

# EFFECTS OF GUIDED-DISCOVERY AND THINK-PAIR-SHARE STRATEGIES ON SECONDARY SCHOOL STUDENTS' ATTITUDE TOWARDS CHEMISTRY

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## **Abstract**

*This study, investigated the effect of three strategies (i.e. guided discovery, think-pair-share and lecture) on senior secondary school students' attitude towards chemistry. A pre-test, post-test, control group quasi-experimental design with a 3x3x2 factorial matrix was adopted for the study. Treatment was at three levels (guided discovery, think-pair-share and lecture strategies), cognitive entry behaviour at three levels (high, middle and low) and gender at two levels (male and female). Two hundred and forty-two (242) senior secondary one (SS1) students in intact classes from six secondary schools in Ijebu-Ode and Odogbolu Local Government Areas of Ogun State were randomly assigned to the treatment and control groups. Three instruments were used to collect data that lasted eight weeks. Results indicate that students taught with guided discovery and think-pair-share strategies obtained significantly higher post-test mean attitude scores than those in the lecture strategy ( $F_{(2,223)} = 76.186, P < 0.05$ ). Thus, appropriate recommendations were made.*

**Keywords:** Effect, Guided-Discovery, Think-Pair-Share, Attitude, Cognitive Entry Behaviour.

In order to improve the quality of life and enhance socio-economic development, Nigerians need to have positive attitude towards learning of science. Learning of science will therefore provide the necessary leverage for desired

development. Viewed differently, one may opine that failure to acquire basic scientific skills and its applications, will make Nigeria to remain a consumer of science products and neither a producer nor a manufacturer. Bajah (1984) asserted that linkage has been established between the study of science and training of young people in the utilisation of their scientific knowledge in solving environmental, social, economic and political problems and positive attitude. Alebiosu (2005) in her work on indigenous science practices and application to secondary school science observed that some indigenous practices were found to have scientific undertones and would yield good benefits if not disregarded. She also observed that there was a rich insight into the existence of link between these practices and modern science as identified by secondary school science teachers in relation to some school science concepts.

The process of teaching consists of three phases of pre-instructional, instructional and post instructional. The instructional phase is the one that involves the implementation of plans and designs of all activities. The quality of instructional strategy employed by the teacher at this phase is a potentially powerful determinant of the levels of learner's affection for the subject and involvement in the learning process. Inquiry-based learning strategies require that students are engaged and are active in the learning process. The instructor serves as a coach or facilitator, guiding students through activities, but letting the students take control of the learning event itself. Guided-discovery and think-pair-share belong to this group of learning strategies. Guided discovery strategy as a philosophy or strategy of learning is based on the constructivist views of learning. It is a learning approach where the learners take an active part in the learning process in which they have maximum measure of freedom and self determination. Studies from literature suggest that guided-discovery strategy could have positive Effect on students' learning outcomes (Hake, 2002; Korey, 2004).

Think-pair-share is a cooperative learning strategy that includes three components; these are time for thinking, time for sharing with a partner and time to share among pairs to a larger group. The use of the strategy unites the cognitive and social aspects of learning, promoting the development of thinking and the construction of knowledge. Think-pair-share strategy has many advantages over the traditional questioning structure. The 'think time' incorporates the important concept of 'wait time'. It allows all children to develop answers, longer and more elaborate answers can be given, answers will have reasons and justifications because they have been thought about and discussed. Students are more willing to take risks and suggest ideas because they have already 'tested' them with their partner. This strategy differs from guided-discovery in that it allows for interaction among the learners during the pairing and sharing stages.

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The need for inquiring into guided-discovery and think-pair-share strategies is founded on certain considerations. First, the situation in Nigerian schools is such that much of the learning that actually take place is one of reception with the teacher (or text) presenting verbal expositions of the facts or concepts to be learned (Bajah, 1986; Ajewole, 1991; Ajeyalemi, 1995; Mansaray, 1995; Alebiosu, 1998, Bilesanmi-Awoderu, 2006; Ajiboye and Ajitoni, 2008). The mode of such presentation therefore becomes crucial for learning. It should be useful then, to explore the role that these learning strategies can play in presentation of facts.

