Impact of Guided Discovery Approach on the Academic Achievement Levels of Secondary School Biology Students with Different Learning Styles in Abuja Municipal Area Council

Olawuwo Adeboola Falilat[*]

Department of Integrated Science, FCT College of Education, Zuba, Abuja, Nigeria

Abstract: **The study determined impact of guided-discovery approach on the academic achievement levels of secondary school biology students with different learning style. The research design adopted for this study was quasi – experimental of pretest, post-test control group design. Cell Biology Achievement Test (CBAT) was used for data collection while guided discovery learning package was used as treatment instrument. Kuder Richardson formula 21 (KR-21 was used to determine the reliability coefficient of CBAT. The reliability coefficient of 0.86 was obtained Data were analyzed using Analysis of Co Variance ANCOVA) Results revealed that, there is significant difference in means scores of the experimental group of interpersonal learning style than control group. Also, in Imaginative learning style the result revealed that there was significant difference in mean achievement scores of the experimental group than the control group. In both learning styles, the gender was not determine the achievement with the result shown that there is no significant difference between the two sexes, i.e. the performance does not determine by the gender, therefore the null hypotheses were not rejected Based on these findings, the following recommended were made: that Guided discovery should be incorporated into the teaching method adopted by Biology teachers since there is a link between students' learning style and the students' achievement and guided discovery can enhance the students' academic achievement. Biology teachers are encouraged to use guided discovery instructions to provide equal opportunity to students of different learning styles.**

Keywords: **ability levels, achievement, guided inquiry, problem solving, retention.**

1. Introduction

Guided discovery approach and other activities-based methods of science teaching could be part of the reasons for poor performance of students in Biology. For teaching to be effective the biology teachers should adopt the guided discovery strategy to deliver their lesson (Usman, 2017). According to Ivowi (2016), discovery is in essence a matter of re-arranging or transforming evidence in such a way that one is enabled to go beyond the evidence and re-assembling additional new knowledge. Bruner (1961) outlines four reasons for using this approach and these are, intellectual potency, intrinsic rather than extrinsic motives, learning the heuristics of discovery and

conservation of memory. Intellectual potency means an individual learn and develop his mind only by using it. Brunner (1961) emphasized "the only way a person learns the techniques of making discoveries is to have opportunities to discover through guided discovery". Thus, students slowly learn how to organize and carry out investigation as they shift from extrinsic to intrinsic motivation, consequently learning may occur in response to some reward or even to avoid failure, as a result they have to change their attitude toward learning either in positive or negative direction. This implies that particular focus can be placed on two areas where the teacher plays a major role.

Guided-discovery, like the Constructivist approach allows the learner to construct a unique material to be learned, the task to be performed, select the information that is relevant and interprets it on the basis of the existing one to attain a meaningful learning. Teacher as a facilitator should bring materials and information to assist the learner in the construction of learning in other to allow the learners to be involved in the series of activities and interaction with materials and information. It is the duty of the teacher with the active support of the school authorities to ensure that the needs of the learners are met; the method should allow the students to learn by doing. Students learn physical or mental skills by actually performing those skills under the supervision of teacher this means that to learn students must practice.

The instructor must therefore allot enough time for meaningful students' activity through doing students learn to follow correct procedures and to draw a reasonable conclusion. Guided-discovery approach provides the students with the opportunity to handle the learning materials unlike the conventional approach where there is no opportunity for students to handle the learning materials, made it difficult for them to develop the practical skills and unable to answer correctly any question that needs practical application which eventually leads to poor performance in Biology.

For the academic performance of the students to improve the teacher needs to consider the student's preferred way of learning which is otherwise known as learning style. Learning

*Corresponding author: bolaolawuwo.2016@gmail.com

styles is a term generally used to describe an individual's natural or habitual pattern of acquiring and processing information in learning situations. There is no commonly accepted definition of learning style however; a core concept is that individuals differ in how they learn. Proponents for the use of learning styles in education said that teachers should assess the learning styles of their students and adapt their classroom methods to best fit each student's learning style. Although there is ample evidence for differences in individual thinking and ways of processing various types of information, few studies have reliably tested the validity of using learning styles in education. There is evidence of pedagogical problems related to the use of learning styles that a student will learn best if taught in a method deemed appropriate to the student's learning style

Learning styles are important to students and science teachers because it can help teachers to analyze and target their audience. It also helps learners to become effective learners because they become aware of their thinking process and focuses on the teachers to students centered learning. Moreover, students whose learning style matches the teaching method tend to retain information longer, apply it more effectively and pay more attention to the subject (Keeler 2014). In addition, it enables educators to provide instruction aimed at accommodating individual differences. Learning styles have been reported to improve students' performance, improve retention and facilitate interaction (Keeler 2014). There are different learning styles exhibited by the students through the same method or approach employed during the classroom instruction. There is no right or wrong learning style, it has nothing to do with intelligence but it has to do with the way a person's brain works to learn and store information efficiently since everyone learns differently, understanding learning style can help teacher to teach efficiently by matching the teaching method with student's learning style for better understanding.

