



Conceptual Change Model as a Catalysts for Intellectual Transformation of Biology Students Academic Achievement and Retention in Genetics concept Among Secondary Schools Students in Dawakin Kudu Zone, Kano State, Nigeria.

Auwalu Abdullahi Tijjani^{1*}, Aisha Muhammad Yakasai², Najib Usman³, Khadija Ado Saleh⁴ & Shamsudden Rabi⁵

^{1, 2 & 3}Department of Education, Federal University Dutse, Jigawa State

⁴ Department of Science and Technology Education, Bayero University, Kano

⁵ Department of General Studies, College of Health, Science and Technology, Jahun, Jigawa State.

ARTICLE HISTORY

RECEIVED

04-07-2026

ACCEPTED

09-07-2026

PUBLISHED

11-07-2026

Corresponding author:

Auwalu Abdullahi Tijjani

Department of Education, Federal University Dutse, Jigawa State.



Abstract

This study investigates the Effects of Conceptual Change Model Strategy on Academic Achievement and Retention of the Concepts of Genetics among Secondary School Students in Dawkins Kudu Zone, Kano state, Nigeria. Using quasi-experimental of the pretest-posttest and post post-test non-equivalent control group design. Data were collected from the population of 2,389 SS III students in the 12 public co-educational secondary schools in the area with 975 males and 1,432 females using Simple random sampling technique. Two objectives, two research questions and two null hypotheses guided the study. Genetics Achievements Test (GAT) was used for Data collection and it was validated by experts from science and technology education department from Bayero university kano. Pilot study was conducted using Test-retest method to ascertain the reliability coefficient of the instrument which yielded a reliability coefficient of 0.81 when analysed using Pearson Product Moment Correlation (PPMC). The instrument was found reliable for data collection. The data collected were analyzed using descriptive statistics (Mean and Standard Deviation) for the research questions and inferential statistics (One-Way Analysis of Covariance) for the null hypotheses at $p \leq .05$ significant level. The findings revealed that the experimental group, taught using Conceptual change model strategy, performed significantly better than the control group, which was taught using conventional methods. The study's major contribution to knowledge is that the strategy significantly improves students' academic achievement and retention. Hence, it was recommended that teachers should switch from conventional teaching methods to CCTS and should be retrained on the appropriate skills and models of the strategy to enhance students' academic achievement and retention.

Keywords: Conceptual Change Model, Academic Achievement, Retention, Genetics, Kano State

Introduction

Biology is a natural science subject that deals with the study of all aspect of living organism and how they came into existence and also ways they interact with one another and with their environment (Umar, 2014). Genetics is one of the concepts studied in biology, it is the study of heredity or inheritance. The study of genetics can be intellectually fascinating, but it also has a plenty of practical applications from the use of DNA to the discovery of new therapies for genetic diseases, a thorough understanding of human genome can have important in medical, social and legal impacts (Bridget, 2018).

Records from WAEC Chief Examiner (2015), show that students have difficulties in understanding some concepts in Biology such as Evolution, Cell physiology, Nervous and Endocrine systems, Advanced Ecology and Genetics. These concepts are taught at the senior secondary schools as well as at the university level, as such, understanding them early enough is of paramount importance to the learner. Usman (2014) opined that One of the reasons discovered for students poor performance in Biology and the Concept of Genetics in particular was the constant use of conventional teaching method which is teacher-cantered activity encouraging rote learning or memorization and not encouraging meaningful learning. Usman (2014) opined that One of the reasons discovered for students poor performance in Biology and the Concept of Genetics in particular was the constant use of conventional teaching method which is teacher-cantered activity encouraging rote learning or memorization and not encouraging meaningful learning.

Conceptual Change Model is the theoretical models that described learning as an active process in which learners become aware of and reason about conceptual relations, or as a process of conceptual refinement. Posner, Strike, Hewson, and Gertzog (1982) first proposed the model of conceptual change, then researchers developed teaching tools and strategies to be used in classes from this model. Conceptual change can be seen as the process of using strategies to bring children's thinking in line with that of scientists.

