*Full Length Research Paper*

# Level of retention of Agricultural Science knowledge in secondary schools students in Nigeria

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This study determined the effect of two teaching methods (demonstration and discussion) on student's retention of Agricultural Science knowledge in secondary schools of Bauchi metropolis. The study was guided by two research questions based on the specific objectives and three null hypotheses, tested at 0.05 level of significance. The pretest-posttest control group quasi-experimental design was employed. All the students from three intact SS II classes were used; one class each from three randomly selected schools. A 20 item multiple choice achievement test was administered to the two treatment groups before and after the treatment and the scores so obtained were analyzed by mean, standard deviation and t-test. The findings revealed that both the two teaching methods have significant effect on student's retention of Agricultural Science knowledge. Demonstration method was found to be more effective in making the students to remember Agricultural Science knowledge. It was therefore recommended that the demonstration method be used with confidence to teach Agriculture Science in Bauchi State secondary schools.

**Key words:** Teaching methods, student's retention, Agricultural Science, secondary schools.

## INTRODUCTION

Engagement in meaningful learning is a universal theme advanced in literature on student's achievement. Integration of instruction into real-world problems is a second emerging theme. *What* students learn is greatly influenced by *how* they are taught. Instructors teaching agricultural curricula have implemented a wide variety of teaching methods, which fit different niches within the agricultural classroom (Allen et al., n.d.).

Some methods of teaching are completely out of phase with background and local environments of the learners particularly in Nigeria. Furthermore, some methods are foreign in nature and have no bearing with the Nigeria culture, and purely derived from euro-centric culture (Achor et al., 2009). One of the consequences of over

dependence on foreign approaches to teaching science is the seemingly lack of basic scientific principles which results to rote-learning and low achievement in the sciences as could be seen in Nigeria today. Attempts to address this problem have necessitated the fact that teachers should evolve strategies that will ensure active participation of learners and be practical and project oriented (Uloko, 2006).

Educators and researchers have repeatedly acknowledged the drawbacks of teaching with a strict lecture format. This format has been referred to as a method resulting in long periods of uninterrupted teacher-centered, expository discourse which relegates students to the role of passive 'spectators' in the college

classroom (Williams and McClure, 2010). Having students serve as passive spectators in the classroom may encourage a drop in attention and decrease their retention of knowledge. Young et al. (2009) found that the drop in attention is avoided when presentation is varied, though this is not necessarily associated with interactive participation techniques. The incorporation of popular culture into presentations leads to a variety in lecture and does not require interactive participation, thus serving as a viable way to avoid a drop in attention.

Integration of instruction into real-world problems is a persistent argument. Students appear to benefit from knowing *how* to execute a strategy (procedural knowledge), knowing *why* the strategy works (conceptual knowledge), and knowing *where* the strategy works (contextual knowledge). General agreement prevails that students will best learn if they realize how the concepts are directly applied to their future lives (Shinn et al., 2003). Moreover, investigators (Maurer, 2000; Balschweid, 2001) have concluded that it is very important to provide students with sufficient context while they learn. Specifically, it is believed that contextualized learning holds promise for improving a student's ability to synthesize information from disparate sources, for furthering understanding of new and sometimes contradictory data, for assisting in making meaning and ultimately, for enhancing one's ability to think critically and transfer learning to future life experience. If the instructor aspires to help students build analytical and synthesis skills, apply concepts, learn to solve problems, develop mature judgment, enhance communication skills, and retain information, then an appropriate method of instruction should be used (Allen et al., n.d.).

Lecturing remains one of the more popular methods for transmitting information and ideas by teachers, trainers and speakers. As students and audience participants we are quite familiar with the approach. Lectures can be informative, boring and overwhelming depending on the compelling nature of the message and the presenter's style and clarity of message. The lecture method usually is one-way communication and allows for little or none audience participation. The result is audience mis-understanding, loss of information and poor retention. Evidences from a number of disciplines suggest that oral presentation to a large group of passive students contributes very little to real learning (Veselinovska, 2011). Teaching methods must be changed to reflect a modern society mandating the need for functioning, thinking-oriented, decision-making students. Therefore the selection of an appropriate teaching method is important to the success of the teaching and learning process. To be successful, teachers should select and use a wide variety of teaching strategies. The most suitable methods for teaching practical oriented subject like Agricultural Science are demonstration and discussion methods. Nowak et al. (2004) articulated this position and  presented  evidence that, demonstration method is generally effective in teaching sciences, mathematics and mechanics as well as subjects within vocational and technical education because it can be very effective for illustrating concepts in class. While, the discussion method has been widely accepted and recommended by some agricultural educators as a good method of teaching agriculture (Phipps and Osborne, 1988). In the discussion method of teaching, the central and essential characteristic is interaction (Binkley and Tulloch, 1981). During discussion session, students participate in the learning process by contributing problems, analyzing the factors associated with the problems, developing possible solutions to the problems, putting the solution(s) into action and evaluating the results of the solution.