There are many classifications of learning style from different Scholars based on different perspectives, however there are three major learning styles as proposed by Myers Briggs (1962) namely, Auditory, Tactile and Visual. Honey (2006) propounded four types of learning styles which are Theorist, Pragmatist, Activist and Reflectors Kolb (2014) classified learning style into Visual, Auditory, Accuracy focused, Kinesthetic and Fluency focused. Herrmann (2009) classified students' learning styles based on the four quadrants of the human brain i. e Analytic, Imaginative, Sequential and Interpersonal. Thus, it is the Herrmann learning styles that this study is focused on

Various researchers have attempted to hypothesize ways in which learning style theory can be used in the classroom. Two of such scholars are Dunn and Dunn (2001) that learning style will inevitably differ among students in the classroom. Dunn and Dunn (2001) suggested that teachers should try to make changes in their classroom that will be beneficial to every learning style. Teachers should assess the preferred way of their students' learning and adapt their classroom methods to best fit each student's learning style. This implies making the classroom a place that naturally motivates students to learn since students and teachers function in an atmosphere where

academic success and the attitudes to learn are respected and rewarded. Marilee Springer is another scholar who believes that learning styles have an effect on the classroom and work base on three premises, teachers can be learners, learners can be teachers and we are all both, everyone can learn under the right circumstances, learning is fun! Make it appealing. This aids the development of lifelong learners who are intrinsically motivated, display intellectual curiosity, find learning enjoyable and continue seeking knowledge after their formal instruction. This means that if teachers can identify their students' preferred ways of learning, they would tailor their teaching towards their style of learning thereby helps them in scoring higher on their tests, more efficient in their studies and enhances their performance in Biology either male or female.

Individuals differ by gender (Greb, 2019). Male and female learn differently from each other. Male tend to be more kinesthetic, tactual and visual and need more mobility in a more informal environment than female. Males are more nonconforming and peer motivated than their female classmates. In group, male tend to learn less by listening, female more than male tend to be auditory, authority-oriented and better able to sit passively at conventional classroom desks and chairs than male. Female also need significantly more quiet while learning (Pizzo, 2017), be more self- and adult – motivated and conforming than male (Marcus, 2017). Thompson (2015) who claims that there are fundamental differences between male and female's ways of communicating, which he terms "genderlects", as a takeoff on language dialect and believes that a male's world focuses on competition, status, and independence. But female's world focuses on intimacy, consensus and sometimes independence. According to Thompson (2015), boys learn to compete in hierarchical groups while girls learn to cooperate in small groups in which mutual liking are important. Studies by Leet-Pellegrini (2018), Aries (2016) and Fox (2016) suggested that males feel comfortable in a lecturing role which is a demonstration of expertise and status but females feel comfortable in a listening role which shows a desire to cooperate, bond and be liked by-products of a world of connections and not status. Females feel more comfortable sharing their expertise with others rather than rivaling others with it. Leet- pellegni (2018) suggests that the male world is based on "adversativeness" in contrast to females who are encouraged to keep the peace.

Problem statement: Despite the emphasis on teaching science by inquiry, there is still a predominance of conventional method of teaching Biology and high rate of failure in Biology school certificate level as evidenced by WAEC and NECO 2018-2022 reports. Educators are seeking alternative ways to teach Biology so as to change this situation, given the numerous advantages of guided discovery teaching approach the researcher wonders if the approach can enhance students' achievement in Biology particularly in difficult topics like Cell and its environment, cell types, genetic and some others. The focus of this study is to find the effectiveness of guided discovery teaching method on students' academic achievement in Biology and what are the considerations for implementing guided discovery in teaching

of Biology? Difficult nature of some concepts such as cell and physical process, cell and its environment and genetic are considered among others to be difficult topics in SSSCE Biology curriculum, can these concepts be understood better by the students if appropriate teaching strategies or methods are adopted like guided discovery method?. Because of difficulties encountered by students in understanding these concepts, they fail to attempt questions set on these topics which leads to their overall poor performance in biology The focus of this study is to find out if teaching cell Biology by guided discovery method will enhance students learning which in turn improve their achievement in Biology.

