EFFECTS OF FOUR INSTRUCTIONAL METHODS AND COGNITIVE STYLE ON STUDENTS ACADEMIC ACHIEVEMENT IN PHYSICS IN DELTA CENTRAL SENATORIAL DISTCRICT

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Abstract

The study was carried out to examine the effects of four instructional methods (problem solving, discussion, demonstration and lecture) and cognitive style on students' academic achievement in secondary school physics. The sample consisted of 361 senior secondary school one (SSS1) students of varied ability drawn from nine secondary schools. The study adopted a 4x2 pretest-posttest non-equivalent control group quasi-experimental design. The cognitive style test (CST) and the Physics achievement test (PAT) were use as research instruments. The ANCOVA statistic was used to analyze some hypotheses using the pre-test scores as covariate and t-test analysis was used to test the remaining hypotheses. The findings of the study revealed significant effect of problem-solving, discussion and demonstration method of instruction on the achievement of students in secondary school physics. The result also revealed that there is no significant interaction effect of treatment and cognitive style on students' academic achievement. It was recommended amongst others that since Problem-solving method, Discussion method and Demonstration method are effective in improving students' performance in physics; teachers should therefore employ these methods of instruction in teaching physics. Seminars and workshops should be organized for teachers so that they will be familiar with these instructional modes for effective teaching of physics.

Science is the bedrock of all technological advancement; the scientific feat has turned the world into a global village and turned those who are not technologically advanced to mere pawns in the game of survival. Physics, on the other hand, is the study of matter as it relates to the environment. The duo of science (physics) and technology holds the key to a nation's development (Onifade, 2001). Science and technology is the parameter upon which the development of any nation is measured today, but cannot strive without Physics (Olorundare, 2011; Agboghoroma, 2009). The developed countries moved ahead by recognizing and appreciating the relevance of chemistry in their national economy. Research evidences have shown that physics contribution to quality of life and nation building are worthwhile in all aspects. It's on this platform, that the Federal Government in her National Policy on Education made chemistry an important science subject at the secondary school level (FRN, 2004).

One major characteristics of the Nigerian school system is the emphasis placed on science programmes. Children are expected to acquire scientific skills and attitudes as well as the main objectives of secondary school science programme which include acquisition of relevant knowledge with understanding, ability to handle and process information and problem solving via acquired knowledge, experimental skills and scientific investigation. Despite the effort of the government to improve science education, there is an identified and recurring problem of students' poor achievement in the science. Science teachers, parents, school principals have continued to show some concern over students' poor achievement in the sciences especially physics. Students learning problems may be attributed to teacher's delivery of lessons not being in consonance with factors like students cognitive style.

Teaching methods like workshops and problem based learning, questioning and discussion, investigation and problem-solving, demonstration and laboratory work methods are being used today

to pass instruction to students in physics. In all this, there is no better way of learning than doing it yourself. This also motivated the researcher to find out what influence instructional methods have on students' achievement. Another factor associated with instructional method and students' performance is cognitive style. To understand cognitive styles, a definition of cognition must be understood. Cognition is a collection of mental processes that includes awareness, perception, reasoning and judgment (Stannard, 2003). Cognitive style is a term used in cognitive psychology to describe the way individuals think, perceive and remember information. Agboghoroma (2009) defined cognitive styles as "the …. Psychological dimensions that represent the consistencies in an individual's manner of acquiring and processing information". Thus, Studies that probe the effect of instructional methods and cognitive styles on students' achievement in physics are not much in existing literatures. So to add to existing literatures, this study specifically investigated if instructional methods (problem solving method, discussion method, demonstration method and cognitive styles (field-dependent and field–independent) have any effect on the achievement of students in secondary school physics.

Meaning and types of Instructional Methods

Methods are the means or ways that we use to teach our students. Our choice of methods depends on what we want to teach (content), who we are teaching and the level of competence expected (White and Manfred, 2002). A teaching method is characterized by a set of principles, procedures or strategies to be implemented by teachers to achieve desired learning in students (Liu and Shi, 2007). These principles and procedures are determined partly by the nature of the subject matter to be taught, and partly by our beliefs or theories about how students learn. One fundamental question that the teacher should ask himself or herself is "how am I going to teach"? This has to do with the method of presenting the subject content or learning experiences in order to make the students achieve the objective of the lesson. teaching methods include but not limited to; lecture, discussion, questioning, problem solving, laboratory and demonstration, peer teaching and cooperative learning etc.

