

## Effects of Metaphor Instructional Strategy on Senior School Students Achievement in Genetics in Ilorin-Nigeria

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Genetics, the biology of heredity provides a unifying conceptual framework linking all the life sciences and has been identified as one of the difficult concepts in biology to teach and learn. The presence of terminologies with meanings different from common usage and the teaching strategies employed by teachers have been identified in the literature as influencing student performance. The study adopted a quasi-experimental design of pre-test, post-test and non-randomized control group. The study sample was 119 senior school students from two intact classrooms. Data were collected using the Genetic Achievement Test, and Group Embedded Figure Test. Data collected was analyzed using descriptive and inferential statistics, hypotheses were tested using ANCOVA at 0.05 level of significance. The results of the study revealed that students exposed to MIS performed better than their counterparts in the control group. It was also revealed that there was no significant difference between the results of the students according to their cognitive styles. Therefore, it was recommended that teachers could adopt the use of MIS in teaching genetics and other hard-to-teach biological concepts.

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**Keywords:** Metaphor, cognitive styles, students' achievement

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### INTRODUCTION

The importance of studying Biology to the survival of any nation cannot be overemphasised. But despite the numerous advantages students and mankind in general stand to gain from studying Biology, students are faced with many challenges. Some of these challenges are students-related (Etobro&Fabinu, 2017), teachers-related (Sakiyo & Waziri, 2015), and the content of the subject itself, which are not directly linked to societal and career needs of students (Olasehinde & Olatoye, 2014). Some other reasons adduced for students having difficulties in learning Biology concepts include the nature of the subject, methods adopted by teachers in teaching, and the abstract level of some concepts (Cimer, 2012) or concepts that are filled with vocabularies that are quite different or strange because they have most of their origin in Greek and Latin, for instance, Zygo – Join, Phago – Eat, Olig – Few, Locus – Place among others (Kratz, 2021). The list of abstract and important biological concepts identified to be hard-to-teach and hard-to-learn by teachers and students include: water transportation in plants, respiration, Mendelian genetics, central nervous system, genes and chromosomes, mitosis and meiosis, evolution, ecology, reproduction, enzyme structure and functions (Chima & Onyebuchi, 2011; Cimer, 2012), most of which are closely related to issues in genetics (Yu-Chien, 2008).

In the secondary school Biology curriculum, genetics plays an essential role in scientific advancement that affects the lives of human beings. Genetics as a branch of Biology deals with the study of inheritance and variation (Ramalingam, 2011). It is a branch that studies how genes are transferred from one generation to another or the transmission of biological traits from parents to offspring through the activities of the genes (Ambuno, Egunyomi & Osakwe, 2008; Alabi, 2016). Genetics as a branch of Biology tries to account for the similarities and variations among individuals by studying the process in which hereditary factors are transferred from parents to offspring. Genetics is a vital aspect of everyday life because of its importance in determining the true paternity of a child, blood transfusion, crime detection, improving farm produce yield, and tracing individuals' pedigree. Genetics 101 (2019) highlighted some of the importance of studying genetics to include; ability to explain why man is unique, look like other members of one's family and why some diseases run in one's family. Colia (2018) pointed out that the study of genetics has led to success in court cases with the use of DNA samples and is also responsible for the production of new therapies for genetic diseases.

The West African Examinations Council (2009, 2010, 2012, 2013, 2015) Chief Examiners' Report (CER) specifically reported that most Biology students did not attempt questions that are related to genetics, and that those who attempted it also performed very poorly. In the years 2010, 2012 and 2016, students were reported to have demonstrated poor knowledge of genetic crossing and did not understand that human sex determination is governed by the XX and XY chromosome pair; instead, they were using other alphabets like M for male and F for the female when answering questions related to genetics. WAEC CER (2015, 2017, 2018)

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reported that many candidates avoided questions relating to genetics and failed to include "X" as a sign for crossing between gametes. Because of these difficulties, there is the need to examine the approaches teachers utilise in teaching Biology in general and genetics specifically.

In selecting the appropriate teaching strategy to be used, the area that requires special emphasis centres on teachers realising that Biology education should be made practical and social (Green, 1996). This is going to make the class active and also prepare the learners to be physically and mentally alive in the class. The non-utilisation of proper teaching strategy in secondary schools and undergraduate introductory courses which could make the students active in class will only promote rote learning. Anthony (2018) opined that the lecture method of teaching is widely practised in Nigeria, and has been pin pointed as one of the underlying factors responsible for students' poor achievement in schools since it makes the learners passive. The use of the lecture method as a medium of instruction, although has its own advantages by ensuring high coverage of the syllabus and useful in introducing new topics, has often led to rote learning, rather than ensuring actual understanding of abstract science concepts.

