females) does not influence achievement in pasture and forage crops. Likewise, self-concept does not have significant main effect on achievement in an aspect of agricultural science (pasture and forage crops). [$F_{1, 137} = 0.036$; $p>0.05$].

Two-way interaction effect of treatment and gender does not have effect on achievement in an aspect of agricultural science. [$F_{2, 137} = 0.494$; $p>0.05$]. Since the main effect of treatment is significant but the interaction effect with gender is not significant, it then means that the treatment does not depend on gender to be effective. In other words, the treatment is not gender sensitive and will be effective

Table 3: ANCOVA of effect of treatment and moderating variables on students' achievement in an aspect of agricultural science

Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Correlated Model	727.691	12	60.641	5.901	.000
Intercept	1143.130	1	114.130	111.245	.000
agric pretest	137.874	1	137.874	13.147	.000
treatment	428.702	2	214.351	20.860	.000
gender	.579	1	.579	.056	.813
self-concept	.366	1	.366	.036	.851
treatment x gender	10.143	2	5.072	.494	.612
treatment x self-concept	6.969	2	3.485	.339	.713
gender x self-concept	.676	1	.676	.065	.798
treatment x gender x self-concept	19.083	2	9.541	.929	.398
Error	1407.782	137	10.276		
Total	25623.000	150			
Corrected Total	2135.473	149			

*Significant ($p< 0.05$)

irrespective of students' gender. Also, two-way interaction effect of treatment and self-concept on students' achievement in an aspect of agricultural science is not significant [$F_{2,\ 137} = 0.339$; $p>0.05$]. This implies that the treatment will be effective irrespective of student self-concept (either high or low). Similarly, gender and self-concept have no significant interaction effect on students' achievement in an aspect of Agricultural Science [$F_{1,\ 137} = 0.066$; $p>0.05$].

Three-way interaction effect of treatment, gender and self-concept has no significant effect on students' achievement in an aspect of Agricultural Science [$F_{2,\ 137} = 0.929$; $p>0.05$]. Thus, the treatment will work irrespective of student gender and self-concept because the main effect of treatment on student achievement is significant.

In summary, all the null hypotheses are being upheld except hypothesis one that states: there is no significant main effect of treatment on students' achievement in an aspect of Agricultural Science (Pasture and Forage Crops).

Table 4: Univariate Tests of the Mean Scores of the Three Groups

	Sum of Squares	Df	Mean Square	F	Sig
Contrast	428.702	2	214.351	20.860	.000*
Error	1407.782	137	10.276		

* Significant ($p<0.05$).

In table 4 above, there is significance difference in the students' mean scores among the three groups; project-based, demonstration and lecture strategies [$F_{2,\ 137} = 20.860$; $p< 0.05$]. Thus, students performed significantly at different levels in the three groups. This indicated that the treatments may not be equally effective. It is therefore important to compare the three groups two-by-two to find out the group(s) that cause(s) the difference. This is why the next table (table 5) is important.

Table 5: Pair wise Comparisons of the Three Groups

(I) treatment	(J) treatment	Mean Difference (I-J)	Std. Error	Sig.
Lecture	demonstration	-2.102	.711	.004*
	Project-based	-4.507	.698	.000*
demonstration	lecture	2.102	.711	.004*
	project-based	-2.405	.741	.001*
Project-based	lecture	4.507	.698	.000*
	Demonstration	2.405	.741	.001*