Cognitive entry behaviour is defined by Igwe (1991) as the amount of pre-requisite types of knowledge, skills and competencies which are essential to the learning of particular new tasks or set of tasks. Thus, students who possess the necessary background characteristics for any particular learning task would be able to master any particular learning tasks quickly, provided the pre-requisite skills necessary for new learning are present in the students. This implies that acquisition of one process or skill is necessary for the acquisition of the successive ones in the learning continuum. The central theme of "acquisition" concept is that each stage in any learning process serves as a building block for another stage of learning (Ogunkola, 2000). This tends to suggest that there is the likely influence of cognitive entry behaviour on the attitude of students to chemistry when they are taught with the use of guided-discovery, think-pair-share and lecture strategies. Another important factor that can influence students' attitude towards science is gender. Literature showed that gender could be a strong prediction of human conduct and that differences have been documented, between the attitudes and behaviours of males and females (Aguele and Uhumuavbi, 2008). This also suggests that there is need to examine gender influence in teaching strategies as one of the intervening variables in this study.

### **Statement of the Problem**

The problem of this study was to investigate the effect of three teaching strategies (guided discovery, think-pair-share and lecture) on students' attitude towards chemistry. Cognitive entry behaviour and gender were incorporated into the research work as intervening variables.

### **Research Questions**

The following research questions were raised;

1. What would be the effect of treatment on students' attitude towards chemistry?
2. Which of the strategies would have higher effect on students' attitude towards chemistry?
3. Would there be any interaction effect of treatment, cognitive entry behaviour and gender on students' attitude towards chemistry?

## **Methodology**

The design was a quasi-experimental one. Intact classes were subjected to different treatment conditions. The independent and intervening variables were crossed in a 3 x 3 x 2 factorial matrix (three treatment groups - guided discovery strategy group, think-pair-share strategy group and control group; three levels of cognitive entry behaviour - high, medium and low, and two gender groups - male and female). The layout of the design is as shown below:

O <sub>1</sub>	X <sub>1</sub>	O <sub>2</sub>	-	Experimental Group 1:
O <sub>3</sub>	X <sub>2</sub>	O <sub>4</sub>	-	Experimental Group 2:
O <sub>5</sub>	X <sub>3</sub>	O <sub>6</sub>	-	Control Group (C):

where O<sub>1</sub>, O<sub>3</sub> and O<sub>5</sub> were observations in form of pre-tests.  
O<sub>2</sub>, O<sub>4</sub> and O<sub>6</sub> were observations in form of post-tests.

X<sub>1</sub> and X<sub>2</sub> were the experimental treatments of Guided-Discovery Strategy (GDS) and Think-Pair-Share Strategy (TPSS) respectively.  
X<sub>3</sub> was the lecture strategy (LS) used in the study as the control condition.

## **Population**

The target population for the study consisted of all Senior Secondary One (SS1) science students in public secondary schools in Ogun State.

## **Sample**

Six senior secondary schools selected from a total of nineteen senior secondary schools in Ijebu Ode and Odogbolu Local Government areas of Ogun State participated in the study. In selecting the schools, firstly judgmental sampling was used. Each school was ensured to:

- (a) be a mixed school;
- (b) be a senior secondary school offering chemistry as one of the science subjects and also registered by West African Examination Council (WAEC) and National Examination Council (NECO) as a centre conducting Senior Secondary Certificate in Education (SSCE) examination in the subject.

Simple random sampling was then used to select six out of the schools that satisfied the conditions. In each of the schools selected, an arm of SS 1 participated in the study. Chemistry teachers in each of the selected schools were encouraged and used as Research Assistants. Altogether from the six schools, a total of 242 students in intact SS 1 classes participated in the study.

### **Instrumentation**

Three instruments were developed, validated and used to collect data for the study. These were:

- (i) Teaching Instructional Guide (TIG). It consisted of notes of lessons in which the major roles of everyone participating in the study (teachers and students) were clearly stated. Its trial testing gave a reliability index of 0.85.
- (ii) Chemistry Cognitive Entry Point Test (CCEPT). This was a 40 item multiple choice test constructed on topics in basic science considered as prerequisites to the instructional content of the study by the researcher. It was to determine the cognitive entry behaviour of the students, after they might have been administered to them.
- (iii) Students Attitude Towards Chemistry Scale (SATCS). It consisted of two sections: the first section contains some background information while the second consisted of 32-items which the students were requested to respond to. An item that reflected positive attitude attracted a score of four for a "Strongly Agree" response progressing downward to a score of one for a "Strongly Disagree" response. The scoring procedure followed a reverse order where "Strongly Disagreed" indicated a positive attitude. It had a Cronbach alpha of 0.76.