Majority of classroom teachers employ lecture method instead of innovative teaching strategies by laying blame on the working environment and lengthy curricula (Mehmood & Zahoor-ur-Rehman, 2011). Thus, there is the need to critically examine the ways through which students could be taught genetics in a manner that will enhance meaningful learning. Some of the innovative strategies that have been used in teaching include the following among others: demo kits, analogies, metaphors and concept maps, jigsaws, wisely managed classroom technology, project-based learning, quick response codes, and inquiry-based learning (Davis, 2017). Science educators have often made use of metaphor in their teaching most especially when trying to answer questions by trying to relate what is common in the environment or concepts students are familiar with to explain concepts they are not familiar with. In this study, effort was made to consciously use metaphor instructional strategies and then compare its effects on teaching genetics among senior school students.

Metaphors evoke mental images that link past knowledge and experience to new knowledge, concepts or experiences and can be used to relate something unknown to something known (Aubusson, Harrison & Ritchie, 2006; Rundgren, Hirsch & Tibell, 2009). Metaphors often provide clues as to where inferences can be drawn. Happel (2002) asserted that metaphors have helped scientists gain new insights in scientific reasoning, formulate scientific terminologies, and develop teaching. A metaphor is made up of two components: the tenor (target) and the vehicle (source).

Metaphors abound in the daily communication of human beings and they are often used without the consciousness of their usage. Lakoff and Johnson (1980) stated that the conceptual system of humans play a widespread position in defining their everyday realities and most of the time, human beings are not privy to this conceptual system. They further observed that one way human beings use to assess their conceptual system is by taking a close look at the language of communication which is commonly filled with metaphors.

Lakoff and Johnson (1980) additionally submitted that metaphor is prevalent in everyday life including in thoughts and actions and it goes beyond being a literary device used only in languages; they are used by all categories of people including scientists, in justifying their research findings to their colleagues and other members of the scientific world. In the same vein, Awofodu (2016) asserted that individuals move about with a large array of concepts that govern their thought processes and everyday functioning that are better expressed through the use of conceptual metaphors. Metaphor is essential when learning abstract concepts that can only be learnt indirectly and its use has been widely practised in a variety of sciences since it has the tendency of reducing the risks of misunderstanding. Science is metaphoric in nature (Darmstadt, 2007) and utilises metaphors that have been drained of their poetic potentials (Rundgren, Hirsch & Tibell, 2009).

Several researchers have examined the efficacy of teaching with the use of metaphor instructional strategies. For instance Aje, Bello, Adeoye and Sulaiman (2021) examined the effects of teaching with metaphor on senior school students' achievement in cells in Ilorin, Nigeria. The study was a quasi-experimental research design of the 2x2x2 factorial design. The instruments adopted in the study were the Cell Achievement Test and Group Embedded Figure Test. Data gathered were analysed using the *t-test* and ANCOVA. Findings from the study revealed that students exposed to metaphor instructions achieved significantly better than their counterparts taught using the conventional method. It was recommended that teachers should utilise the use of metaphors in lesson delivery. Adesina (2019) in a separate study examined the effects of metaphor

instructions on senior school students' achievement and retention on cell. The study was quasi experimental in nature. Data were gathered using Cell Achievement Cell and data collected in the study were analysed using the t-test statistics at 0.05 level of significance. It was revealed from the study that senior school students taught cell and its components demonstrated better understanding and achieved better than students in the control group that were taught using the traditional teaching method. It was therefore, recommended that teachers and students should utilise the use of metaphors in bringing about conceptual change. Awofodu (2016) studied the effect of metaphor on senior school students' achievement in ecology. The study adopted the quasi-experimental design approach. Data was collected with the aid of Cognitive Achievement Test in Ecology and were analysed using Multivariate Analysis of Covariance. The researcher established that metaphor instructional strategy enhances students' cognitive achievement and practical skills in ecology and by implication could be adopted by biology teachers in lesson delivery.

Aside the teaching strategy employed by teachers in the classroom environment, the way students' processes information can also be a militating factor against students' achievement in Biology. In order for effective communication to take place between the teachers and the learners, the way learners reason, generate meaning and receive information in terms of their cognitive styles need to be examined. Ahmadzade and Shojae (2013) defined cognitive style as the process by which an individual receives and organises information. Several researchers such as Yunusa and Tukur (2013); Safyanu, Ado, and Olarinoye (2016) have documented the need to examine students' cognitive styles as a predictor of their academic achievement. Cognitive styles are consistent characteristics that induce a student's usual manner of understanding, remembering and problem-solving skills. Okoronka (2009) submitted that cognitive styles of students have a strong relationship with their achievement in sciences, and to a large extent, influence students' performance in sciences. Okoronka's view was corroborated by Aydin Ceran and Ates (2020) who averred that differences in cognitive styles of students are an effective factor in determining students' academic success.