*The mean difference is significant at the .05 level

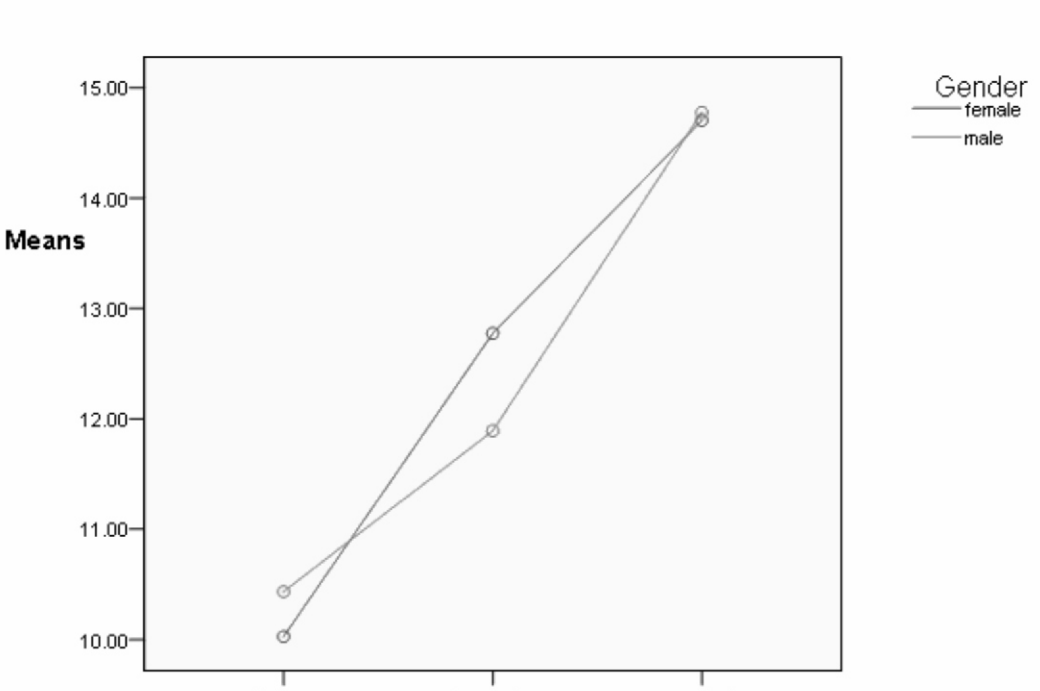
The essence of pair wise comparisons is to explain the cause of the significant difference reported in table 4. In table 5, there is pair wise comparison. The groups are compared two-by-two. There is significant mean difference between demonstration and lecture strategies. Demonstration strategy is significantly better than lecture strategy. Also, there is significant difference between project-based and lecture strategies. Project-based strategy is significantly better than lecture strategy. There is also significant difference between project-based and demonstration strategies. However, project-based strategy is significantly better than demonstration strategy.

Table 6: Mean Scores of Male and Female Students in the Three Groups

Treatment	Gender	Mean	Std. Error
Lecture	female	10.027	.734
	Male	10.434	.616
Demonstration	female	12.774	.672
	Male	11.892	.701
Project-based	female	14.702	.801
	Male	14.774	.666

The findings in table 6 above are graphically presented in figure.1. The interpretation follows the figure.

Figure 1: Mean plot of interaction effect of treatment and gender



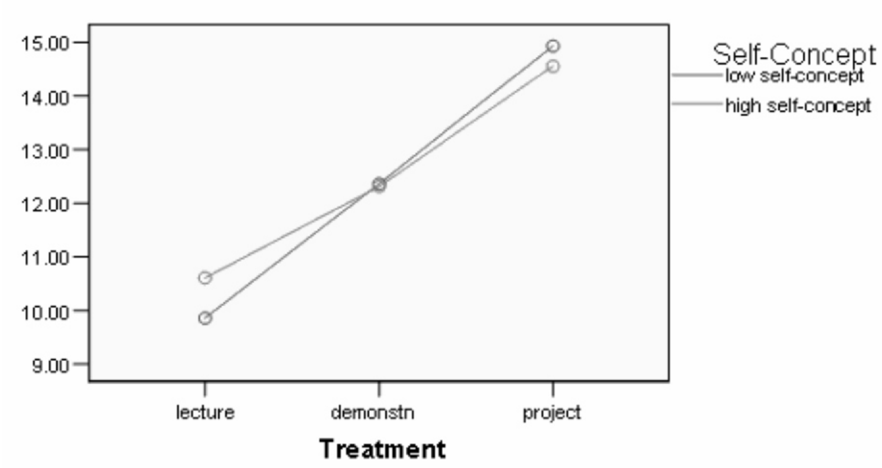
In Figure1 above, project-based strategy is the best strategy for teaching pasture and forage crops in Agricultural Science. Besides project-based strategy where the performance of male and female students almost tied, female students performed better than male students in the demonstration group while male students performed better in the lecture group. However, the difference in male and female students' achievement is not significant according to the findings earlier presented in table 3.

Table 7: Mean Scores of Students with High and Low Self-concept in the Three Groups

Treatment	Self-Concept	Mean	Std. Error
Lecture	low self-concept	9.857	0.681
	high self-concept	10.604	0.676
Demonstration	low self-concept	12.358	0.787
	high self-concept	12.307	0.577
Project-based	low self-concept	14.926	0.543
	high self-concept	14.550	0.883

The findings in table 7 above are graphically presented in fig 2. The interpretation follows the figure

Figure 2: Mean plot of interaction effect of treatment and self-concept



In Figure 2 above, project-based strategy is also shown to be the best strategy of teaching pasture and forage crops in Agricultural Science. Besides demonstration strategy where the mean scores for students of high and low self-concept tied, students with high self-concept performed better in lecture strategy but lower in peer-tutoring strategy. However, the interaction effect of treatment and self-concept is not significant according to the findings earlier presented in table 3.

