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## Effects of Cooperative Instructional Strategy and Concept Mapping-Guided Discovery Integrated Instructional Approach on Basic Science Students' Attitude, Achievement and Retention

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### **Abstract:**

*This study investigated the effect of Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach attitude, achievement and retention of Basic Science students. Simple random sampling procedure was employed to select 103 Primary six Pupils from three public primary schools in North-East Senatorial District, Benue State, Nigeria. Quasi experimental design was employed for the study. Three research questions guided the study and three research hypotheses were tested at 0.05 level of significance. Two instruments were used for data collection namely; Basic Science Attitude Questionnaire (BSAQ) and Basic Science Achievement Test (BAT). The reliability of BSAQ was determined using Cronbach Alpha and the coefficient obtained was 0.80 while split half was used to determine the reliability of BAT and the reliability coefficient was found to be 0.81 implying that the instruments were reliable enough for the study. Mean Gain scores were used to answer the research questions while the hypotheses were tested using Analysis of Covariance (ANCOVA). Scheffe's post-hoc test was used to determine the magnitude of the differences. The findings of the study revealed that significant differences were found in the interest and retention of students taught using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach and the Conventional Demonstration Method.*

**Key word:** Achievement, attitude, basic science, cooperative, concept mapping-guided discovery and retention

### **1. Introduction**

Basic Science is the foundational science subject taught at the Junior Secondary School level of the Nigerian educational system. It is a prerequisite subject for science subjects at the Senior Secondary and other applied at the tertiary institutions of learning (Samuel, 2017). The relevance of Basic Science in all fields of Science made it imperative to be included in the curriculum of Junior Secondary School as enshrined in the national policy of education (Federal Republic of Nigeria (FRN), 2014).

Basic Science education's purpose is to train students to acquire proper understanding of basic principles as well as application. It is also aimed at developing appropriate scientific skills and attitudes as a prerequisite for future scientific activities. To achieve these objectives, active participation and collaborative learning activities become imperative and these need functioning instructional media to make Basic Science instruction effective (Osokoya, 2013; Samuel, 2017; Eriba& Samuel, 2018; Agu& Samuel, 2018).

Despite the relevance of Basic Science to national development, security, economy, manpower and government's efforts to improve science instruction in schools, students' achievement is below average. This has become a great concern for science educators. Researchers such as Bukunola and Idowu (2012), Osokoya (2013), Alabi (2014), Oni (2014) Kabutu, Oloyede and Bandele (2015) and Samuel (2017) observed that poor instructional strategies employed in the teaching of the subjects by teachers contribute to students under achievement. In order to achieve the objectives of Basic Science education, the student-activity-based mode of teaching strategies have been recommended by the Federal Republic of Nigeria (FRN, 2014).

Cooperative learning can be defined as a teaching method that involves students in learning process in order to understand and learn content of the subject (Slavin, 1986). Traditional class activities create a win-win situation, where one can only succeed if others loose, while cooperative learning is direct and opposite of it. In the latter case, conquest of all is success of all. It has been argued that cooperative learning has an edge over other teaching methods in terms of its effectiveness for improved cognition, social skills and motivation (Kabutu, Oloyede&Bandele, 2013; Gull &Shehzad, 2015;

Gambari& Yusuf, 2017; Eriba& Samuel, 2018; Agu& Samuel, 2018). There are dozens of strategies that can be used by the teachers under the umbrella of cooperative learning strategies. In this study, STAD was explored.

In STAD strategy, students are assigned to a heterogeneous group that consists of three members that are mixed in achievement level and genders. Students take a group quiz during which they reach consensus in decision making. They also take individual quizzes on the material without helping one another. Students' scores are then summed up to form team scores. Teams that meet certain criteria earn certificates or other rewards (Slavin, 1986).

Concept mapping based instruction was developed by Novak at Cornell University in the 1970s. Concept maps are graphical tools for organizing and representing knowledge. They include concepts, usually enclosed in circles or boxes of some type, and relationships between concepts indicated by a connecting line linking two concepts. Words on the line, referred to as linking words or linking phrases, specify the relationship between the two concepts (Novak, 1991). Concept maps are used as tools for meaningful learning, assessment, instructional planning and finding out the alternative concepts or misconceptions held by the learners. Learning through concept mapping has long lasting effect on memory (Awodun, 2017; Fatokun&Eniayeju, 2014).