Lecture method is based on the traditional view of teaching that the Teacher knows everything and the learner is almost blank (Adeyemo, 2010; Olatoye, 2011). This is to say that the students who are usually supposed to be ignorant and bare acquire the knowledge from the teacher. Discussion method involves a greater degree of teacher- pupil's interaction than the lecture method (Osakinle, Onijigin and Falaba, 2010). Communication flows from the teacher to the pupils and eventually pupil to pupils. This method takes care of inter- learning but the method is suitable only with small groups of learners ranging from two to fifteen. Most teachers however teach large classes of thirty, forty or even fifty. In the lower classes of the Nigerian Secondary School most classes are quite large (Osakinle, Onijigin and Falaba, 2010).

Teaching method comprises the principles and methods used for instruction (Westwood, 2008). Commonly used teaching methods may include class participation, lecture, demonstration, recitation, memorization, or combinations of these. The choice of teaching method or methods to be used depends largely on the information or skill that is being taught, and it may also be influenced by the aptitude and enthusiasm of the students (White and Manfred, 2002). Content can be divided into the three domains of knowledge: Skills, Attitudes, and Values. When we are teaching knowledge, we can use a variety of methods, with the goal of getting the learner to actively engage in learning the material. When teaching skills, we need to demonstrate and point out important aspects, supervise the student doing the skill, or talk the student through the skill. When teaching about attitudes, we need to use methods that require the application of the attitude in particular situations.
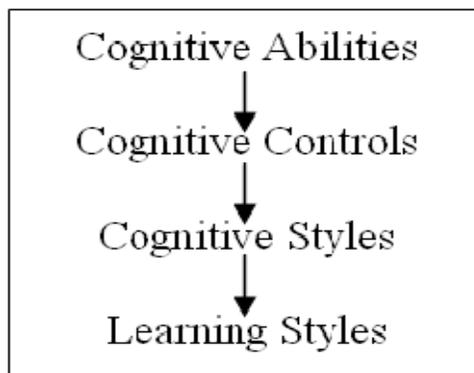
Importance of Instructional Methods

White and Manfred (2002) outlined the following as the importance of instructional methods:
- motivate students and help them focus attention
- organize information for understanding and remembering
- monitor and assess learning

Concept of Cognitive Styles

There appears considerable confusion in the literature concerning the terms cognitive and learning styles. Numerous authors and researchers use the terms interchangeably. However, various authors draw a distinction between cognitive and learning style. Learning styles refer to ways that people learn information, and cognitive styles are more global, referring to the way that people see the world around them and interact with it (Agboghoroma, 2009).

Egbule (2009) see cognitive styles as the "…psychological dimensions that represent the consistencies in an individual's manner of acquiring and processing information. According to Egbule (2009) cognitive style deals with the manner in which people prefer to make sense out of their world by collecting, analyzing, evaluating, and interpreting data. These styles are thought to remain consistent preferences throughout life Egbule (2009) proposed a transition from cognitive abilities to learning styles (See, Figure 1). Cognitive abilities cover the content and refer to the level of cognitive activity whereas learning styles indicate the manner and form of learning. According to the Egbule (2009), abilities are stated in terms of maximal performance; therefore, they are unipolar (i.e., less ability...more ability) and value directional measures (having more is better than having less), whereas styles are bipolar (visual....verbal) and value differentiated (neither pole is necessarily better). He conclude that abilities enable learners to perform tasks whereas styles control the ways in which tasks are performed. The figure below shows the relational transition of cognitive processes (Egbule, 2009).

Source: Egbule (2009)

For Egbule (2009), cognitive style is seen as an individual's particular way of processing and representing information. Studies that probe the effect of instructional methods and cognitive styles on students' achievement in Physics are not much in existing literatures. So to add to existing literatures, this study is therefore important. This study specifically investigated if instructional methods (problem solving method, discussion method, demonstration method and cognitive styles (field-dependent and field–independent) have any effect on the achievement of students in secondary school physics.