Table 8 Mean Scores of the Male and Female Students with high and low self-concept

Gender	Self-concept	Mean	Std. Error
Female	low self-concept	12.520	.547
	High self-concept	12.482	.639
Male	low self-concept	12.241	.534
	High self-concept	12.493	.534

The findings in table 8 above are graphically presented in figure 3. The interpretation follows the figure.

In Figure 3 above, male students with high self-concept have higher scores in an aspect of Agricultural Science than male students with low self-concept. However, females of high and low self-concept have almost the same mean scores. It should be noted that the interaction effect of gender and self-concept gender has no significant effect on achievement in an aspect of Agricultural Science.

DISCUSSION

The analyses and results of this study showed that the project-based strategy brought about the most significant change in the achievement of students. This might be due to the social interaction and friendliness that the project-based strategy provided for the students. Students in the project-based strategy group were better motivated to learn; this might be as a result of the discipline of having to and respect the opinion of others during discussion having discovered that knowledge does not belong to only a person. Webb (1988) had opined that the more interactions there among students the better their performance. The project-based learning encourages collaboration in some form, either through small groups, student-led presentations, or whole-class evaluations of project results (Buck Institute for Education, 2002). Project-based strategy of learning shares some overlapping characteristics with inquiry-based or experimental learning and appears to be an equivalent or slightly better model for producing gains in academic achievement, although results vary with the quality of the project and the level of student engagement (Dohn & Wagne, 1999; Buck Institute for Education, 2002).

Furthermore, the demonstration and project strategies yielded significant difference in students' achievement when compared with the control group. The lecture method is the most widely used form of presentation and may be combined with other teaching strategies to give added meaning and direction. The students in this study are conversant with demonstration as their teachers often used them because of their adaptability to many different settings, including either small or large groups.

Dynamic Flight (2003) gave an illustration on selection of appropriate teaching method(s) for science lesson. Teaching methods should be compared to maintenance technician's box. The instructor's tools are the teaching methods. Just as the technician uses some tools more than the others, there will be times when a less used tool will be the exact instrument needed for a particular situation. The instructor's success is determined to a large extent by the ability to organize materials and to select and utilize teaching methods most appropriate to a particular lesson.

In selecting teaching method(s) for a science class, Abdullahi (1982) enjoined the teacher/instructor to consider the following factors:

- The learners' age, their previous knowledge on the topic and their ability.

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- The method should be suitable to the topic being taught
- The science teacher should select the method he/she can effectively handle.
- The time the lesson will take place
- The size of the class where the lesson is being taught.
- The resources that are at the disposal of the teacher.

Thus the fact that a method is suitable for the teaching of pasture and forage crops does not mean it will be a suitable topic for teaching another topic even in the same subject. There are times Agricultural science teacher may need to combine different methods to teach a particular topic. Olatoye (2006) identified methods that can be used to teach science effectively. These methods include demonstration, discussion, individualized, field trip method and computer-based instruction.

CONCLUSION

Learning agricultural science leads to the development of thinking skills and understanding of the other sciences. Project-based learning has been found challenging but can be evaluated as a rewarding exercise and an overall success as a result of its capability to help the students learn to develop the ability to think critically and analytically and a high degree of independence is required as the students have to learn how to identify resources and how to communicate effectively and this no doubt helped the learners to comprehend abstract concepts.

The project-based teaching strategy in this study produces significantly better performance in the Agricultural Achievement Test than the demonstration and lecture teaching strategies; thus, project-based teaching strategy is an effective mode of instruction for students in the secondary schools. However, a teaching method is seldom used by itself. In a typical lesson, an effective instructor normally uses more than one method. The findings of this study has revealed that project-based and demonstration teaching strategies can be used for teaching and learning processes depending on the topic but project strategy is the most effective because it afforded the students the opportunity to study on their own. Thus, while satisfying the attempt to improve the utilization of the regular school hours of the students; the provision of the sort of learning by "doing" is a technology that could be adequately employed in our classrooms. This paper concludes that the use of project-based teaching strategy should be embraced by all secondary school science teachers. Learning is deeper and more meaningful when students are involved in constructing their own knowledge if students are given the opportunity to select topics that interests them within the required content framework and then they are responsible for creating their project plan.

RECOMMENDATIONS

In view of the results of these findings and conclusions reached in this paper, the following recommendations are hereby offered:

- Governments should be implored to give enough grants to equip laboratories with chemicals and apparatus, and also to provide useful materials and appropriate teaching aids. Students need these materials to carry out projects in Agricultural science

Teachers occasionally should give students topics to go and make inquiry about, so that before the teacher teaches a new concept, students will be able to explain in their own terms what they know about the new concepts. That is, students' explanation will be regarded as hypothesis to be discussed and tested, if the teacher can create an atmosphere in the classroom of a kind in which the students can express themselves without bordering about making mistakes, their hypotheses can be used to illustrate their concepts.

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