According to Lucy (2015), academic Achievement is a measure of what a person has accomplished after exposed to educational program. Fatokun, Egya and Uzoechi (2016) observed that the students' achievement is dependent on several factors among which are learning environment and instructional methods. Teachers with good teaching strategy challenge students to work at higher intellectual level and attain sound academic achievement and retention.

Okurumeh (2016) defines Retention as the amount of materials remembered over-times and it involves recognition and recall. Teachers could improve retention of concepts and information after teaching, by explicitly creating memorable events involving auditory or visual images and actively engaging the students during teaching and learning (Saeed, Shanka, Ali, Majoka & Muhammad, 2011).

Research Problems

Teaching biology as a subject in secondary schools is faced with many problems (Nsofor, 2010). This poor performance in Biology and genetics in particular has been attributed by inadequate curricular, topic difficulty, overloaded timetable and Inadequate teaching methods. However, the WAEC Chief Examiners' Reports (2015) reported that students also perform poorly in genetics concepts. Maigoro (2017) showed that, students have difficulties, misconceptions and confusion in Genetics Concepts which in turn affects their overall academic achievement in Biology. This reveal

that only very few candidates attempt questions under genetics while majority of the candidates do not even attempt such questions. The weakness of candidates in biology generally and genetics in particular was linked to the facts that candidates lacked basic concepts in genetics. They were not able to link biological concepts to real life.

Objective of the Study

However, the study specifically seek to

1. Determine the Effect of Conceptual Change model on Students' Academic Achievement in Genetics Concept.
2. Examine the Effect of Conceptual Change texts on Students' Retention in Genetics Concept.

Research Questions

Based on the objectives stated the following research questions are put forward:

1. What are the mean achievement scores of students in Genetics Concepts when taught using Conceptual Change Texts strategy and those taught using conventional method?
2. What is the difference between the Mean Retention Scores of Students taught Genetics Concepts using Conceptual Change Texts Strategy and those taught using Lecture Method?

Research Hypotheses

1. There is no significant difference in the mean achievement scores of students in Genetics Concepts when taught using Conceptual change Texts Strategy and those taught using Lecture Method.
2. There is no significant difference in the Mean Retention Scores of Science Secondary School Students in Genetics when taught using Conceptual Change Texts Strategy and those taught using Lecture Method.

Methodology

The design for this study was quasi-experimental research design, specifically, pre-test-post-test and post-test non-equivalent control group design. This design was adopted because it is not possible to have a complete randomization of the subjects. Thus, intact classes was used for both experimental and control groups, since it is not possible to disrupt existing classes in a school. The population of the study comprises of 2,389 SS III science students in public co-educational senior secondary schools in Dawakin Kudu Zone which comprises of 957 males and 1432 females. In selecting the sample, simple random sampling techniques was used to select two schools out of the twelve (12) co-educational Schools in Dawakin Kudu Zone, using balloting method. The Two Schools selected were randomly assigned in to experimental and control groups using random sampling technique. The Two sampled schools have two intact science classes; out of the two classes, one intact class from each schools was selected. The sample size of the study was 126 SS 3 Biology students which comprised of 65 males and 61 females. Genetics Achievement Test (GAT) was validated by two senior lecturers from Bayero University kano and one experienced biology teacher who have more than 10 years of teaching experience in senior secondary school in order to determine whether the items in the instrument will match the ability of the students to test what they are intended to test and weather the language used is clear, unambiguous and correct. The researcher pilot tested the instrument using a small sample group of 30 SS II students in a school which is part of the population but not included in the sample. The reliability was determined using test-retest method using Pearson Product

Moment Correlation (PPMC) as such the reliability index of GAT is 0.82. The hypotheses was tested using ANCOVA (One-Way Analysis of Covariance) at 0.05 level of significance.