Statement of the Problem

There has been government and non-governmental effort to improve the performance of students in the sciences, but the poor achievement of students in the sciences is still prevailing. The poor performance of students has been attributed to many factors as earlier mentioned: lack of science facilities, inadequate and non-qualified science teachers, teaching methods used by teachers, students' learning ability (learning style) amongst others. Students learning ability is one of the major factors responsible for poor performance of students in the sciences. This learning ability may be attributed to teachers' method of instruction or students learning style. The issue of methods of instructions and their effects on students' achievement in the sciences has been a paramount issue in recent times.

Research had pointed out that there is a significant impact of instructional methods on students' performance.

Science education is a pivot in the development of any nation. Any nation that wants to succeed must pay adequate attention to how science is being taught in her school system. Thus, taking into cognizance of the factors that impede the proper teaching of science – cognitive style of the students, as well as teachers teaching mode, needs to be considered in this study. The problem of this study therefore is: what is the effect of problem-solving, discussion, demonstration and lecture methods of instruction on students' achievement in physics? also, what is the impact of cognitive styles (Field dependent–independent) on students' achievement in physics.

Research Questions

The following research questions were raised based on the problem stated.
1.   What is the effect of treatments (problem-solving, discussion, demonstration and lecture method of instruction) on students' achievement in secondary school physics in Delta Central Senatorial District?
2.   Is there any difference in the achievement of field dependent and field-independent students' in secondary school physics in Delta Central Senatorial District?
3.   Is there any difference in the achievement scores among students' taught with the four different teaching methods in secondary school physics in Delta Central Senatorial District?
4.   Is there any interaction effect of treatments (i.e. problem solving, discussion method, demonstration method and lecture method) and cognitive styles (field-dependent and field-independent) on students' achievement in secondary school physics in Delta Central Senatorial District?

Hypotheses

The following hypotheses were tested at .05 level of significance.
HO_1.   There is no significant effect of treatments (problem-solving, discussion, demonstration and lecture method of instruction) on students' mean achievement test score in secondary school physics in Delta Central Senatorial District.
HO_2 There is no significant difference in the mean achievement test score of field-dependent and field-independent students in secondary school physics in Delta Central Senatorial District.
HO_3.   There is no significant difference in the mean achievement test score among students taught with the four different teaching methods in secondary school physics in Delta Central Senatorial District.
HO_4.   There is no significant interaction effect between method of instruction (problem-solving method, discussion method, demonstration method and lecture method) and cognitive styles (field-dependent and field-independent) on students' achievement in secondary school physics in Delta Central Senatorial District.

Methodology

This study used the quasi-experimental non-randomized pretest-posttest control group design. There was no randomization of subjects in this study. Intact classes were randomly assigned to the experimental and control groups. It is a quasi- experimental study because non-randomized intact classes were used for the study. The independent variables are cognitive style and Instructional method. The dependent variable is the achievement score of the students. This study employed the 4x2 factorial design consisting of four instructional methods and two cognitive styles:

Table 1: Design of the study

Methods Of Teaching	Cognitive Style	Treatment (X)			GROUP
Problem Solving Method	Field Independent Field Dependent	O_1	X_1	O_2	Experimental
Discussion Method	Field Independent Field Dependent	O_3	X_2	O_4	Experimental
Demonstration Method	Field Independent Field Dependent	O_5	X_3	O_6	Experimental
Lecture Method	Field Independent Field Dependent	O_7	X_4	O_8	Control

Where $O_1, O_3, O_5, O_{7=}$ pre-test measures

O_2, O_4, O_6, O_8 = posttest measures

While x_1 x_2 x_3 and x_4 represent treatments in experimental groups

X_1 = Problem solving Method
X_2 = Discussion Method
X_3 = Demonstration Method
X_4 = Lecture Method

The variables for this study are the instructional methods, cognitive style and students' achievement. The achievement of the students is the dependent variable. In the course of this work the independent variables which include the four methods above were manipulated to see their effects on the students. The population of this study comprises of male and female students from public senior secondary schools in Delta Central Senatorial District offering physics as a subject. Delta Central Senatorial is made up of eight Local Government Areas namely: Ethiope East, Ethiope West, Ughelli North, Ughelli South, Udu, Uvwie, Sapele and Okpe. The population for this study comprises of all the public secondary school students in Delta Central Senatorial District. The targeted population of this study is 7,452 (Source: Office of the Secretary, Post-Primary Education Board, Asaba 2016).