### **Procedure and Data Collection**

The researcher visited and sought permission from the principals and teachers of the selected schools. The participating teachers were encouraged so that their maximum co-operation could be obtained. Participating teachers were subjected to training programmes, particularly the experimental groups' teachers. This was done in order to ensure that teachers did not deviate from the instructional principles and procedures governing the experiment. Demonstration lessons were organised by the researcher. The training session started off with more than the required number of teachers and finally six were selected.

Before the commencement of teaching according to the demands of the teaching strategies of specific treatment groups, Chemistry Cognitive Entry Point Test (CCEPT) and Students Attitude Towards Chemistry Scale (SATCS) were administered on the students by the participating teachers in the three treatment groups. The subjects' scores on the CCEPT were used to classify them into three levels of cognitive entry behaviour; high, medium and low. Their scores on Students Attitude Towards Chemistry Scale (SATCS), was used as pre-test scores and served as covariates. This was done in the first week of the experiment. The teaching commenced immediately after the students' cognitive entry behaviour had been sampled

through pre-testing. The teaching lasted for six weeks. At the end of the sixth week, the teachers administered the SATCS as post-tests.

### Data Analysis

The data collected were analysed with the use of inferential statistics. Analysis of Covariance (ANCOVA) was computed for the three dependent variables for the three instructional groups in order to test for possible post experimental differences with respect to treatments, cognitive entry behaviour and gender. Pre-test scores were used as covariates so as to cater for initial differences in the dependent variables and other factors which could compound treatment Effect. Where the main Effects were significant, Multiple Classification Analysis (MCA) technique was employed to detect the direction of the difference among the groups and to ascertain the amount of variation due to treatment. Scheffe statistical techniques were further employed as post hoc measures. Where significant interactions were observed, graphs were plotted to depict the nature of interaction.

Table 1 below which shows the result of the analysis of covariance (ANCOVA) on students' attitude scores with respect to the main and interaction effects of the learning strategies (i.e. guided discovery, think-pair-share and lecture), cognitive entry behaviour and gender was used to answer the questions asked.

**Table 1: Summary of Analysis of Covariance of Students' Attitude Scores According to Treatment, Cognitive Entry Behaviour and Gender**

Source of Variation	Sum of Squares	Df	Mean Square	F	Significant of F
Intercept	20332.766	1	20332.766	519.85 1	.000
Covariates(pre-test)	47.795	1	47.795	1.222	.270
Treatment	5959.666	2	2979.833	76.186	.000*
Cognitive Entry Behaviour	62.346	2	31.173	.797	.452
Gender	25.033	1	25.033	.640	.425
Treatment x CEB	214.786	4	53.696	1.373	.244
Treatment x Gender	161.814	2	80.907	2.069	.129
CEB x Gender	55.953	2	27.968	.715	.490
Treatment x CEB x Gender	760.728	4	190.182	4.862	.001*
Explained Residual	8622.521	18	479.029		
(Error)	8722.124	223	39.113	12.247	.000
<b>Total</b>	<b>17344.645</b>	<b>241</b>	<b>71.969</b>		

\*Denote significant F at .05 level

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**Results**

The result in Table 1, with respect to the main effect of treatment on the students' attitude to chemistry, revealed significant outcome ( $F_{(2,223)} = 76.186, P < 0.05$ ). In order to determine the magnitude of the mean attitude scores of students exposed to the different treatment conditions, the result of the Multiple Classification Analysis (MCA) presented in Table 2 was used.

**Table 2: Multiple Classification Analysis of Students' Attitude Scores According to Treatment, Cognitive Entry Behaviour and Gender**

Variable + Category Teaching Strategy	N	Grand Mean =112.560		Adjusted for Indep. + Covariates	Beta
		Unadjusted Deviation	Eta		
Guided Discovery	84	4.50		7.62	
Think-Pair-Share	80	0.10		3.29	
Lecture	78	-9.33	.41	-6.18	.63
Cognitive Entry Behaviour					
Low	69	-2.18		0.98	
Medium	129	-0.48		1.73	
High	44	-1.95	.07	1.91	.26
Gender					
Female	117	-0.93		1.66	
Male	125	-1.61	0.3	0.88	0.17
Multiple R Squared					.497
Multiple R					.705

