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Original Research Article

Effects of Flipped Classroom Learning on Perception in Genetics Concepts among Secondary School Students in Gusau, Zamfara State, Nigeria

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Abstract: The study examined the effects of flipped classroom learning on perception in genetics concepts among secondary school students in Gusau, Zamfara State, Nigeria. The research design employed was quasi-experimental; specifically, pre-test, post test, non equivalent control group design. A sample of 279 SS 3 Biology students drawn using multistage sampling technique from 5,804 SS 3 students for 2020/2021 session from 29 senior secondary schools in Gusau Local Government Area, Zamfara State, Nigeria. Students' Perception of Genetics Concepts Scale (SPGCS) was the instrument used in collecting data, as Pretest and Post-test. A reliability coefficient of 0.98 was found using Cronbach's alpha. The data were analysed using mean, standard deviation and Independence Z-test at 0.05 level of significance. Results indicated that students taught using Flipped Classroom Learning possessed high level of perception in genetic concepts than those exposed to lecture method with significant difference in the mean perception scores. The findings equally indicated the insignificant difference between the perception of male and female students exposed to Flipped Classroom Learning. The study recommends among others that Biology teachers should be encouraged to use Flipped Classroom Learning as the main teaching strategy to improve students' perception in genetics concepts in senior secondary schools. Similarly, Biology teachers should be trained by the Ministry of Education and other education agencies on effective procedures for implementing Flipped Classroom Learning for high level of perception in genetics concepts.

Keywords: Flipped Classroom Learning, Perception, Genetics Concepts, Secondary School Students.

INTRODUCTION

Science education deals with sharing of science content and process with individuals who are not considered traditionally to be members of the scientific community, the individuals could be students, farmers, market women or a whole community (Kola, 2013). It has its focus on preparing individual with appropriate skills, abilities and competencies both mental and physical to live and contribute to the development of the society. Science education therefore, is the bedrock and tool towards a sustainable economic, social and political development of a nation which therefore, should be given a great consideration. According to the National Policy on Education FRN (2014), the general aim and objective of science education is to produce scientifically literate students, by exposing learners to scientific contents, as well as scientific methods to acquire scientific knowledge for practical application. This can be achieved by the inculcation in the learners the necessary scientific skills and attitudes through high level perception of concepts. The inculcation of scientific skills and attitudes in students can only be achieved through the proper teaching of the various science subjects such as Chemistry, Physics and Biology.

Biology as a science subject was developed in the nineteenth century as scientists discovered that organisms shared fundamental characteristics. Biology is now a standard subject of instruction at secondary schools and universities around the world and over a million papers are published annually in wide array of Biology and Medicine journals, (Christopher, 2010). Ekwueme and Ali (2012) defined Biology as a natural science which deals with the study of living organisms. It is derived from two Greek words "Bios" which means life and "logos" which connotes knowledge. It is a fascinating study that ranges from microscopic cellular molecules to the biosphere, encompassing the earth's surface and its living organisms.

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The Teaching and learning of Biology at secondary school is a complex activity in any educational setting which involves teachers, students, and resources as well as their roles during the process (Benjamin & Emmanuel, 2017). According to Taiye (2016), effective teaching of Biology is a process by which a Biology teacher adopts all the possible method used in teaching to make sure that students understand Biology and be able to respond positively during assessment or to produce a good result. Therefore, the Biology teacher is at the center, guiding and supporting students while the students actively participate for a good teaching and learning to take place. The Biology teacher therefore has many opportunities to make the subject more interesting for students, thus contributing to the formation of students' positive perception towards Biology (Kubiatko, Torkar & Rovnanova, 2017). Biology teachers however, often adopt the teacher centred approach to instruction which is often more suitable for covering large content areas which is common with most Biology topics, teaching large number of students and covering the scheme of work, this invariably leads to poor perception of students in some Biology concepts such as genetics (Ezenwabachili & Okoli, 2021).