A. Justification of the Study

Academic achievement has become a key factor for students' progress. The desire for high Achievement has put a lot of pressure on students, teachers, parents, schools and the education system in general. It appears as if the whole education system revolves around the academic achievement of the students. Several research reports have shown that students' Academic achievement generally is poor. Poor Senior Secondary Certificate examination result can be said to be a threat to aim of achieving high socioeconomic advancement through the production of relevant skilled man power in the field of science and technology and other fields. There is need to work on how to improve students' Academic achievement by considering their preferred ways of learning

Blames have been apportioned. on one hand, it was the students who refuse to work hard at these subjects, hence their low performance and growing apathy. On the other hand, the teachers bear the blame for failing to employ a proper pedagogy and skills that can assist the students in the effective conception of science. Despite school improvement being placed high on the policy agenda, the results of such actions have been poor. Therefore, there is a need to explore additional ways in which academic performance can be enhanced such as the inclusion of learning styles in the Curriculum of Senior Secondary School in FCT, Abuja.

Research questions: This study was guided by the following research questions:
1) What are the mean achievement scores of Biology students with Interpersonal learning styles exposed to Guided-discovery and conventional methods.
2) What are the mean achievement scores of Biology students with Imaginative learning styles exposed to Guided-discovery and conventional methods.
3) What are the mean achievement scores of male and female Biology students with Interpersonal learning styles exposed to Guided-discovery method.
4) What are the mean achievement scores of male and female Biology students with Imaginative learning styles exposed to Guided-discovery method.

Null hypothesis:
1) There is no significant difference in the mean achievement scores of Biology students with Interpersonal learning style exposed to guided discovery and conventional methods

2) There is no significant difference in the mean achievement scores of the Biology students with Imaginative learning style exposed to Guided-discovery and conventional methods.
3) here is no significant difference in the mean achievement scores of the male and female Biology students with Interpersonal learning style exposed to Guided-discovery.
4) There is no significant difference in the mean achievement scores of the male and female Biology students with Imaginative learning styles disposed to Guided-discovery method

2. Methodology

Research design: The research design for this study was quasi – experimental of pretest, post-test control group design. For the experimental design of the study the pre - test – post- test Control Group Design was considered appropriate (Sambo, 2005). Schematic representation of the design is as follows,

Table 1
Representation of the research design

Group	Pretest	Treatment	Posttest
Experimental E	O_{11}	x	O_{12}
Control C	O_{21}	-	O_{22}

Where,
O = Measurement
X = Treatment (guided discovery method)
E = Experimental group
C = Control group

Both groups (experimental and control) received pretests (O_{11} and O_{21}) and posttest (O_{12} and O_{22}) The test was on Cell Biology Achievement test developed by the researcher based on the topics treated in the package.

Population: Population for the study comprised all senior secondary school one (SS1) Biology students (N= 1,260 made up of 676 boys and 584 girls) in Abuja Municipal Area Council (AMAC) of the Federal Capital Territory (FCT) 2023/2024 academic session. In the area council there are twenty-one coeducational day secondary schools

Sample and Sampling: A sample of 86 senior secondary year one Biology students was selected from two coeducational schools in Abuja Municipal area council (AMAC) out of eight co-educational secondary schools that participated in the pretest exercise using a simple random sampling technique, the instrument CBAT was administered in eight intact classes from eight different co-educational schools, the schools were paired and the difference in their means was determined using an independent sampled t-test. Two schools with equivalent mean scores selected for the study. The schools were assigned to experimental and control groups, the experimental group consist of 26 female and 20 male students while the control group was made up of 18 female and 22 male students, the age of the student's ranges from 11 to 12.

Instrumentation: For the purpose of data collection, one instrument was developed by the researcher and the second one

was adapted and validated by the experts. The instruments are;

Cell Biology Achievement Test (CBAT), and Learning Style Questionnaire (LSQ).

Cell Biology Achievement Test (CBAT): The Cell Biology Achievement Test (CBAT) consists of twenty-five multiple choice objectives, test items with four options (A-D), drawn from past JAMB and SSCE questions on Cell as a living unit, cell structure, types of cell, forms of cell and cell and its environment. It was used as pretest and post-test. The pretest questions were re - reshuffled for the post test. The items in the test covered the topics selected for the study.