The result of the multiple classification analysis in Table 2 revealed that the students exposed to guided discovery strategy had the highest adjusted post attitude mean score of 120.18, with the grand mean being 112.56. the students exposed to think-pair-share strategy had the next higher adjusted post attitude mean score of 115.85 while the students exposed to lecture strategy (the control group) had the least adjusted post attitude mean score of 106.38. This result showed that the guided discovery had the greatest potency at effecting students' attitude towards chemistry. The result in Table 2 also showed that teaching strategy alone accounted for 39.69%  $(0.63)^2$  of the variation in students' attitude towards chemistry while the independent and intervening variables jointly accounted for 49.7%  $(0.705)^2$  of the variation in the students' attitude scores in chemistry. In order to trace the source of the significant difference recorded in table 2, the Scheffe post-hoc analysis presented in table 3 below was carried out.

**Table 3: Summary of Scheffe Multiple Range Test of Attitude Scores on Treatment Groups**

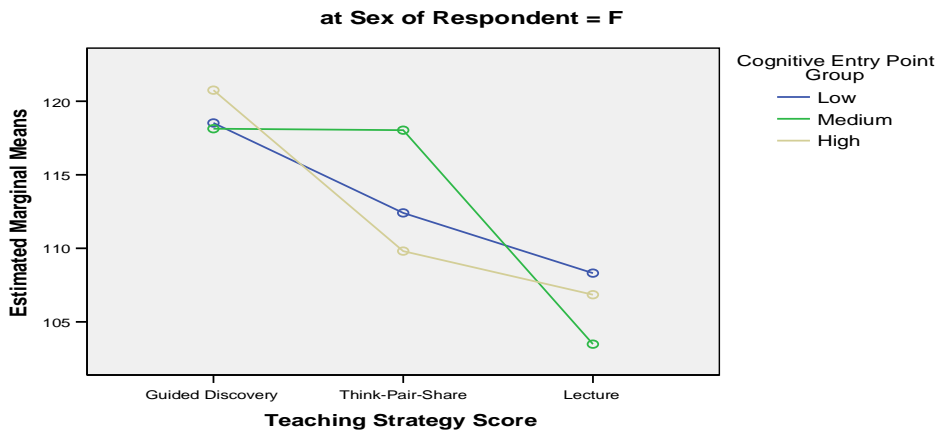
Mean	Treatment Group	Guided Discovery	Think-Pair-Share	Lecture
118.620	Guided Discovery		*	*
114.258	Think-Pair-Share	*		*
104.802	Lecture	*	*	

\* Denote pairs of groups, which are significantly different at  $P < 0.05$ .

The result of the post-hoc analysis in Table 3 showed that the source is due to the significant difference between the pairs of groups 1 and 2, groups 1 and 3 and groups 2 and 3 respectively.

The result of the 3-way interaction in table 1 revealed significant outcome, ( $F_{(4,223)} = 4.862, P < 0.05$ ). This implied that there was significant difference in the students' attitude to chemistry based on teaching strategies among all the possible combinations of cognitive entry behaviour groups and gender: low-boys; low-girls; medium-boys; medium-girls; high-boys; high-girls. As a result, the null hypothesis seven was rejected. The significant 3-way interaction Effect recorded in table 1 called for simple graphical illustration in figures 1 and 2 to disentangle the group Effect.