Bateson, who coined the term Genetics in 1906 aptly defines it as the science dealing with heredity and variation, seeking to discover laws governing similarities and differences in individuals related to descent. Genetics occupies a central position in modern Biology, so its understanding is essential in sciences. The discipline has great impact on many everyday aspects of human life, the food we eat and the clothes we wear come from organisms improved by application of genetic principles, the causes of important human diseases are being discovered, and therapies developed, based on fundamental genetic investigations. Secondary school students study Genetics as part of the secondary school Biology curriculum to function effectively both as individuals who might be receiving health care and as responsible citizens participating in the broader process by which health policy decisions are made. Therefore, it is essential for secondary students not to see genetics concepts as a 'black box', but to understand the basic concept of Genetics to make informed choices in their lives. Upon all the advantages, relevance and importance of learning the concept of Genetics, it is teaching in secondary schools is bedevilled by a lot of factors which includes; unqualified teachers, inadequate teaching and learning materials, poor laboratories and poor use of teaching methods which lead students to perceive it as a difficult concept. The active learning methodologies like flipped classroom learning allow a change of the traditional teaching model, inserting students actively in the classroom.

The term 'flipped learning' (also referred to as a 'flipped classroom') is used to describe a pedagogical approach in which the conventional notion of classroom-based learning is inverted (Almodaires, Alayyar, Almsaud & Almutairi, 2019). It is "an educational technique that consists of two parts: direct individual instruction outside the classroom and interactive group learning activities inside the classroom" as shown in Figure 1 (Bishop & Verleger, 2019). Flipping the classroom employs easy-to-use technology to free class time from traditional lecture allowing for more active learning. In-class time is used for cooperative learning and involves interactive activities that promote critical thinking, teamwork, personalised learning, and content knowledge acquisition as shown in Figure 1 (Sánchez & Espino, 2017). There is an increasing focus in schools and colleges on the research of the effectiveness of flipped classrooms instruction, it is important to understand how this movement from conventional learning changes academic achievement and perception.

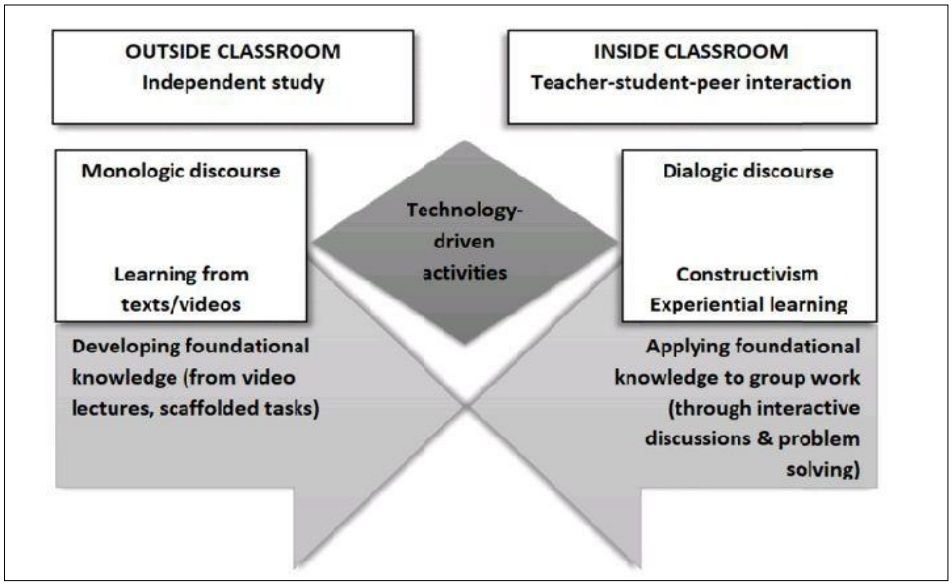

Figure 1: Theoretical bases of Flipped Classroom (Faisal, Abdullahi & Alaa, 2020)

Perception is a prediction that involves the organization of objects, events or relationship leading to the process by which we interpret our sensory input. In fact, the participation level of students in the society is affected by the negative or positive perception of students towards the sciences, technologies and science education (Dikovic, 2009). In this research, perception refers to how senior secondary students in Gusau, Zamfara State, Nigeria see and interpret their understanding of concepts or topics in Genetics that were discovered by many researchers as a problem that is affecting learning of Biology. Perception of the concepts is one of the most important factors of students' understanding of scientific inquiry and the nature of science including Biology (Shin, Lee & Ha, 2015). Isma'il and Matazu (2024) findings reported that, both Biology teachers and students in Zamfara State perceived certain topics within senior secondary school biology curriculum as difficult.