Treatment for Experimental Group

The subjects in the experimental group was subjected to the learning activities based on conceptual change texts teaching strategy. There are five parts in the text and has been planned in accordance with the conditions of dissatisfaction, intelligibility, plausibility and fruitfulness in the conceptual change Model. These steps are:

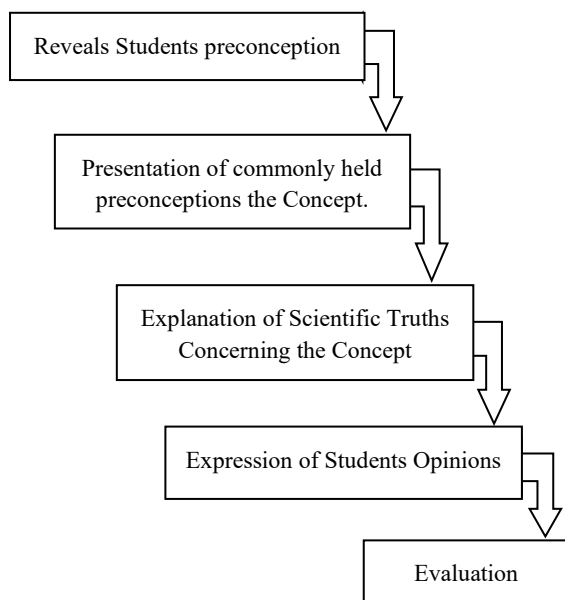


Figure 3.5: Flow Charts to represents steps in using Conceptual Change model Strategy.

Table 4.2: ANCOVA test for post-test mean achievement scores of the control and experimental groups.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1649.238 ^a	2	824.619	39.637	.000	.392
Intercept	724.594	1	724.594	34.829	.000	.221
Pretest	38.621	1	38.621	1.856	.176	.015
Group	1557.317	1	1557.317	74.856	.000	.378
Error	2558.896	123	20.804			
Total	69991.000	126				
Corrected Total	4208.135	125				

a. R Squared = .392 (Adjusted R Squared = .382)

Table 4.2 indicated the ANCOVA analyses for post-test mean achievement scores of control and experimental groups. The F calculated value variable (achievement) is 74.856 with the significant F at 0.000 which is less than the P-value 0.05. Therefore, the null hypothesis is hereby rejected because the observed p-value is less than the significant level p-value (0.05). Hence, there is significant difference in the mean achievement scores of students in Genetics Concepts when taught using Conceptual change Texts Strategy and those taught using conventional method. ($f\text{-cal} = 74.856$, $p=0.000<0.05$).

Research Question Two: Is there any difference between the mean retention scores of students taught Genetics Concepts using Conceptual Change Texts Strategy and those students taught using Lecture Method?

Analysis and Results

Research Question One: What are the mean achievement scores of students in Genetics Concepts when taught using Conceptual Change model strategy and those taught using Lecture method?

Table 4.1: Analysis of the Post-test scores Means and Standard Deviations of Experimental and Control Groups

Group	N	Pre-test score		Posttest		Mean Gain Score
		$\bar{x}$	Sd	$\bar{x}$	Sd	
Experimental	77	15.16	2.01	25.70	5.63	10.54
Control	49	14.82	2.07	18.37	1.95	3.55

Table 4.1 reveals that, the pretest and post-test scores mean and standard deviation of the experimental group are (15.16 & 2.01) and (25.70 & 5.63) respectively while those of control group are (14.82 & 2.07) and (18.37 & 1.95) respectively. This result clearly indicated that students taught using conceptual change texts teaching strategy have high mean gain scores than those taught using Lecture method. This indicated there is difference between the mean scores of experimental group exposed to conceptual change texts teaching strategy and the control group. However, the responses of students in control group ($SD=1.95$) were closely around the mean compare to responses of students in experimental group ($SD= 5.63$). This is because the standard deviation of the control group is lower than that of the experimental group

Hypotheses Testing

H₀₁: There is no significant difference in the mean achievement scores of students in Genetics Concepts when taught using Conceptual change model Strategy and those taught using Lecture Method.