In selecting schools to participate in this study, the researcher selected nine (9) secondary schools drawn from the population. All the schools are mixed. Out of the eight Local Government Area making up the Delta Central Senatorial District, the researcher also used the simple random sampling technique by balloting without replacement (to avoid picking one Local Government twice and giving all Local Government equal opportunity to participate in the study) to select three Local Government Areas that were used for the study. The three local Government areas are Ethiope East, Ughelli North and Okpe. The sample for this study comprised of three hundred and sixty one (361) senior secondary one (SSII) students of varied ability from the nine schools selected this set of students was chosen because at this stage, they have pass through series of instructional method. The students were grouped into field-dependent and field-independent based on their response to Seigel Cognitive Style test which consist of 20 triads of familiar pictures. In each school, an intact class was used as either the experimental group or the control group. In this study, no school had more than one treatment group. This decision was taken to avoid the problem of contamination, which might occur as a result of having more than one treatment group per school.

Instruments that were used for this study include:

I. **Cognitive Style Test (CST):**

This was a version of the Siegel (1977) cognitive style test, which consists of twenty triads of familiar pictures. This instrument, which had been modified and validated for Nigerian setting (Olajengbesi, 2006 and Agboghoroma, 2009), was used to classify subjects into field dependent and field-independent based on the reasons they gave for their answers. In estimating the reliability of the test instrument, the test-retest reliability method was employed using a school in Sapele Local

Government of Delta State. The Spearman rank order correlation coefficient technique was employed for the computation of data after an interval of two weeks. Data yielded reliability estimate of r = 0.4 which was seen significant at .05 level of significance since it was less than r – critical (.77). The test was to measure how students chose and analyzed a set of drawing of common objects e.g. plants, animals, houses etc. for the purpose of classifying them. It consists of 20 set of familiar pictures with each set consisting of a triad set of pictures like a bus, a girl, a lorry. In this case the students were made to match any two of the pictures in each set and give reasons for their choices. Based on their reasons, subjects were classified into field dependent or field independent.

In this cognitive style test, three main categories of behaviours are possible:

a. **Analytic:** This involves the ability of the subjects to group objects on the basis of discernible features e.g. giving a triad of a lorry, bus and a girl, an analytic subject may group a bus and a lorry because they have four wheels.

b. **Relational:** This is concerned with the ability of the subject to group objects together based on their functional relationship. For example, a relational subject may choice a bus and a girl because the girl is either a driver or a passenger

c. **Inferential:** This involves the tendency to group things based on subordinate inferred features. For example, given the triad of pictures consisting of a man, a ruler and a watch, an inferential subject may group a ruler and a watch together because they are measuring instruments or a bus and a lorry because they are means of transportation.

For the purpose of this study, responses from the analytical and inferential categorization were grouped together to form the field independent cognitive style as both categories are similar in certain ways and they demand comparable skills (Agboghoroma, 2009), while responses under relational cognitive style category were grouped as field dependent. Each student was scored a maximum of 1mark for each triad as relational, analytic or inferential responses. In this case, each student had a score separately for analytic/inferential responses and another score for relational responses. With these order students were grouped as either field dependent or field independent. In this order, students with scores above the median on the analytic / inferential responses and below the median on relational responses were regarded as Field Independent students while students with scores above the median on relational responses and below the median on analytic / inferential were grouped as Field dependent**.**

II. **Physics Achievement Test (PAT):**
This was a 50 item multiple choice Physics Achievement Test (PAT) based on the selected topics for this study. The test items were spread to cover the topics selected from the SSI curriculum
In constructing the items, a table of specification was provided. This is a two dimensional table that shows the test objectives and the content to be tested. In the table of specification, the number of test items and percentage of items in each topic were clearly stated. The table helped the test constructor to achieve content validity for the test.

In drawing up the PAT, the researcher took into account Bloom's (1956) taxonomy of objectives in the cognitive domain. While the test was made to cover the six levels – Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation cognitive domain, most of the items were clustered around the five levels: knowledge (22), comprehension (28), application (24), analysis (10), synthesis (8), evaluation (8).