As a matter of fact, there are differences in the way an individual perceives the same object in the environment under different conditions (Yakubu & Abdulkarim, 2010). This is due to the fact that there are individual differences in learning styles, motivation, interest, values, cultural background, experience and expectations among others. Other factors that influence perception include; characteristics of the perceiver, characteristics of the target perceived and the characteristics of the situation or context within which the perception takes place (Pawar & Sapre, 2014). From this perspective, there appeared to be need for further and deeper insight into students' perception in genetics concepts. Understanding students' perception in genetics concepts is crucial, as many researchers such as Omwirhiren and Anderson (2016) suggest that in order to improve the quality of teaching and learning in school, students' perception must be taken into consideration. This means teachers need to address students' perception before introducing concepts and expecting meaningful learning in class that ensures equal opportunities for both males and females students in teaching and learning, it improves students' achievement, retention and perception regardless of gender (Jacob & Linus, 2017).

Gender differentiation is an old controversial issue in education; it could be a factor that influences students' perception of concepts. In this regards, gender differences have gradually become a common discuss in educational cycles (Awodun, Oni & Oyeniyi, 2015). Many researches has been done in gender, some studies revealed that males' outperformed females in achievement (Eshetu, 2015; Brownell & Wenderoth, 2014) while other studies reported opposite (Nbina & Wagbara, 2012). Some studies on the other hand disclosed that there was no significant gender difference in the students' academic performance in various science subjects such as Mathematics, Physics, Chemistry and Biology (Gambari, Obielodan & Kawu, 2017; Fatokun, Egya & Uzoechi, 2016; Okoyefi, 2014).

Research findings have shown that a number of concepts in Biology such as Genetics, Ecology, Mitosis and Meiosis (cell division) pose a lot of difficulty for Biology students, in some cases even to the Biology teachers (Okolo & Oluwasegun, 2020). The WAEC Chief Examiner's report (2016 - 2021) has highlights on students' weakness in answering questions from some difficult topics which includes genetics due to poor perception. It is good to note that students' performances are not consistent over the years according to Chief Examiners' general comments. The fluctuation in students' achievement in Biology concepts and inability to attain high achievement in the subject create gap that necessitated more studies related to students' perception in genetics, there is need to find out the effectiveness of other alternative teaching strategies that will help students to better perceive Genetics concepts and attain higher perception level.

Objectives of the Study

The objectives of this study are to;

1. Investigate the students' perception in genetics concepts when taught using Flipped Classroom Learning and lecture method in Gusau, Zamfara State, Nigeria.
2. Find out the difference in the perception of male and female students taught genetics concepts using Flipped Classroom Learning in Gusau, Zamfara State, Nigeria.

Research Questions

The specific research questions to be addressed are:

1. What are the students' perception in genetics concepts when taught using Flipped Classroom Learning and lecture method in Gusau, Zamfara State, Nigeria?
2. What is the difference between the perception of male and female students taught genetics concepts using Flipped Classroom Learning in Gusau, Zamfara State, Nigeria?

Research Hypotheses

The following null hypotheses were formulated at 0.05 alpha level of significance.

$H0_1$:

There is no significant difference between the students' perception in genetics concepts when taught using Flipped Classroom Learning and lecture method in Gusau, Zamfara State, Nigeria.

$H0_2$:

There is no significant difference between the perception of male and female students taught genetics concepts using Flipped Classroom Learning in Gusau, Zamfara State, Nigeria.

METHODOLOGY

Research Design

The research design for this study is Quasi-experimental design (pre-test and post-test experimental

control group design). In this design, the Experimental Group (EG) and the Control Group (CG) were selected with random assignment. A pretest was administered to both the experimental and control groups to determine the equivalence in perception level. Then a post-test was administered to all groups after the treatment to determine the effectiveness of the treatment and measure the level of perception. The experimental groups were taught using Flipped Classroom Learning Strategy for six weeks while the control groups were taught using lecture method of teaching.