Guided discovery is an instructional strategy that employs exploration, manipulation and experimentation to find out new ideas. It is regarded as convergent thinking. The instructor conceives a succession of declarations or questions that guides the learner, step by step, making a series of information that leads to a single predetermined goal. Summarily, the teachers initiate a stimulus and the learners react by engaging in an active inquiry thereby discovering the appropriate response (Alabi&Lasisi, 2015; Omiko, 2017).

Nwachukwu (2013) viewed achievement basically as the competence a person has in an area of content. This competence is the result of many intellectual and nonintellectual variables. Researchers (Akanbi&Kolawale, 2014) have come out with constructive results on the causes of poor academic achievement in Secondary School Science, instructional strategies ranked very high amongst other causes identified. This indicates that the depreciation of instructional strategies, by not encouraging, promoting and improving learners' understanding of Basic Science and Technology concepts, this has made the desired achievement unattainable.

Retention is the ability to hold, keep or recall past experience and reproduce a learnt concept when the need arises (Bukunola&Idowu, 2012). It is an important variable in learning because only a learnt experience is recalled, learning cannot be said to have taken place if there is no proper retention. The ability of students to recall past learnt Basic Science concepts as an objective of the Basic Science teaching and learning process may likely enhance achievement in the subject. For so long, researchers have been keen on knowing what could be done by teachers to enhance maximum retention of knowledge or skills long after they have been acquired whether in the classroom or outside the classroom (Azuka, 2012; Eriba& Samuel, 2018; Agu& Samuel, 2018).

Attitude as a concept is concerned with an individual's way of acting and behaving. It has very serious implications for the learner, the teacher, the immediate social group with which the individual learner relates and the school system. Attitudes are formed as results of some kind of learner experiences. They may also be learned simply by following the examples, opinions of parents, teachers or friends. This is imitation which also has a part to play in the teaching and learning situation. In this respect the learner draws on his teacher's deposition to form his own attitude which may likely affect his learning outcomes (Eriba, 2013). Negative attitude can lead to low expectations on students 'academics. Also teaching strategies can influence the attitude of students positively or negatively. Reports have shown that improved instructional strategy affects the attitude of students. Gambari& Yusuf (2017) reported that students taught using cooperative learning strategy had positive attitude to the educational benefits derived from group work.

The aim of the present study was to determine the extent to which classroom exposures to Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach could enhance Basic Science students' attitude, achievement and retention. Specifically, the study sought to find out:

- The effects of Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach on attitude of Basic Science students.
- The effects of Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach on achievement of Basic Science students.
- The effects of Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach on retention of Basic Science students.

### 1.1. Research Questions

- What is the mean attitude scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method?
- What is the mean achievement scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method?

- What is the mean retention scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method?

### 1.2. Research Hypotheses

- H<sub>01</sub>: There is no significant difference in the mean attitude scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method.
- H<sub>02</sub>: There is no significant difference in the mean achievement scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method.
- H<sub>03</sub>: There is no significant difference in the mean retention scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method.

## 2. Methodology

Quasi experimental research design was employed for the study. The sample for study comprised one hundred and three primary six pupils from three intact classes randomly selected from three public co-education schools in North-East Senatorial District, Benue State, Nigeria. The schools were randomly assigned to experimental groups (taught using Cooperative instructional strategy (n = 30), Concept Mapping-Guided Discovery integrated instructional approach (n = 33) and the control group (taught using the Conventional Demonstration Method (n = 40)).

Two instruments were used for data collection namely; Basic Science Attitude Questionnaire (BSAQ) and Basic Science Achievement Test (BAT). BSAQ contained 20 items designed to determine students' interest in Basic Science. BSAQ was rated using a four-point rating scale. The options were; Strongly agreed (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagreed (SD) = 1 point. Basic Science Achievement Test (BAT) was a 25-item instrument with options A – D that tested the students' knowledge, comprehension, application of selected topics in Basic Science in The Human Circulatory System. The items were allotted 2 marks each, culminating to the total score of 50 marks. The test was validated by experts in Science and Technology and were trial tested. The reliability of BSAQ was determined using Cronbach Alpha and the coefficient obtained was 0.80 while split half was used to determine the reliability of BAT and the reliability coefficient was found to be 0.81 implying that the instruments were reliable enough for the study. Mean Gain scores were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance. Scheffe's Post-hoc test was used to determine the magnitude of the differences among the strategies of instruction used.