Treatment Procedure
The study employed a quasi-experimental non-randomized pretest-posttest control group design. After the initial random selection of the classes to be used in each of the school, this was followed by the administration of the pre-test after which the classes were randomly assigned to the treatment condition for six (6) weeks. The post test was administered after the treatment.

1.   Experimental group one: Problem solving Method
2.   Experimental group two: Discussion Method
3.   Experimental group three: Demonstration Method
4.   Control Group   Lecture method

The subject teachers of the various schools selected were trained and engaged by the researcher to assist in the presentation of treatment to the groups. The subject teachers are the research assistants and helped also in the administration of the post-test.

Prior to the commencement of treatment the researcher trained nine research assistants (one each) from the sampled schools. The teachers received a comprehensive training from the researcher on the chemistry curriculum materials selected for the study and the instructional methods to be used. Then the teachers were provided the six weeks material of instruction. These research assistants helped the researcher in administering the pre-test and the answer scripts collected immediately and the achievement recorded. The samples were then subjected to treatment for six weeks. At the end of the six weeks treatment, the posttest was administered and the students scripts were collected immediately marked by the researcher and achievement recorded for further analysis.

Method of Data Analysis

The researcher use the mean and standard deviation for research questions. The testing of hypotheses involved the use of t-test statistical analysis and Analysis of covariance (ANCOVA). The t-test statistical analysis was used to test hypotheses 1 & 2, while the ANCOVA was used to test hypotheses 3 and 4. The ANCOVA statistical method was used because it helps in creating a level platform for the inequalities observed in the pre-test score that the researcher has no control over when analyzing data collected. The ANCOVA was also used because in an experimental research design or quasi experimental design, the ANCOVA help to control for factors which cannot be randomized but which can be measured on an interval scale. Another reason for using ANCOVA was because of the presence of covariate; covariates are commonly used as control variables (which lecture method is posing in this study). It reduces experimental error by statistical rather than experimental procedures.

Results

The analysis and presentation of results are organized around the research questions and its corresponding hypotheses.

Research Question One: Is there any effect of problem-solving, discussion, demonstration and lecture method of instruction on students' achievement in secondary school physics in Delta Central Senatorial District?

Table 5a: Descriptive Statistics Showing the Effect of Problem Solving Method of Instruction on Secondary School Students' Achievement in Physics

Variable	N	Mean	SD	Mean Difference	Decision
Pretest	133	25.42	5.03	-12.06	Positive effect
Posttest	133	37.48	4.67		

Data presented in table 5a showed that problem solving method group had a mean score of 37.48 with a mean difference of 12.06 indicating there was a positive effect of problem-solving method of instruction on secondary school students' chemistry achievement. This is seen in the improved posttest mean (37.48) achievement score compared to the pretest score (25.42).

Table 5b: Descriptive statistics showing the Effect of Discussion Method of Instruction on Secondary School Students' Achievement in Physics

Variable	N	Mean	SD	Mean Difference	Decision
Pretest	72	26.33	4.68	-11.48	Positive effect
Posttest	72	37.81	4.36		

Data presented in table 5b showed that there was a positive effect of discussion-method of instruction on secondary school students' physics achievement. This is shown by an improved posttest mean (37.81) achievement score compared to the pretest score (26.33).

Table 5c: Descriptive Statistics showing the Effect of Demonstration Method of Instruction on Secondary School Students' Achievement in Physics

Variable	N	Mean	SD	Mean Difference	Decision
Pretest	69	25.49	4.77	-12.52	Positive effect
Posttest	69	38.01	4.80		

Data presented in table 5c showed that there was a positive effect of demonstration-method of instruction on secondary school students' physics achievement. This is shown by an improved posttest mean(38.01) achievement score compared to the pretest score (25.49).

Table 5d: Descriptive Statistics showing the Effect of Lecture Method of Instruction on Secondary School Students' Achievement in Physics

Variable	N	Mean	SD	Mean Difference	Decision
Pretest	87	25.57	4.21	-3.56	Positive effect
Posttest	87	38.14	4.24		

Data presented in table 5d showed that there was a positive effect of lecture method of instruction on secondary school students' physics achievement when compared to the other methods. This significance is as a result of these learners being more familiar with this method than the other methods under investigation. There was good improved posttest mean (38.14) achievement score compared to the pretest score (25.57).

