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ABSTRACT

The approach used by teachers is very important to the success of the teaching process. This is why this study seeks to determine which teaching approaches – problem solving and subject-matter, would best improve the problem solving ability of selected secondary agricultural education students in Ikorodu Local Government Area. Ten classes and 150 students, based on Hay's (1973) cluster sampling formula for determining sample size, were selected. The classes were taught with instructional units prepared using the problem solving approach model presented in Newcomb, McCracken and Warmbrod (1993) and subject matter approach as described by Rosenshine and Steven (1986). At the conclusion of all instruction, a problem solving ability posttest and Group Embedded Figures Test (GEFT) Instruments were administered to all participants. The scores obtained from the problem solving ability posttest was analyzed using the univariate analysis of covariance and it found, among other things, problem solving approaches scored significantly higher (P=0.046) on the posttest than scores of students assigned to classes using the subject matter approach. The implication of this figure is that the problem solving ability of secondary

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school students can be accelerated with instructional approaches, such as the problem solving technique.

INTRODUCTION

The approach used by teachers is very important to the success of the teaching process. Teachers should learn how to use several teaching methods. No one method of instruction will work all of the time and under every circumstance. Thus, the selection of a teaching method is critical to the learning style of those being served by instruction.

The problem solving approach is a student-centered approach to teaching where the central and essential characteristic is solving problems (Binkley and Tulloch, 1981). Students participate in the learning process by contributing problems, analyzing the factors associated with the problems, developing possible solutions to the problems, placing the solution(s) into action, and evaluating the results of the solution. The subject matter approach is a teacher-centered approach to teaching where students are more passive participants in the learning process. Students listen to the information, participate in limited discussion, take notes, and retrieve or recall the information for evaluation purposes. With the subject matter approach the focus is more on acquisition of information than on group driven problem solving.

Odumosu (1999) explained the problem solving method as a form of the discussion and development methods in which the students set out with a wider problem to guide their study or discussion. The problems may be given by the teacher or it may be suggested through the children's own experiences in that subject or in a life situation. It is their task to find the facts that will help in solving it. The problem solving approach has been widely accepted and recommended by agricultural

educators as the best method of teaching agriculture (Phipps and Osborne, 1988). Today, that approach remains the primary method of teaching offered to pre-service agriculture teachers in many teacher education programs. However, its actual use throughout the agricultural education profession is limited, with some educators questioning its validity as a superior approach to instruction. Many teachers view the problem solving approach as archaic, tied to the farm backgrounds and supervised agricultural experiences of the learners (Moore and Moore, 1984). Critics of the problem solving approach also accuse that while the approach has a sound theoretical base, it has been accepted with little empirical evidence to either defend or reject its usefulness in the classroom.

Some students may possess a style of learning which is not complimentary to the use of problem solving. Their inability to solve problems interacts with their inability to use past knowledge and experiences to help in the solution. Research on learning and teaching styles serves as a basis for selecting teaching approaches. According to Barr and Tagg (1995), two types of teaching behaviors and two different types of student learning strategies exist. They wrote that teachers educate from either an instructional paradigm that focuses on what the teacher does in the classroom, or from a learning paradigm that focuses on whether and how students learn. Most teachers teach from the instructional paradigm that is less concerned with how students learn and more about the teacher's actions (Lasley, 1998). Learning strategies refer to the different activities that students apply and by which learning is achieved (Sankaran & Bui, 2000). Two types of learning strategies have been proposed: deep, to satisfy curiosity and to understand the meaning of a task by an in-depth study of a subject; and surface, which is just to satisfy requirements by memorizing facts well enough to earn a good grade without fully mastering the material (Sankaran & Bui,

2000). For teachers to foster the deep learning strategy they must teach outside of the instructional paradigm. In other words, teachers must present information in a way that encourages students to seek their own answers using their own strategies. Gallagher and Stepien (1996) wrote that instruction which fosters higher order thinking can result in learners who can construct meaningful connections between significant pieces of information, transfer information to new settings, and are motivated to learn. By teaching students how to think and learn independently, teachers increase their power to think and to learn outside of the classroom (Kahler, Miller & Rollins, 1988). These statements support the need to determine the appropriate teaching approach different from the traditional methods of lecture and rote memorization still used today by teachers who view education from the instructional paradigm and by students who use surface learning strategies. The problem-oriented approach has been used as an educational tool for many years. Educators such as John Dewey proposed it nearly a century ago. According to Barrow (1996), problem based learning was reintroduced into medical education in the 1960s to better prepare physicians for the demands of professional practice. There is opposition to the use of the problem oriented approach as a method of education. Critics of the problem solving approach say that while the approach has a sound theoretical base, it has been accepted with very little empirical evidence to either defend or reject its usefulness in the classroom (Dyer & Osborne, 1999). Additionally, Dyer and Osborne (1999) found that problem solving instruction may not fit the learning style of some students. In fact, abstract learners may not recognize problems as such when presented to them. Problem solving instruction may be an effective instructional alternative, but little empirical evidence from school settings currently exists concerning teaching for knowledge acquisition using this approach.