Learning Style Questionnaire (LSQ): The Learning Style Questionnaire was originally developed by Herrmann (2009), Herrmann's Brain Development Instrument (HBDI) tools which consisted of 50 items was adapted, items with two options of Yes or No was modified to 25 items for this study. The instrument was used to obtain data on the learning styles of the students before the treatment in order to ascertain their learning styles.

Validation and Reliability of the Instruments: The content of the instruments was validated by the expert in measurement and evaluation from University of Abuja and two experienced Biology teachers from FCT College of Education Zuba. To ascertain the reliability of the instruments. Kuder Richardson formula 21 (KR-21) was used and reliability coefficient of 0.86 was obtained

Administration of the Instruments. The CBAT was administered as pretest to select the sample for the study. It also administered as posttest after given the treatment to the Experimental and Control groups.

Procedure for Data Analysis: The scores obtained from the CBAT provided data for answering the research questions and null hypotheses formulated for the study. Descriptive statistics of mean and standard deviations was used to answer research questions and Analysis of Covariance (ANCOVA) at 0.05 levels of significance for the hypotheses. The choice of ANCOVA for testing the hypotheses is because it statistically removes all the initial differences between the groups.

3. Result

Research Question 1: What are the mean achievement scores of Biology students with Interpersonal learning styles exposed to guided discovery method and conventional method?

Table 2

Means and standard deviations of post test scores of experimental and control groups with interpersonal learning style

Group	Interpersonal Learning Style	N	Mean	Std. Dev
	Experimental Group	15	18.07	2.840
	Control Group	13	11.38	2.293

Table 2 shows the mean scores of Biology students with Interpersonal learning style in Experimental and Control groups. The table revealed that the treatment has great influence on academic performance of students under experimental group.

The corresponding hypothesis to research question 1.

Hypothesis 1: There is no significant difference in the mean achievement scores of Biology students with Interpersonal learning style exposed to guided discovery and conventional methods.

Table 3 shows the ANCOVA result of mean scores of Experimental and Control groups with Interpersonal learning style. The $F(1) = 52.112$ and $0.000 > \alpha = 0.05$, meaning that there is significant difference in means scores of the experimental group than control group. Therefore, the null hypothesis is rejected

Research Question 2: What are the mean achievement scores of Biology students with Imaginative learning style exposed to guided discovery method and conventional method?

Table 4
Means and standard deviations of posttest scores of experimental and control groups with imaginative learning style

Group	Imaginative Learning Style	N	Mean	Std. Dev
	Experimental Group	11	19.18	1.401
	Control Group	10	10.70	1.160

Table 4 shows the mean achievement scores of Biology students with Imaginative learning style in Experimental and Control groups. The mean scores for students exposed to guided discovery was 19.18 while those exposed to the Conventional method was 10.70 with both having a standard deviation of 1.401 and 1.160 respectively. The treatment has great influence on academic performance of students taught with guided discovery method.

The corresponding hypothesis to research question 2.

Hypothesis 2: There is no significant difference in the mean achievement scores of Biology students with Imaginative learning style exposed to guided discovery and conventional methods.

Table 3
Result of ANCOVA of posttest mean scores of experimental and control groups with interpersonal learning style

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	340.305	2	170.153	29.005	0.000
Intercept	150.016	1	150.056	25.579	0.000
Post-test ILS	29.351	1	29.351	5.003	0.034
ILSnGDnCM	**305.705**	**1**	**305.705**	**52.112**	**0.000**

Table 5
Result of ANCOVA of posttest mean scores of experimental and control groups with imaginative learning style

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	377.099	2	188.549	107.84	0.000
Intercept	183.378	1	183.38	104.88	0.000
Pre test	0.264	1	0.264	0.151	0.702
ImLSnGDnCM	**361.408**	**1**	**361.48**	**206.69**	**0.000**

Table 7
Result of ANCOVA of posttest mean scores of experimental male and female biology students with interpersonal learning style

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	39.110	2	19.555	3.179	0.078
Intercept	81.521	1	81.521	13.251	0.003
Pre test	35.776	1	35.776	5.815	0.033
GenderILSnGD	**4.406**	**1**	**4.406**	**0.716**	**0.414**

Table 9
Result of ANCOVA of posttest mean scores of experimental male and female biology students with imaginative learning style

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1.575	2	0.787	0.349	0.716
Intercept	162.442	1	162.442	71.949	0.00
Pre test	0.238	1	0.238	0.105	0.754
GenderIMLSnGD	**1.539**	**1**	**1.539**	**0.681**	**0.433**

Table 5 shows the ANCOVA result of mean scores of Experimental and Control groups with Imaginative learning style. The F (1) = 206.69 and 0.000 > α = 0.05, meaning that there is significant difference in mean scores of the experimental group than the control group. Therefore, the null hypothesis is rejected.