Hypothesis One (HO$_1$): There is no significant effect of treatments (problem-solving, discussion, demonstration and lecture method of instruction) on secondary school students' mean achievement test score in physics in Delta Central Senatorial District.

Table 6a: t-test of Significant Effect of Problem-Solving Method of Instruction on Physics achievement

Variable	N	Mean	SD	df	t-cal	t-crit.	P-value	P-crit.	Decision
Pretest	133	25.42	5.03	264	20.265	1.96	0.00	.05	Reject HO$_1$
Posttest	133	37.48	4.67						

From table 6a shown above the t-cal. of 20.265 is greater than the t-crit. which indicates that there is a significant effect of problem-solving method of instruction on secondary school students' achievement in physics.

Table 6b: t-test of Significant Effect of Discussion Method of Instruction on Physics Achievement

Variable	N	Mean	SD	df	t-cal	t-crit.	P-value	P-crit.	Decision
Pretest	72	26.33	4.68	142	15.23	1.96	0.00	.05	Reject HO_1
Posttest	72	37.81	4.36						

Data presented in table 6b showed that the t-cal of 15.23 is greater than the t-crit. 1.96 leading to the rejection of the null hypothesis that there is no significant effect of Discussion method of instruction on physics achievement of secondary school students.

Table 6c: t-test of Significant Effect of Demonstration Method of Instruction on Secondary school Students Physics Achievement

Variable	N	Mean	SD	df	t-cal	t-crit.	P-value	P-crit.	Decision
Pretest	69	25.49	4.77	136	15.365	1.97	0.00	.05	Reject HO_1
Posttest	69	38.01	4.80						

Data presented in table 6c showed that the t-cal of 15.365 is greater than the t-crit. 1.97which indicates that there was a significant effect of Demonstration method of instruction on students' physics achievement in secondary schools.

Table 6d: t-test of Significant Effect of Lecture Method of Instruction on Secondary school Physics Achievement

Variable	N	Mean	SD	df	t-cal	t-crit.	P-value	P-crit.	Decision
Pretest	87	25.57	4.21	172	5.56	1.96	0.00	.05	Reject
Posttest	87	38.14	4.24						HO_1

Data presented in table 6d reveals that the t-cal. of 5.56 is greater than the t-crit. of 1.96 implying that there is a significant effect of lecture method of instruction on secondary school students' achievement in physics. This is so because these learners are more familiar with the lecture method than the once under investigation.

Research Question Two: Is there any difference in the achievement scores of field dependent and field-independent on secondary school students' achievement in Physics in Delta Central Senatorial District?

Table 7: Descriptive Statistics Showing the Effect of Cognitive Style on Secondary School Students' Achievement in Physics

Variable	N	Mean	SD	Mean Difference	Decision
Field Independent	199	38.29	4.98	5.901	High
Field Dependent	161	32.39	4.91		Low

Data presented in table 7 showed that students who are field independent (38.29) performed better than students who are field dependent (32.39). indicating that field independent students perform better.

Hypothesis Two (HO$_2$): There is no significant difference in the mean achievement test score of field dependent and field-independent secondary school students' in physics in Delta Central Senatorial District.

Table 8: Test of Significant effect of Cognitive Style on Physics Achievement

Variable	N	Mean	SD	DF	t-cal	t-crit.	P-value	P-crit.	Decision
Field Independent	199	38.29	4.98	358	11.253	1.966	0.00	0.05	Reject HO$_2$
Field Dependent	161	32.39	4.91						

Data presented in table 8 showed that the t-calculated of 11.253 is greater than the t-crit. value of 1.966 which implies a significant effect of cognitive style on students' achievement in secondary school physics. Thus, the hypothesis is hereby rejected.

Research Question Three: Is there any difference in the achievement scores of secondary school students taught with the four teaching methods in physics in Delta Central Senatorial District?

Table 9: Univariate Analysis of Physics Achievement by Method of Instruction

Method of Instruction	N	Mean	SD
Problem solving	133	37.48	4.67
Discussion	72	37.81	4.36
Demonstration	69	38.01	4.80
Lecture	87	38.14	4.24

Table 9 shows the physics achievement scores of students taught with the four different methods of Instruction. It indicates that students taught with Lecture method had a better achievement score when compared to others while those taught with problem solving method had the least achievement score.