## Statement of the problem

The lecture method has long since failed these educators as an effective way to present their information (Halpern, 2000). This is due to the fact that the teaching method that is best for the students is often not economically feasible, especially in terms of public schooling. Similarly, the teaching resources best suited for the students, such as the latest technology that will make the students to remember information for a long time, may not be available to the teacher (Slowbyte, 2000). Therefore teachers must find the most suitable methods to teach the students in order to determine best practices for classroom delivery and minimize achievement loss, using the resources available to them (Williams and McClure, 2010). These can usually be done by comparing the effectiveness of two or more teaching methods in enhancing students' retention ability.

## Purpose of the study

The purpose of the study was to determine which method - discussion or demonstration - will be the most effective in teaching secondary school vocational agricultural students that will enhance better their retention upon completion of the instructional unit. Specifically the study is to:

1. determine the level of retention between students taught with discussion method and those taught with demonstration method; and
2. determine the differences in achievement loss between students taught with discussion method and those taught with demonstration method.

## Research questions

1. To what extent does students' retention of knowledge differ between students taught with a demonstration

method and those taught with a discussion method?
2. What is the difference in achievement loss between discussion method and demonstration method?

## Hypotheses

Ho1. There is no significant difference between the mean scores of students taught with the discussion method and those taught with demonstration method on an achievement test administered at the conclusion of the instructional unit.

Ho2. There is no significant difference between the mean scores of students taught with the discussion method on a retention test administered three weeks after the achievement test and those taught with the demonstration method.

Ho3. There is no significant difference between the achievement loss of students taught with the discussion method and those taught with demonstration method between the achievement test and retention test.

### METHODOLOGY

The design for this study is pretest-posttest non-equivalent control group design. This was because the researcher used the existing classes (intact classes). The area for this study is Bauchi Local Government in Bauchi State. Bauchi State is located in the North-East sub-region of Nigeria. The target population of this study was all the students offering Agricultural Science in all the secondary schools in Bauchi Local Government up to senior secondary (SS) level. However, the access population was all SS II students offering Agricultural Science in the selected secondary schools. Random sampling technique was employed in selecting the sample schools. There were three sampled schools; two schools were experimental schools while the other one was a control. In each school, one class was randomly selected as the sample from the set of SSII classes. The whole subjects in the class were used as intact class.

The researcher has taught the instructional units to each school (group) twice a week for 45 min up to four weeks. One group was taught using a discussion method and the second group was taught using a demonstration method; while the third group was taught using any lecture method. The unit plan contained an equal amount of instructional material; the only difference was the two teaching methods used in the study. The topic of the unit (Maize Production), the timing of the unit (second term 2010/2011 session), and the method of teaching (demonstration or discussion) were assigned to each group. Three parallel forms of 20 items achievement tests were adopted from WAEC and NECO SSCE examinations in Agricultural Science. A table of specification was developed using Bloom's taxonomy to guide the adoption of the questions. Each question was selected based on its relevance to the content of the topic covered (Maize production). Two experts in the field from School of Technology Education, School of Agriculture of Abubakar Tafawa Balewa University Bauchi and two teachers in the selected secondary schools validated the instruments for face and content validity. For the content validity, the test items were given to the expert together with the table of specification containing the objective and content areas for validation. The instrument was pilot tested in a school not selected in the sample but has the same characteristics with the selected schools. The result was analyzed using Kuder Richardson coefficient formula (K-R 21) (Uzoagulu,

1998). The internal consistency was found to be 0.71.

The first instrument was used as pre-test while the second and third instruments were given as post-tests to all the groups. The post-tests were tagged post-test one and post-test two. Post-test one is achievement test, while post-test two is retention test (delayed achievement test) which was administered three weeks after the first post-test. The scores obtained from the tests were analyzed using mean, standard deviation, t-test and ANOVA at 0.05 level of significance. ANOVA was used because it embodies a family of tests that are special cases of linear regression in which the linear model is defined in terms of group means. The resulting *F* test is, therefore, an overall test of whether group means differ across levels of the categorical independent variable or variables. ANOVA can be used for analysis if there are more than two variables. Here, the variables are the three teaching methods: Discussion, Demonstration and Lecture methods.

## RESULTS

### Research questions 1

To what extent does students' retention of knowledge differ between students taught with a demonstration method and students taught with a discussion method?

In order to answer this research question, the means and standard deviations of the two groups (students taught with Discussion and Demonstration Methods of teaching) were calculated and tabulated in Table 1.