The theoretical framework for this study was founded in Mitzel's Conceptual Model for the study of classroom teaching (Dunkin and Biddle,1974). The Mitzel Model suggests that the effectiveness of a teaching approach (process variable) on the problem solving ability of students (product-variable) is moderated by the learning styles of the students (context variable), even though teacher effects (presage variables) are held constant. However, student learning styles shall not be considered or included in the analyses of this study.

Few studies have attempted to address the effects of the problem solving and the subject-matter approach on the problem solving ability of secondary agricultural education (mostly foreign authors) and reported. Whereas Dawson (1956) reported an increase in problem solving ability in favor of the problem solving approach; Thompson and Tom (1957) found no difference. A study of agriculture students from Illinois which compared the effects of the problem solving approach to the subject matter approach found the problem solving approach to be no more or less effective in producing student achievement or knowledge retention (Flowers & Osborne,1988). Flowers (1986) reported no significant differences in the short-term retention of subject matter when the problem solving approach was compared to the subject matter approach. The problem solving approach was; however, effective in reducing achievement loss when compared to the subject matter approach (Dyer & Osborne, 1999; Lee, George and Donald,2001).

PURPOSE OF THE STUDY

The primary purpose of this study was to compare the effectiveness of the problem solving approach to the subject

matter approach in teaching given agricultural science problem areas to subjects. The specific objectives of the study are:

- To analyze the descriptive statistics of sample students.
- To determine the effects of the problem solving and subject matter approaches on the problem solving ability of secondary school agricultural education students in Ikorodu Local Government Area.

HYPOTHESES TESTED

There is no difference in the problem solving ability of students taught by the problem solving approach and the problem solving ability of students taught by the subject matter approach.

RESEARCH DESIGN

The study was conducted using a quasi-experimental design. Since random assignment of subjects to treatment groups was not possible, intact groups were used with random assignment of treatments to the groups. The study followed a variation of the nonequivalent control group design described by Campbell and Stanley (1963), but differed in that the subject matter approach to instruction was used as the control.

POPULATION STUDIED

The population of this study consisted of all Ikorodu Local Government Area (Lagos, Nigeria) Secondary Agricultural Education Students.

SAMPLE AND SAMPLING TECHNIQUE

Ikorodu Local Government Area has about 50 Secondary Schools (both public and private together). Ten classes and 150 students taught by five teachers were selected. Cluster sampling based upon Hays (1973) formula for determining sample size was used in an attempt to ensure that instructors were capable of using each of the two teaching approaches properly.

RESEARCH INSTRUMENT; VALIDITY AND ADMINISTRATION

The instruments used for the study were instructional units, Group Embedded Figures Tests (GEFT) and questionnaires. GEFT enumerates the degree of abstractness concreteness on a scale of 0-18. The GEFT instrument is considered to be a standardized instrument. Its validity has been established and reported by Witkin, H.A., Oltman, P.K. Rosking, E and S.A. Karp (1971). Instructional units were prepared using the problem solving approach model presented in Newcomb, McCracken, and Warmbrod (1993) and subject matter approach model as described by Rosenshine and Steven (1986). To ensure that the proper teaching approach was used, instructors were provided in-service workshops of two hours in length concerning the proper use of both teaching approaches.

Face, content and construct validity of the researcher-constructed instruments were determined by an expert panel in agricultural education and research. All instruments were pilot tested and appropriately adjusted.

Students were administered a pretest designed to measure pre-treatment problem solving ability. Normal curve

equivalent (NCE) scores were also obtained to statistically control for existing ability levels. One treatment group received instruction in classes taught by the problem solving approach, the other group received instruction in classes taught by the subject matter approach. Two units of instruction were taught to each group. At the conclusion of all instruction, a problem solving ability posttest and the GEFT instruments were administered to all participants. Data collection was carried out between May and July 2008.