**Estimated Marginal Means of Post Attitude Test**

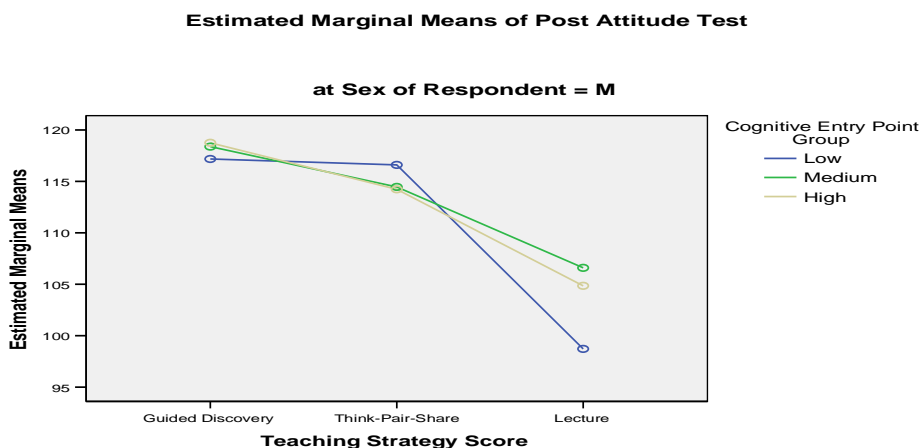


**Figure 1: Post-Attitude of Treatment and Cognitive Entry Behaviour at Gender= Female**

*3-way interaction effect of treatment, cognitive entry behaviour and gender*

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The interaction effect illustrated in figure 1 revealed that when gender was held constant, the interaction effect was disordinal. This implied that teaching strategies could influence attitude towards chemistry scores of students differentially across low, medium and high levels of cognitive entry behaviour of female students. However, the teaching strategies were not consistently affecting cognitive entry behaviour levels of the female students; while guided discovery strategy for instance recorded the highest attitude for high female students, think-pair-share for the same students recorded the lowest attitude scores and lecture strategy for the same group of students had the middle attitude scores.



**Figure 2: Post Attitude of Treatment and Cognitive Entry Behaviour at Gender=Male**

*3-way interaction effect of treatment, cognitive entry behaviour and gender*

Figure 2 revealed that when gender was held constant for male students, the interaction Effect was also not ordinal, implying that there was significant but inconsistent interaction Effect of teaching strategies on students' attitude towards chemistry across the low, medium and high levels of cognitive entry behaviour of the male students. The inconsistent result implied that for guided discovery strategy, male students with low cognitive entry behaviour recorded the lowest post attitude scores, while the same group of students recorded the highest post attitude scores for the think-pair-share strategy and the lowest post attitude scores for the lecture strategy.

## **Discussion**

Results of this research work indicated significant main Effect of treatment on students' attitude towards chemistry. This confirmed the positive Effect of these strategies, in improving on the attitudes of students towards chemistry and to science education generally. This finding is in tandem with the finding of Miller and Picher (2002) who found out that think-pair-share strategy brought about positive attitude on the part of students in agricultural science. The result further showed that there was no significant main Effect of cognitive entry behavior on students' attitude towards chemistry. This view is in conflict with research findings of Ogunkola (2000) which implied that cognitive entry behavior is significantly related to attitude in the sciences. Another finding of this study is that there was no significant main Effect of gender on students' attitude towards chemistry. These findings corroborated the study findings of Alebiosu (1998) in chemistry, Bilesanmi-Awoderu (1998) in biology, Ogunkola (2000) in biology and Erinoso (2005) in senior secondary school physics that there were no significant Effects of gender on students' attitude towards the various science subjects.

In this study, it was found out that treatment did not interact with gender in determining students' attitude towards chemistry. The insignificant difference in attitude with respect to the interaction of treatment and cognitive entry behavior which was also observed could be attributed to the fact that the period of treatment was not sufficient enough for students to be able to internalise the spirit of collaboration and inquiry into their affective domain. The study was interested in student attitude to chemistry, but the basic fact is that attitude changes over time and in the study, the time was not sufficient to effect the attitudinal change.

## **Conclusion**

The findings of this study have significant contribution and great implications for educational practices. It was found out that students taught with guided discovery and think-pair-share strategies obtained significantly higher post-test mean scores than those in the lecture strategy group both in attitude. It is thus suggested that practicing science teachers should use guided discovery and think-pair-share strategies in science classroom. In all learning settings, students tend not to have equal cognitive entry behavior but when inquiry approach such as guided discovery and collaborative approach such as think-pair-share are used as instructional strategies, students are always at an advantage, in that these strategies foster inquiry and cooperation among them, despite their different strengths and weaknesses with respect to cognitive entry behavior and other different aspects of learning factors. As they interact among themselves and try to solve problems on their own, they develop social skills which lead to successful inquiry and better attitude.

### **Recommendations**

Based on the findings of this research, it is hereby recommended that teachers should make guided-discovery and think-pair-share strategies fundamental parts of their instructional strategies in science classroom. Furthermore, more efforts should be geared towards popularizing the strategies for use among students of the two gender groups. Ministry officials at both state and federal levels, curriculum planners and heads of schools should encourage and support training on how to implement guided discovery and think-pair-share learning strategies in schools.

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