## 3. Results

### 3.1. Research Question One

What are the mean attitude scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method?

The mean gain scores of students' attitude in Basic Science taught using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method are presented in Table 1.

Group		Pre-attitude	Post-attitude	Mean Gain Score
Cooperative instructional strategy	N	30	30	
	Mean	33.55	63.56	30.01
Concept Mapping-Guided Discovery integrated instructional approach	N	33	33	
	Mean	30.05	60.77	30.72
Conventional Demonstration Method	N	40	40	
	Mean	31.42	58.32	26.90

Table 1: Mean Gain Scores of Students' Scores Using Cooperative Instructional Strategy and Concept Mapping-Guided Discovery Integrated Instructional Approach with Those Taught Using Conventional Demonstration Method

From Table 1, it is observed that there was a significant mean gain in the attitude between students taught Basic Science Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method with mean gain scores of 30.01, 30.72 and 26.90 respectively. This

indicates that all the groups benefitted from the treatment with the Concept Mapping-Guided Discovery integrated instructional approach having the highest mean gain scores.

### 3.2. Research Question Two

What is the mean achievement scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method?

The mean gain scores of students' achievement in Basic Science taught using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method are presented in Table 2.

Group		Pretest	Post-test	Mean Gain Score
Cooperative instructional strategy	N	30	30	46.76
	Mean	21.07	67.83	
Concept Mapping-Guided Discovery integrated instructional approach	N	33	33	44.51
	Mean	20.87	65.38	
Conventional Demonstration Method	N	40	40	42.60
	Mean	19.79	62.39	

*Table 2: Mean Gain Scores of Students' Scores Using Cooperative Instructional Strategy and Concept Mapping-Guided Discovery Integrated Instructional Approach with Those Taught Using Conventional Demonstration Method*

From Table 2, it is observed that there was a significant mean gain in the achievement between students taught Basic Science Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method with mean gain scores of 46.76, 44.51 and 42.60 respectively. This indicates that all the groups benefitted from the treatment with the cooperative instructional strategy having the highest mean gain scores.

### 3.3. Research Question Three

What are the mean retention scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method?

The mean loss scores of students on retention in Basic Science taught using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method are presented in Table 3.

Group		Post-test	Post-Post-Test	Mean Loss Score
Cooperative instructional strategy	N	30	30	7.49
	Mean	67.83	60.34	
Concept Mapping-Guided Discovery integrated instructional approach	N	33	33	3.36
	Mean	65.38	62.02	
Conventional Demonstration Method	N	40	40	2.73
	Mean	62.39	59.66	

*Table 3: Mean Loss Scores Between Post-Test and Post-Posttest for Cooperative Instructional Strategy concept Mapping-Guided Discovery Integrated Instructional Approach and Conventional Demonstration Method Groups*

Table 3 shows a decrease in the post-posttest scores of the three groups as compared to the post-test scores. Cooperative instructional strategy had the highest decrease in the form of a mean loss score of 7.49, followed by Concept Mapping-Guided Discovery integrated instructional approach with a mean loss score of 3.36 and Conventional Demonstration Method with a mean loss scores of 2.73. This indicates that all the groups benefitted from the treatment with the cooperative instructional strategy having the highest mean loss scores; this implies that the cooperative group did not outperformed the other groups on retention.

### 3.4. Research Hypotheses One

There is no significant difference in the mean attitude scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method.

The test of this hypothesis provided the data on Table 4.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Result
Corrected model	6578.691	3	5214.810	93.562	0.000	S
Intercept	5821.734	1	7312.435	504.628	0.001	S
Pre-attitude	341.762	1	341.762	55.404	0.000	S
Group	8523.472	1	5345.512	14.803	0.000	S
Error	26812.705	97	97.852			
Total	48078.364	103				

Table 4: Result of Analysis of Covariance on Students' Attitude in Basic Science Using SBAQ Significant at  $P < 0.05$

Table 4 shows a significant difference among the learning strategies on attitude,  $F =$  ratio of 14.803,  $P < 0.05$ . The result implies that the instructional strategies produced significant effects on the attitude scores of students when covariate effect (pre-attitude) was controlled. The null hypothesis of no significant difference was therefore rejected indicating that there is significant difference. The result indicates that the treatment using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach accounted for the difference in the attitude scores of the students.