From Table 1, the demonstration method of teaching had the highest post-test II mean score of 55.54 with standard deviation of 13.94 above the discussion method of teaching which had mean score of 43.27 with standard deviation of 15.89. The difference between the two means is significant. That means there is a significant difference between the retention of student taught using demonstration method and those taught using discussion method. This result implied that demonstration method of teaching brings about better retention of learned materials than discussion method of teaching maize production to vocational agricultural students.

### Research questions 2

What is the difference in achievement of loss between discussion method and demonstration method?

In order to answer this research question, the differences between post-test I (Achievement test) and post-test II (Retention test) of the two groups (students taught with discussion and demonstration methods of teaching) were calculated and tabulated in Table 2.

From Table 2, the demonstration method of teaching had the highest Achievement losses mean score of -2.19 with standard deviation of 1.57 than the discussion method of teaching which had mean score of -2.13 with standard deviation of 0.58. There is no significant difference between the achievement loss of students taught with the discussion method and those taught with

**Table 1.** Mean and standard deviation of the Post-test II (Retention Test) score of students taught with discussion and demonstration methods of teaching vocational Agriculture.

| Teaching method | n | X | SD | t-cal | t-crit | Decision |
|---|---|---|---|---|---|---|
| Demonstration | 56 | 55.54 | 13.94 | 4.17 | 1.66 | Sig. |
| Discussion | | 49 | 43.27 | 15.89 | | |

**Table 2.** Achievement losses of students taught with discussion and demonstration methods of teaching vocational agriculture.

| Teaching method | Post-test II | Post-test I | Achievement losses | SD | df | t-cal | t-crit | decision |
|---|---|---|---|---|---|---|---|---|
| Demonstration | 55.54 | 57.73 | -2.19 | 1.57 | 104 | 0.28 | 1.66 | NS |
| Discussion | 43.27 | 45.40 | -2.13 | 0.58 | | | | |

**Table 3.** ANOVA result of the Post-test I (achievement test) score of the discussion method, demonstration method and the control group.

| | Sum of square | df | Mean square | F cal | F. crit | P | Decision |
|---|---|---|---|---|---|---|---|
| Between group | 115.38 | 2 | 57.69 | 0.28 | 3.04 | 0.05 | NS |
| Within group | 31296.18 | 151 | 207.26 | | | | |
| Total | 31411.56 | 153 | | | | | |

demonstration method in terms of the achievement test and retention test. This result implied that discussion method of teaching brings about better retention of learned materials than demonstration method of teaching maize production to vocational agricultural students.

**Hypothesis 1**

*Ho$_1$. There is no significant difference between the mean scores of students taught with the Discussion method and those taught with demonstration method on an achievement test administered at the conclusion of the instructional unit*

The ANOVA result for the three groups gave F-cal value of 0.28 which is less than F-crit of 3.04 at P<0.05 with df = 2 and 151 (Table 3). Therefore the null hypothesis was not rejected. There is no significant difference between the mean scores of students taught with the discussion method and those taught with demonstration method on an achievement test administered at the conclusion of the instructional unit.

**Hypothesis 2**

*Ho$_2$. There is no significant difference between the mean scores of students taught with the discussion method on a retention test administered three week after the achievement test and those taught with the demonstration method.*

The ANOVA result for the three groups gave F-cal value of 0.27 which is less than F-crit of 3.04 at P<0.05 with df = 2 and 150. Therefore, the null hypothesis was not rejected. There is no significant difference between the mean scores of students taught with the Discussion method on a retention test administered three week after the achievement test and those taught with the demonstration method (Table 4).

**Hypothesis 3**

*Ho$_3$. There is no significant difference between the achievement loss of students taught with the Discussion method and those taught with demonstration method between the achievement test and retention test.*

The t-test result for the two groups gave t-cal value of 0.28 which is less than t-crit of 1.66 at P<0.05 with df = 104. Therefore the null hypothesis was not rejected. There is no significant difference between the achievement loss of students taught with the discussion method and those taught with demonstration method between the achievement test and retention test.