Hypothesis Three (HO$_3$): There is no significant difference in the mean achievement test score of secondary school students taught with the four teaching methods in physics in Delta Central Senatorial District?

Table 10: **Analysis of Covariance for Physics Achievement by Method of Instruction**

Source	Sum of Squares	df	Mean Square	F	Sig.
Pretest	36.093	1	36.093	1.759	.186
Teaching method	4725.228	3	1575.076	76.763	.000
Error	7304.661	356	20.519		
Total	469764.000	361			

The table indicates a significant interaction effect of teaching method on the physics achievement of secondary school students.

Table 11: **Pair wise Comparisons and Effect of Teaching Methods on Physics Achievement**

Group I	Mean	Adjusted Mean	Problem Solving	Discussion	Demonstration	Lecture
				Adjusted Mean Differences (I-J)		
				Group (J)		
Problem Solving	37.48	37.362[a]	-	-	-	-
Discussion	37.81	37.788[a]	-.426	-	-	-
Demonstration	38.01	38.025[a]	-.664	-.238	-	-
Lecture	38.14	38.201[a]	8.161[*]	8.587[*]	8.825[*]	-

a. Covariates appearing in the model are evaluated at the following values: Pretest = 25.6537.
[*] It is also important to note that values 8.161 and 8.587 having * are significant at P<.05

  The table indicates that a pair wise comparison of the interaction effect of teaching methods on physics achievement shows that there were no significant differences in the adjusted mean differences in all teaching methods. By implication therefore, there was no significant differences between those taught with Problem solving method, discussion method, and demonstration method when compared to the lecture method. This is so because the learners in lecture method group are very familiar with the lecture method of instruction compared to the learners in the problem solving, discussion and demonstration method of instruction that are just coming in contact with these methods. With frequent usage of these methods under investigation over time their performance will improve better than that of the lecture method.

Research Question Four: Is there any interaction effect of treatment (Problem-solving method, Discussion method, Demonstration method and Lecture method) and cognitive styles (field – dependent and field – independent) on secondary school student's achievement in physics in Delta Central Senatorial District?

Table 12: Univariate Analysis of Physics Achievement by Method of Instruction and Cognitive Style

Method of Instruction	Field Independent		Field Dependent	
	Mean	SD	Mean	SD
Problem Solving	40.31	3.06	33.95	3.82
Discussion	40.34	2.63	34.51	3.97
Demonstration	41.05	2.89	34.06	3.83
Lecture	40.29	3.40	34.21	3.85

Table reveals the mean achievement scores of field independents and field dependents taught by various methods of instruction. In each of the methods, the field independent individuals had a better mean achievement 40.31, 40.34, 41.05 and 40.29) as against their counterpart in field dependent with mean score of (33.95, 34.51, 34.06, and 34.21).

Hypothesis Four (HO₄): There is no significant interaction effects of methods of instruction (problem-solving method, discussion method, demonstration method, lecture method) and cognitive styles (field-dependent and field-independent) on secondary school students' achievement in physics in Delta Central Senatorial District.

Table 13: Analysis of Covariance for Physics Achievement by Method of Instruction

Source	Sum of Squares	df	Mean Square	F	Sig.
Pretest	4.370	1	4.370	.375	.541
Teaching method	4580.712	3	1526.904	131.041	.000
Cognitive	2905.781	1	2905.781	249.378	.000
Teaching method * Cognitive	53.608	3	17.869	1.534	.205
Error	4101.540	352	11.652		
Total	469764.000	361			

The table indicates a non significant interaction effect of teaching methods (problem-solving method, discussion method, demonstration method, lecture method) and cognitive styles (field-dependent and field-independent) on secondary school students' achievement in physics.

Discussion of Results

Findings from this study revealed a significant impact of teaching methods on the physics achievements of secondary school students. The study revealed that problem – solving method of instruction had a significant positive impact on the Physics achievement of secondary school students. This observation is in line with the submission of Greenwald (2000), Collins (2001) and Olajengbesi (2006) who in their different studies asserted that the best way for students to learn science is to experience challenging problems and the thought, habits of mind and actions associated with solving them. From the above it is evident that doing motivate students to learn and further improve their performance in physics.