Table 4.3: Analysis of the Post Post-test scores Means and Standard Deviations of both Experimental and Control Groups

Group	N	Pre-test score		Post Post-test		Mean Gain Score
		$\bar{x}$	Sd	$\bar{x}$	Sd	
Experimental	77	15.16	2.01	23.68	5.49	8.52
Control	49	14.82	2.07	16.08	1.86	1.26

Table 4.3 reveals that, the pre-test and post post-test scores mean and standard deviation of the experimental group are (15.16 & 2.01) and (23.68 & 5.49) respectively while those of control group are (14.82 & 2.07) and (16.08 & 1.86) respectively. This result clearly indicated that students taught using conceptual change texts teaching

strategy have high mean gain scores than those taught using Lecture Method at the post post-test stage. This indicated there is difference between the mean retention scores of experimental group exposed to conceptual change texts teaching strategy and the control group in respect to the experimental group. However, the responses of students in control group (SD=1.86) were closely around the mean compare to responses of students in experimental group (SD= 5.49).

H02: There is no significant difference in the mean retention scores of students when taught Genetics concepts using Conceptual Change Texts Strategy and those taught using Lecture Method.

Table 4.4: ANCOVA test for post post-test retention scores of the control and experimental groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1746.078 ^a	2	873.039	43.952	.000	.417
Intercept	649.235	1	649.235	32.685	.000	.210
Pretest	19.357	1	19.357	.974	.325	.008
Group	1683.678	1	1683.678	84.763	.000	.408
Error	2443.200	123	19.863			
Total	58295.000	126				
Corrected Total	4189.278	125				

a. R Squared = .417 (Adjusted R Squared = .407)

Table 2 indicated the ANCOVA analyses for post post-test mean retention scores of control and experimental groups, the F calculated value variable (achievement) is 84.763 with the significant F at 0.000 which is less than 0.05 therefore, the null hypothesis is hereby rejected because the observed p-value is less than the significant level p-value (0.05). Hence, there is significant difference in the mean retention scores of students when taught Genetics concepts using Conceptual Change Texts Strategy and those taught using Lecture Method. (f-cal = 84.763, p=0.000<0.05).

Research findings and Discussions

Major Findings

1. The mean academic achievement scores of students taught using conceptual change model strategy is significantly greater than the mean academic achievement scores of students taught using Lecture method.
2. The mean retention ability scores of students taught using conceptual change model strategy is significantly greater than the mean retention ability scores of students taught using Lecture method.

Discussions

The researched revealed that, there is significant difference in the academic achievement means scores of students taught using Conceptual Change model Strategy and those taught using lecture method. This implies that exposing students to conceptual change model as an instructional strategy helps them to understand and comprehend genetics concepts more easily than those exposed to lecture Method. This finding agreed with the earlier finding, (2019); Ekon & Edem (2018); Grace (2018); Cetin, Ertapinar & Gulcan (2015); whose studies were directly on Biology. Similarly, the finding is in line with the studies of Cayci (2018) who carried out a study on the Impacts of Conceptual Change Texts-based Teaching on Academic Achievements, Attitude and Self-efficacy. Similarly, the findings is in line with Yumusak, Maras and Sahin (2015) who in his study reported that most of the learners taught using conceptual change texts strategy where more successful in terms of improving students achievements. The findings of the research question two disclosed that students taught using Conceptual change

texts have higher retention ability in genetics concepts than those students taught using lecture method. This indicated that the positive effect of Conceptual change model strategy is not only on academic achievement of students but also on the retention ability of the students. Edoho, Asuquo, Anditung, and Abasi (2020) in line with this finding who found that conceptual change strategies found to have positive effects on students' retention and make learning to be permanents.

Conclusions

The following conclusions were drawn based on the findings of this study:

1. Conceptual change model strategy improves science secondary school students' academic achievement in learning Concepts of Genetics.
2. Conceptual change texts improves students' retention ability in learning Concepts of Genetics.

Recommendation

Based on the findings of this study, the following recommendations were made:

1. Secondary Schools biology teachers in Dawakin Kudu Educational Zone should exposed their students to conceptual change model, in order to improve the students' academic achievement.
2. For better performances in biology, Biology teachers should incorporate use of conceptual change model teaching strategy to complements their traditional teaching-learning approach.

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