Based on the established difference in the attitude scores of the groups, Scheffe's test was used for post-hoc analysis to determine the direction of the difference. The results of this post-hoc analysis are as shown in Table 5.

Groups	Mean Scores	Cooperative	Concept Mapping-Guided Discovery	Conventional Demonstration Method
Cooperative Instructional Strategy	63.56		0.426	0.204
Concept Mapping-Guided Discovery integrated instructional approach	60.77	0.426		0.035
Conventional Demonstration Method	58.32	0.204	0.005	0.209

Table 5: Scheffe's Post-Hoc Results of Students' Attitude Mean Scores of Cooperative Instructional Strategy concept Mapping-Guided Discovery Integrated Instructional Approach and Conventional Demonstration Method Groups The Mean Difference Is Significant at 0.05 Levels

The results shown in Table 5 indicate that there was no significant difference in the mean attitude scores of students exposed to Cooperative instructional strategy ( $X = 63.56$ ) and those exposed to Concept Mapping-Guided Discovery integrated instructional approach ( $X = 60.77$ ). A significant difference was established in the mean attitude scores of students exposed to Concept Mapping-Guided Discovery integrated instructional approach ( $X = 60.77$ ) and Conventional Demonstration Method ( $X = 58.32$ ). A significant difference was established in the mean attitude scores of students exposed to Cooperative instructional strategy ( $X = 63.56$ ) and those exposed to Conventional Demonstration Method ( $X = 58.32$ ) in favour of the Cooperative instructional strategy.

### 3.5. Research Hypothesis Two

There is no significant difference in the mean achievement scores of students' taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method.

The test of this hypothesis provided the data on Table 5.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Result
Corrected model	5678.352	3	6324.916	105.762	0.000	S
Intercept	6121.523	1	8132.521	653.800	0.001	S
Pretest	371.682	1	371.682	87.412	0.000	S
Group	6573.472	1	4553.512	47.890	0.000	S
Error	28112.705	97	102.852			
Total	46857.814	103				

Table 6: Result of Analysis of Covariance on Students' Achievement in Basic Science Using BAT  
Significant at  $P < 0.05$

Table 6 shows a significant difference among the learning strategies on interest,  $F =$  ratio of 47.890,  $P < 0.05$ . The result implies that the instructional strategies produced significant effects on the attitude scores of students when covariate effect (pretest) was controlled. The null hypothesis of no significant difference was therefore rejected indicating that there is significant difference. The result indicates that the treatment using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach accounted for the difference in the attitude scores of the students.

Based on the established difference in the achievement scores of the groups, Scheffe's test was used for post-hoc analysis to determine the direction of the difference. The results of this post-hoc analysis are as shown in Table 7.

Groups	Mean Scores	Cooperative	Concept Mapping-Guided Discovery	Conventional Demonstration Method
Cooperative Instructional Strategy	67.83		0.513	0.324
Concept Mapping-Guided Discovery integrated instructional approach	65.38	0.513		0.043
Conventional Demonstration Method	62.39	0.324	0.008	0.197

Table 7: Scheffe's Post-Hoc Results of Students' Achievement Mean Scores of Cooperative Instructional Strategy concept Mapping-Guided Discovery Integrated Instructional Approach and Conventional Demonstration Method Groups  
The Mean Difference Is Significant at 0.05 Levels

The results shown in Table 7 indicate that there was no significant difference in the mean achievement scores of students exposed to Cooperative instructional strategy ( $X = 67.83$ ) and those exposed to Concept Mapping-Guided Discovery integrated instructional approach ( $X = 65.38$ ). A significant difference was established in the mean attitude scores of students exposed Concept Mapping-Guided Discovery integrated instructional approach ( $X = 65.38$ ) and Conventional Demonstration Method ( $X = 62.39$ ). A significant difference was established in the mean achievementscores of students exposed to Cooperative instructional strategy ( $X = 67.83$ ) and those exposed to Conventional Demonstration Method ( $X = 62.39$ ) in favour of the Cooperative instructional strategy.