It was also shown in the study that lecture method of instruction produces significant effect on the achievement test score of secondary school students in physics. It was observed in this study that lecture treatment had the best result. This is because lecture method of instruction entails questioning and answering, and questioning remains one of the most influential teaching method in the classroom because of its potentials in stimulating thinking and learning. This finding is in consonance with the submission of study done by De Caprariis, Barman and Magee (2001) who noted that lecture method of instruction leads to the ability to recall facts but lecture produces higher level of comprehension. The findings of this study also gives further credence to the works of Akpochafo, (2001); Perkins and Saris, (2001); Arisi, 2004; Yoder and Hochevar, 2005; and Agboghoroma, (2009) that found out that group-oriented discussion methods has shown that team learning and student-led lecture method not only produce favorable student performance outcomes, but also foster greater participation, self confidence and leadership ability.

From the study, it was observed that demonstration method of instruction also have significant effect on the achievement mean test score of secondary school physics students. Though when compared to the other methods of instruction has the least mean. This is due to the fact that the students are not well used to this method of instruction yet, but with time and more practice their achievement will improve. This finding is in line with the Abimbola (1994) and Westwood (2008) proved that demonstration and laboratory work when properly utilized, affects students academic achievement positively in the science.

Furthermore, the study also reveals that the lecture method of instruction is not a bad method of instruction as widely acclaimed. It is only being criticized for being teachers centred in which case there is a one way channel of communication flow from teacher to students. However, it is useful in creating new ideas to learners and teaching large classes. This finding is in agreement with the summation of Eggen and Kauchak (2004) that the weakness seen in lecture method of instruction can be overcome if the presentation time is interspersed with frequent period of questioning and discussion, this help learner to be more active in class. Again the performance of the students in the lecture method was also significant because this is the method of instruction that they have been used to. As a result assimilation will not be a problem hence, their achievement is significant. In contrast to these findings, a study by Barnes and Blevins (2003) suggested that active, discussion-based methods are inferior to the traditional lecture-based method. A comparison of lecture combined with discussion versus active, cooperative learning methods by Morgan, Whorton, and Gunsalus (2000) demonstrated that the use of the lecture combined with discussion resulted in superior retention of material among students.

The observed significant difference in the achievement of Field independent and Field dependent students confirms the findings of Tinajero and Paramo, (1997) who noted that Field independent students typically outperform their field dependent counterparts in all academic subjects. Likewise, Asiri (2004), also examined the effects of cognitive style and instructional methods on students' academic achievement in social studies, and found out that there is a significant relationship between cognitive style and instructional method on students' academic achievement. Although this study showed a significant interaction of teaching methods and cognitive style on academic achievement, there was no significant interaction of the combined variables (Cognitive style and teaching method) on the physics achievement of these students it is in line with the submissions of Olatoye, Aderogba, Aanu, (2011) who examined student performance in team learning methods, finding positive learning outcomes as compared to traditional lecture-based methods.

Conclusion

Based on the findings of this study the following conclusions were drawn: Problem-solving method of instruction, Discussion method of instruction and Demonstration method of instruction have significant effect on physics achievement of secondary school students. It is concluded therefore that these methods are suitable for teaching physics and practicing physics teachers are encouraged to use them in their teaching. Likewise it is seen also that cognitive style has significant effect on the achievement of the physics student. By implication the physics teachers and science teachers in

general should take into account these variables when planning and delivering their lessons to elicit desired performance in the students. The study also revealed that there was no significant interaction of the instructional mode and cognitive style on the achievement of secondary school students in physics.

Recommendations

From the findings and conclusion of this research the following recommendations were made:

1. It is evident that Problem-solving, Discussion and Demonstration method of instruction are effective in improving students' performance in physics. Teachers should therefore employ these methods of instruction in teaching physics.

2. Seminars and workshops should be organized and made mandatory for practicing teachers so that they can embrace the skills of the instructional mode for effective implementation of these strategies of teaching physics

3. The type of cognitive style the student possesses has also been seen to affect his/her learning outcome. it is recommended therefore that the teacher strive to understand the type of cognitive style the learner is having and present instruction in that direction to facilitate learning.

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