Research Question 3: What are the mean achievement scores of male and female Biology students with Interpersonal learning style exposed to guided discovery method?

Table 6
Means and standard deviations of post test scores of experimental male and female biology students with interpersonal learning style

Gender	N	Mean	Std. Dev
Female	10	18.40	2.72
Male	5	17.40	3.29

Table 6 shows the mean achievement score of female students as 18.40 while that of male students was shown as 17.40 with each having a standard deviation of 2.72 and 3.29 respectively. That means there is no significant difference between the two sexes The corresponding hypothesis of research question 3.

Hypothesis 3: There is no significant difference in the mean achievement scores of male and female Biology students with Interpersonal learning styles exposed to guided discovery.

Table 7 shows the ANCOVA result of mean scores of male and female Biology students with Interpersonal learning style, F(1) = 0.716 and p = 0.414 > α = 0.05 meaning there is no significant difference between the two sexes, i .e the performance does not determine by the gender, therefore the null hypothesis is not rejected

Research Question 4: What are the mean achievement scores of male and female Biology students with Imaginative learning style exposed to guided discovery method?

Table 8
Means and standard deviations of post test score of experimental male and female biology students with imaginative learning style

Gender	N	Mean	Std. Dev
Male	6	19.50	1.05
Female	5	18.80	1.79

Table 8 shows the mean achievement score of Imaginative Biology students male students as 19.50 that of female students were 18.80 with each having a standard deviation of 1.05 and 1.79 respectively, this shows there is no significant difference in their mean scores of both sexes

The corresponding hypothesis to research question 3.

Hypothesis 4: There is no significant difference in mean achievement score of male and female Biology students with Imaginative learning styles exposed to guided discovery method.

Table 9 shows the ANCOVA result of mean scores of male and female Biology students with Imaginative learning style, F(1) = 0.681 and 0.433 > α = 0.05, meaning there is no significant difference between the two sexes, i.e., the performance does not determine by the gender, therefore the null hypothesis is not rejected.

A. Major Findings

There was significant difference in the mean achievement scores of Biology students with Interpersonal learning style exposed to guided discovery and conventional methods

There was significant difference in the mean achievement scores of Biology students with Imaginative learning style exposed to guided discovery and conventional methods

There was no significant difference in the mean achievement scores of boys and girls of Biology students with Interpersonal learning style that are exposed to guided discovery method. Both genders performed significantly

There was no significant difference in the mean achievement scores of Biology students with Imaginative learning style that are exposed to guided discovery method. Both genders performed significantly.

4. Discussion and Conclusion

The discussion of the results was made on the research questions answered and the corresponding hypothesis that were tested.

The research questions one and two was intended to find out to what extent students mean achievement scores differ when taught cell Biology with guided discovery and conventional teaching approaches. The mean achievement scores of Biology students with learning styles taught with guided discovery method perform better than those taught with conventional method despite the fact that the two groups are of the same learning style, this was further confirmed by the test of hypothesis 1 and 2 which revealed that teaching approaches were significant factor on students' achievement in CBAT. It was discovered from this study that there is a link between students' learning style and the students' achievement, which is

mostly due to the method of teaching.

In Interpersonal learning styles, it was observed that the mean achievement scores of experimental groups were greater than the Control group. Findings was in support of Zippert (2005), Dunn, Griggs, Olson and Bearsly (2005) that preferred learning styles and preferred teaching method exist, if properly used will improve the academic performance of not only Biology students but to all other disciplines and Brunner's assertion that students learn science best through discovery method. Many factors could be responsible for this, ranging from method of teaching, students' interest, their attitude and learning environment. Using analysis of covariance (ANCOVA) to compare the mean achievement scores of Biology students with Imaginative learning styles in guided discovery and conventional methods, it was observed that those in experimental group perform significantly better than those in control group. The null hypothesis was rejected. This result is in line with Bello (2007) and Gardner (2003) that the use of guided discovery method can improve academic achievement of students in Biology. In guided discovery instruction, teachers provide such help and concept explanation in the class. In addition, students need to work in group to conduct their laboratory activities, these features of instruction facilitate interpersonal and Imaginative learners to conduct their inquiry activities, thus enhance their performance towards science learning.

Acknowledgement

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