**DISCUSSION**

The result also revealed that the demonstration method of teaching had the higher retention test mean score and low standard deviation above that of discussion method of teaching. This result implied that demonstration method

**Table 4.** ANOVA result of the post-test ii (retention test) score of the discussion method, demonstration method and the control group.

|               | Sum of square | df  | Mean square | F cal | F. crit | P    | Decision |
|---------------|---------------|-----|-------------|-------|---------|------|----------|
| Between group | 97.33         | 2   | 48.67       | 0.27  | 3.04    | 0.05 | NS       |
| Within group  | 26742.73      | 150 | 178.28      |       |         |      |          |
| Total         | 26840.06      | 152 |             |       |         |      |          |

**Table 5.** Achievement losses of students taught with discussion and lecture methods of teaching vocational agriculture.

| Teaching method | Achievement losses (X) | SD   | n  | df  | t-cal | t-crit | Decision |
|-----------------|------------------------|------|----|-----|-------|--------|----------|
| Demonstration   | -2.19                  | 1.57 | 56 | 104 | 0.28  | 1.66   | NS       |
| Discussion      | -2.13                  | 0.58 | 50 |     |       |        |          |

of teaching brings about better retention of learned materials than discussion method of teaching maize production to Vocational Agricultural students. This finding is in agreement with Achor et al. (2009) who reported that the retention mean scores (58.01) of students taught using ETA is higher than the retention mean scores (21.35) of those taught with the conventional approach. This also agrees with the results of Chianson (2008) who found that students in the experimental group retain better than those in the conventional group. It also agreed with the findings of Williams and McClure (2010) who reported that knowledge retention was highest and most consistent over time for the students who received their information via public pedagogy. This was also supported by the findings of Wright (2007) who found that students engaged more in the curriculum when public pedagogy methods were used. Kamis et al. (2005) noted that for adult learners, using different methods bring about equal knowledge retention.

The result also revealed that demonstration method of teaching had higher Achievement losses in terms of mean score and standard deviation than the discussion method of teaching. This result implied that demonstration method of teaching brings about higher achievement losses of learned materials than discussion method of teaching maize production to vocational Agricultural students. This can be due to the fact that when the students observed the teacher demonstrating a particular concept and were not opportune to do it repeatedly due to non availability or inadequacy of school garden or demonstration farm, the students may tend to forget. But when they are involved in a discussion session of what they already know and are doing it at home, they may tend to remember it more. This finding is in agreement with Flowers and Osborne (1987) who reported that for low level cognitive items, achievement loss for the problem solving group was slightly lower, but not significantly lower, than for the subject matter group.

In support, Flowers and Osborne (1988) found "that for high level cognitive items [that is application, analysis, synthesis, and evaluation] students taught by the problem solving approach had less achievement loss than students taught by the subject matter approach". Young et al. (2009) also found lack of engagement brought on by students being passive spectators in the classroom led to decreased retention in material.

The ANOVA result for the three groups in the first Hypothesis shows that there is no significant difference between the mean scores of students taught with the demonstration method and those taught with discussion method on an achievement test administered at the conclusion of the instructional unit. This finding was supported by Smith et al. (2001) who reported that the results of the comparison between the groups on the immediate post-test revealed no significant difference at the 0.10 alpha level. Therefore, the null hypothesis is retained. But it disagreed with Achor et al. (2009) who reported that the difference in achievement between the experimental and control groups was significant ($F_{1.248}$ = 241.317, p < 0.000). This may be due to the fact that in the lecture method factual material is presented in a direct and logical manner. It may also provide experiences that inspire useful knowledge for large groups.

The ANOVA result for the three groups in the second Hypothesis shows that there is no significant difference between the mean scores of students taught with the demonstration method on a retention test administered three week after the achievement test and those taught with the discussion method. This finding was in agreement with that of Iji (2002) who in his study found that the difference was not significant statistically. Smith et al. (2001) also reported that the analysis of the scores on the 35 item delayed post-test (retention test) revealed that the problem-oriented group earned higher than the lecture-study question group. But this was not found to be significantly different. The null hypothesis is retained for

the delayed post-test. But this result disagrees with that of Achor et al. (2009) who reported that the difference between the retention means scores of experimental and a control groups is statistically significant ($F_1$, 248=270.421, p < .000).

The t-test result in the third hypothesis for the two groups shows that there is no significant difference between the achievement loss of students taught with the discussion method and those taught with demonstration method in terms of the achievement test and retention test. This finding is in agreement with Flowers and Osborne (1987) who reported that for low level cognitive items, achievement loss for the problem solving group was slightly lower, but not significantly lower than for the subject matter group. The hypothesis of no difference in achievement loss for lower level cognitive Items was not rejected.

## Conclusion

Based on the findings of this study, demonstration method is not more or less effective than the discussion method in producing higher scores on the delayed retention test in teaching maize production in Agricultural Science. Students taught by the discussion method exhibit lower achievement loss than students taught by the demonstration method.

## RECOMMENDATION

Based on the findings, the following recommendations were made:

1. Because of the slight advantage of the demonstration method in the area of students' retention of knowledge, the demonstration method may be used with confidence to teach Agriculture Science in Bauchi State secondary schools.
2. The education ministries at every government level should regularly organize workshops and refresher courses for instructors. This will help in exchange of ideas on the various relevant and innovative ways for teaching Agricultural Science.

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