The population of this study consisted of 5,804 SS 3 male and female students respectively from 29 Senior Secondary School Students of Gusau Local Government, Zamfara State as indicated by data obtained from Zamfara State Ministry of Education (2021). Multistage sampling technique was employed to select schools and classes for participation. In the first stage, cluster sampling was utilized to divide the population of schools into clusters, and then four schools from these clusters were randomly selected to ensure a representative sample. Upon selecting the schools, four intact classes of SS3 were randomly selected from each. Two of these classes from each school were then assigned as experimental groups, while the remaining two were designated as control groups.

The instrument used for data collection was Students' Perception of Genetics Concepts Scale (SPGCS) which was adapted from Ahmad S. S. The SPGCS was validated by experts and subject to pilot testing which has a reliability coefficient of 0.98 by using the Cronbach's alpha statistical tool for determining the reliability coefficient.

Frequency count, mean and standard deviation were used for data analysis to answer the research questions, while hypotheses were tested using inferential statistics (independent sample Z-test) at $\alpha = 0.05$ level of significance, using Statistical Package for Social Sciences (SPSS) version 20.0.

RESULTS

Research Question 1:

What are the students' perceptions in Genetics Concepts when taught using Flipped Classroom Learning and lecture method in Gusau, Zamfara State, Nigeria?

To answer this research question, mean and standard deviation were used. The result obtained using SPGCS for flipped classroom learning and lecture method was used. The mean and standard deviation were computed and presented in Table 1.

Table 1: Mean and Standard Deviation of Students Perception in the Experimental and Control Groups

Groups	N	Mean	SD	Mean Diff.
Experimental	159	85.8491	9.44014	
				4.765
Control	120	81.0833	9.19315	

Table 1 shows that the means and standard deviations of experimental group were 85.84 and 9.44 and that of control group were 81.08 and 9.19 respectively. The mean difference in the perception scores was found to be 4.76 in favour of the experimental group. This shows that the experimental group had high perception scores of genetics concepts as a result of exposure to flipped classroom learning strategy. Also, the result shows that the standard deviation of experimental group (9.44) was higher than that of control group (9.19), which indicates that the control group perception scores are closely around the mean score more than the experimental group perception scores. To find out if the difference in mean was statistically significant, the corresponding hypothesis was tested.

$H0_1$:

There is no significant difference between the students' perception in Genetics Concepts when taught using Flipped Classroom Learning and lecture method in Gusau, Zamfara State, Nigeria. To test this hypothesis, the post-test scores of the students' perception in the experimental group were compared with that of the control group using Z-test statistical tool as shown in Table 2.

Table 2: Z-test Analysis on the Mean Perception Score of Secondary School Students in the Experimental and Control Groups

Group	N	Mean	SD	Standard Error	Df	Sig (2-tailed)	Decision
Experimental	159	85.84	9.44	0.74865			
					4.76	.000*	*Significant
Control	120	81.08	9.19	0.83922			

* Significant, $P \leq 0.05$

The results presented in Table 2 shows that the significant (2-tailed) value is 0.000 which is less than $P \leq 0.05$. Therefore, there is significant difference in the mean scores of experimental and control group. This implies that there is significant difference in the mean perception scores of secondary school students taught genetics concepts using flipped classroom learning and those taught using lecture method.

Research Question 2:

What is the difference between the perception of male and female students taught genetics concepts using Flipped Classroom Learning in Gusau, Zamfara State, Nigeria?

To answer this research question, mean and standard deviation were used. Data on perception of Secondary School male and female students taught genetics concepts using Flipped Classroom Learning were subjected to descriptive statistics based on gender (i.e. male and female). Mean and standard deviation were computed and presented in Table 3.

Table 3: Mean and Standard Deviation of Perception for Secondary School Male and Female students taught genetics concepts using Flipped Classroom Learning

Group	N	Mean	Standard Deviation	Mean Difference
Male	75	85.61	9.189	
				0.446
Female	84	86.05	9.770	

Table 3 shows that the means and standard deviations of male students in the experimental group were 85.61 and 9.18 and that of female students were 86.05 and 9.77 respectively. The mean difference in the perception scores was found to be 0.44 in favour of female. This shows that there is difference of male and female perception scores when taught using flipped classroom learning strategy. Also, the result shows that the standard deviation of female (9.77) is more than that of male (9.18), which indicates that the male achievement scores were closely around the mean score more than the female scores. To find out if the difference in mean is statistically significant, the corresponding hypothesis ($H0_2$) was therefore tested.