### 3.6. Research Hypothesis Three

There is no significant difference in the mean retention scores of students taught Basic Science using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach with those taught using Conventional Demonstration Method.

The test of this hypothesis provided the data on Table 8.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Result
Corrected model	6518.221	3	6432.872	125.062	0.000	S
Intercept	5421.462	1	7751.021	454.230	0.001	S
Posttest	394.421	1	394.421	79.322	0.000	S
Group	5816.451	1	4911.502	68.790	0.000	S
Error	26071.315	97	98.955			
Total	44221.870	103				

Table 8: Result of Analysis of Covariance on Students' Retention in Basic Science Using BAT  
Significant at  $P < 0.05$

Table 8 shows a significant difference among the learning strategies on retention,  $F=$  ratio of 68.790,  $P<0.05$ . The result implies that the instructional strategies produced significant effects on the retention scores of students when covariate effect (posttest) was controlled. The null hypothesis of no significant difference was therefore rejected indicating that there is significant difference. The result indicates that the treatment using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach accounted for the difference in the retention scores of the students.

Based on the established difference in the retention scores of the groups, Scheffe's test was used for post-hoc analysis to determine the direction of the difference. The results of this post-hoc analysis are as shown in Table 8.

Groups	Mean Scores	Cooperative	Concept Mapping-Guided Discovery	Conventional Demonstration Method
Cooperative Instructional Strategy	60.34		0.371	0.128
Concept Mapping-Guided Discovery integrated instructional approach	62.02	0.371		0.022
Conventional Demonstration Method	59.66	0.128	0.011	0.017

*Table 9: Scheffe's Post-Hoc Results of Students' Retention Mean Scores of Cooperative Instructional Strategy concept Mapping-Guided Discovery Integrated Instructional Approach and Conventional Demonstration Method Groups The Mean Difference Is Significant at 0.05 Levels*

The results shown in Table 9 indicate that there was no significant difference in the mean retention scores of students exposed to Cooperative instructional strategy ( $X= 60.34$ ) and those exposed to Concept Mapping-Guided Discovery integrated instructional approach ( $X= 62.02$ ). A significant difference was established in the mean retention scores of students exposed to Concept Mapping-Guided Discovery integrated instructional approach ( $X= 62.02$ ) and Conventional Demonstration Method ( $X = 59.66$ ). A significant difference was established in the mean retention scores of students exposed to Cooperative instructional strategy ( $X= 60.34$ ) and those exposed to Conventional Demonstration Method ( $X = 59.66$ ) in favour of the Cooperative instructional strategy.

#### 4. Discussion

The findings of this study revealed that the use of Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach had significant effects on students' attitude, achievement and retention in Basic Science. The students taught using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach had significant attitude than those taught using the Conventional Demonstration Method. This result is in agreement with the findings of Gambari& Yusuf (2017) they found that cooperative instructional strategies have positive effect on students' attitude in Science.

In relation to achievement and retention, the study revealed that the use of Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach had a significant effect on Basic Science students than the Conventional Demonstration Method. This finding is consistent with findings of Kabutu, Oloyede&Bandle, 2013; Fatokun&Eniayeju, 2014; Furo, 2015; Gull &Shehzad, 2015; Nwafor&Okoi, 2016; Awodun, 2017; Omiko, 2017; Gambari& Yusuf, 2017; Eriba& Samuel, 2018; Agu& Samuel, 2018; they found out that cooperative, concept mapping and guided discovery instructional strategies enhances students' achievement and retention in Science.

These findings have strong implications for the teaching and learning of Basic Science and in Secondary Schools in Nigeria using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach. Furthermore, the findings of this study suggest that exposing Basic Science students to a Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach could improve attitude, achievement and retention toward the subject. These should be given strong emphasis in the teaching of Basic Science in Junior Secondary Schools of Nigeria.

#### 5. Conclusion

The findings of the study, among others have shown that; using Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach has a way of improving attitude, achievement and retention in Basic Science at the Junior Secondary School level in Nigeria. The present demonstration method should be minimized and innovative student-centered approaches should be incorporated.

#### 6. Recommendations

Basic Science teachers should be encouraged to adopt Cooperative instructional strategy and Concept Mapping-Guided Discovery integrated instructional approach so as to improve and promote social interaction, active learning, discovery learning, motivation, learning by doing and learning by experience among students.

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