PROCEDURE

The data for this study were collected using a quasi-experimental counterbalance design (Campbell and Stanley, 1963). Teachers were purposefully selected for their ability to use the problem solving approach to teaching by a panel of experts consisting of three faculty members from The Federal College of Education's (Technical) Agricultural Education Department and nine staff members from the Supervisors of the Lagos State Post-primary Teaching Service. The panel of experts was selected on the basis of their knowledge of the teaching ability of the Lagos agricultural science teachers. Fifteen teachers were identified by the panel of experts, five teachers agreed to participate in the study, and all five teachers provided usable data to the researcher. Four teachers provided audio tapes of their instruction. The sampled population was150 students enrolled in agricultural science in ten comprehensive high schools. Each teacher taught two instructional units. One unit was taught using a problem solving approach and a second unit was taught using a subject matter approach. The unit plans contained an equal amount of instructional material; the only differences were related to the two teaching approaches used in the study. The problem solving approach unit plans were prepared for each of the

instructional units. Equivalent unit plans were prepared for the subject matter approach to teaching, including identical information used in the problem solving unit plans. The instructional unit plans were then submitted to a panel of experts consisting of four faculty members and six graduate students from The Federal College of Education's (technical) Department of Agricultural Education to establish content validity and equality. The panel of experts was selected on the basis of their experience teaching high school agricultural science. The topic of the unit (Farm Implement and Mechanization), the timing of the unit (first or second in the instructional series), and the approach to teaching (subject matter or problem solving) were randomly assigned to each teacher. Instruction on all units was audio taped to verify the administration of the experimental levels of the treatment. Data were collected using a 40 question achievement test (Farm Implement and Mechanization unit test), a 15 item attitude toward instruction instrument (Farm Mechanization Attitude instrument), and a 14 item teaching approach evaluation instrument (Teaching Approach Instrument) developed by the researchers. The 40 achievement test questions were arranged in different ways to produce three identical forms of the exam. The three forms were used as a pretest, posttest #1 and posttest #2.

Content validity of the instruments was established by a panel of experts consisting of four faculty members and six graduate students from The Federal College of Education's (technical) Department of Agricultural Education with experience teaching high school agricultural science.

DATA ANALYSIS

Statistics such as the covariance analysis, mean and percentages were used for analyzing the data generated with the instruments.

RESULTS

Table 1.0. Numbers and Percentages of Students by Gender and Teaching Approach

GENDER	TEACHING APPROACH	
	PSA n = 102	SMA N = 48
Male Female	66 (64.7) 36 (35.3)	34 (70.83) 14 (29.17)

Note: Percentages are in parentheses.
PSA = Problem Solving Approach
SMA = Subject Matter Approach

Table 1.0 shows that 102 students (66 male and 36 females) were taught by problem solving approach while 48 (34 males and 14 females) were taught by subject matter approach. Majority of the students who completed the study were males.

Table 2.0. Mean Scores of Student Problem Solving Ability

GENDER	Problem Solving Ability Pretest		Problem Solving Ability Posttest	
	Mean	SD	Mean	SD
Male Female	6.08 3.68	2.45 1.32	8.56 6.30	3.63 2.25

Table 2.0 statistically the performance of students taught by problems solving teaching approach. The comparison revealed that male students scored significantly higher on the problem solving ability pretest than did female.

Hypothesis:- There is no difference in the problem solving ability of students taught by the problem solving approach and the problem solving ability of students taught by the subject matter approach.

Table 3.0. One–way Analysis of Variance for Problem Solving Ability.

Source	Df	Ms	F
Pretest Between groups Within group.	 6 143	 (24.10) (3.12)	 8.84**
Post test Between groups Within groups	 6 143	 (18.01) (8.35)	 1.98

* P< .01

The problem solving ability of students was measured by the numerical score obtained from analysis of the problem solving ability posttest completed by each student. All tests were scored according to the problem solving analysis form developed by the researcher. Scores on the problem solving ability pretest were used as a covariate measure to adjust for pre-existing group differences.

A one-way analysis of variance revealed significant differences (P = 0.000) across the groups. The univariate analysis of covariance testing the effects of the treatment on the problem solving ability of students indicated that the scores of students in classes taught by the problem solving approach were significantly higher (P = 0.046) on the posttest than were scores of students assigned to classes using the subject matter approach. As a result, the null hypothesis of no difference between treatment groups was rejected in favor of the problem solving approach.

CONCLUSION AND RECOMMENDATIONS

The study shows that the problem solving approach is more effective than the subject matter approach in increasing the problem solving ability of students. This finding agreed with earlier studies reported by Dawson (1956) and Chuatong (1987). The problem solving approach to teaching should be used whenever improved problem solving ability is a desired outcome of instruction. According to Witkin, et al (1997) students scoring less than 11.3 on the GEFT instrument possess little inherent ability to solve problems. They must acquire this skill. Based on the results of this study, the problem solving approach proved to be an effective tool and should therefore be used as an instructional approach to enhance problem-solving ability. In secondary schools, the ability to solve problems increases by class level. However, that ability can be accelerated with instructional approaches, such as the problem solving approach, which focuses on the solution of problems. Suffice it to say that this study, though clinical in nature, is severely limited in its ability to be generalized to other populations. Further studies should be conducted to increase the level of understanding and usability.

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