$H0_2$:

There is no significant difference between the perception of male and female students taught genetics concepts using Flipped Classroom Learning in Gusau, Zamfara State, Nigeria.

To test this hypothesis, mean perception scores of the male and female students in the experimental group were compared. Data on perception of secondary school male and female students taught genetics concepts using Flipped Classroom Learning was tested using Z-test.

Table 4: Z-Test Analysis on the Perception Scores of Male and Female Students taught Genetics Concepts using Flipped Classroom Learning

Group	N	Mean	SD	Stand. Error	Sig. (2-tailed)	Decision
Male	75	85.61	9.189	1.128		
					0.768	**Not Significant
Female	84	86.05	9.770	1.002		

** Not Significant at P ≤ .05

Results presented in Table 4 shows that the significant (2-tailed) value is 0.76 which was more than P ≤0.05. Therefore, there is no significant difference in the mean scores of male and female students. This implies that there is no significant difference in the mean perception score of male and female students taught genetics concepts using flipped classroom learning.

DISCUSSION

The result of Research Question 1 and Research Hypothesis 1 in Table 1 and 2 shows that, the means and standard deviations of experimental group were 85.84 and 9.44 and that of control group were 81.08 and 9.19 respectively. The mean difference in the mean perception scores was found to be 4.76 in favour of the experimental group. To find out if the difference is statistically significant, the corresponding hypothesis ($H0_1$) was therefore tested using Z-test. Z-test value is statistically significant and therefore the null hypothesis was rejected. This implies that there is significant difference in the mean perception scores of students taught genetics concepts using flipped classroom learning and lecture method. The finding is in line with that of Lee, Shin and Haa (2015) who revealed that perception of the concepts is one of the most important factors of students' understanding of scientific inquiry and the nature of science. On the other hand, the study is not in line with that of Achor and Agbidye (2014) who revealed that students‟ perception has no significant effect on the method used for teaching and their academic achievement.

The result of Research Question 2 and Research Hypothesis 2 in Table 3 and 4 shows that that there is no significant difference in the mean perception of male and female students taught genetics concepts using Flipped Classroom Learning. This implies that gender was not a determinant factor in Biology students' perception ratings in genetics concepts. The result of the means and standard deviations of male students in the experimental group were 85.61 and 9.18 and that of female students were 86.05 and 9.77 respectively. The mean difference

in the mean perception scores was found to be 0.44 in favour of female. This finding is in conformity with many findings reported by researchers such as Anidu and Udoh (2021) who revealed that there is no significant difference in the perception of male and female students on Biology topics in senior secondary school Biology curriculum. The finding is also supported by Achor and Agbidye (2014) who found that there is no significant difference in the mean scores of male and female students who perceived science concepts difficult and those who perceived it not difficult. The results showed that students exposed to flipped classroom instruction had better perception in genetics concepts and that gender has no significant influence on their perception. However, the influence of gender on the perception of Biology concepts was observed by Vlckova, Kubiatko and Usak (2019), the correlation among was analyzed and females had more positive attitudes toward Biology than males.

CONCLUSIONS

Based on the finding of this study, the research concludes that there is a positive perception among the Biology students who learned genetics concepts using Flipped Classroom Learning strategy. This implies that when Flipped Classroom Learning strategy is used to teach genetics it enhances the students' perception level. The research also concludes that there is no significant difference between the perception of male and female students who learnt genetic concepts by means of Flipped Classroom Learning strategy and lecture method.

RECOMMENDATIONS

Based on the findings from this study, the following recommendations are made:

1. Biology teachers should be encouraged by the school management to use Flipped Classroom Learning as the main teaching strategy in order to improve the perception of genetics concepts in senior secondary Biology.
2. Biology teachers should be trained by the Ministry of Education on effective procedures for implementing Flipped Classroom Learning strategy in their classrooms by organizing extensive seminars and workshops.
3. The Federal and State Government through Ministry of Education and other educational agencies should provide teachers with learning materials based on Flipped Classroom Learning strategy.

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