Instructional design.org (2021) inferred that in literature, varieties of cognitive styles ranging from field independent-dependent, scanning, leveling vs sharpening, reflection vs impulsivity and conceptual differentiation have been investigated. Umar (2013) reported that there are different types of names used in studying cognitive styles in literature, among which are Visual/ Haptic, Imager/ Verbalizer, Leveling/ Sharpening, Serialist/Holist, and Field Dependent/Field Independent (FD/FI). This present research, however, made use of the field dependent and independent cognitive styles. The reason for the choice of the FD/FI is that it involves structuring a stimulus field and deals with high information load. A host of empirical studies have examined the influence of cognitive styles on students' achievement over the years.

Aydin Ceran and Ates (2020) examined the influence of students' cognitive styles on their conceptual understanding of the unit of force. The study was a casual-comparative study and the sample for the study was 80 seventh-grade students in a public school in Ankara, Turkey. Two instruments namely: Group Embedded Figure Test and Life Based Concept Test were used in gathering data. Data obtained were analysed using MANOVA, one-way ANOVA and *t-tests*. Result of the analysis revealed that there was a significant difference in the level of conceptual understanding of students based on their cognitive styles in favour of the students who had the field-independent cognitive styles. It was therefore, recommended that future researchers could carry out researches that deals with new generation science questions and different cognitive styles features.

Olanrewaju (2019) examined effects of video assisted instructional package on secondary schools students' achievement in photosynthesis in Omu-aran, Nigeria. The Study adopted a 2 x 2 x 2 quasi-experimental research design. The entire population for the study was all senior school students offering Biology in Omu-aran, Nigeria while the entire senior secondary school I students offering biology constituted the target population. A total of 118 senior school students (44 males and 74 females) served as sample for the study. Three research instruments namely: Photosynthesis Achievement Test (PAT), Cognitive Style Checklist (CSC) and Video Assisted Instructional Package in Photosynthesis (VAIP) were used for getting data. The finding from the study revealed that there was no significant difference in the achievement of field-dependent and field-independent students that were exposed to VAIP. The researcher therefore, recommended that teachers should adopt the use of VAIP in teaching other hard-to-teach Biology concepts.

In a separate study, Benard and Thaddeus (2019) investigated the effect of cognitive styles on students' achievement and retention in physics. The study adopted an ex-post facto research design. The population was made up of 1015 SS1 students from where a sample of 150 students was selected using simple random

sampling. Data were collected using Group Embedded Figure Test, Physics Achievement Test and Physics Retention Test. Findings from the study revealed that there was a significant difference in the achievement of field dependent and the field independent students in favour of the field independent groups.

### Research Questions

1. What is the difference in the achievement of senior school students exposed to genetics with the use of metaphor instructional strategy and those taught using the conventional teaching strategy
2. What is the difference in the achievement of field-dependent, field-neutral and field independent cognitive styles students taught genetics using metaphor instructional strategy
3. Is there any interaction effect between metaphor instructional strategy and cognitive styles on students achievement in genetics

### Research Hypotheses

**H<sub>01</sub>:** There is no statistically significant difference in the achievement of senior school students taught genetics using metaphor instructional strategy and those taught using the conventional teaching strategy

**H<sub>02</sub>:** There is no statistically significant difference in the achievements of field-dependent, field-neutral, and field-independent students taught genetics using metaphor.

**H<sub>03</sub>:** There is no statistically significant interaction effect of metaphor and cognitive styles on the achievement of students taught genetics

### RESEARCH DESIGN and METHOD

The study is quasi-experimental and adopted the non-randomised, pre-test, post-test, control group design of 2 x 3 factorial design. The two represents the two instructional strategies (MIS and Conventional Instructional Strategy), while the three represents the students cognitive styles at three levels (Field-dependent, Field-neutral and Field-independent cognitive styles). The population for the study was all senior school students offering biology in Ilorin, Nigeria while the target population was all senior school three students offering biology within the metropolis. The average age range of the sample students was between 15-18 years. The intact classes utilised in the study consists of both male and female students since the participating schools were mixed gender schools. A larger proportion of the students were Yoruba with small proportion of Hausa's and Nupe ethnic groups of Nigeria because Kwara State is one of the states in the Middle belt region of Nigeria and is a colony of different ethnic groups. Purposive sampling technique was employed in selecting the two participating schools, while simple random sampling technique was used in placing the schools into the experimental and control groups. After selecting the schools an intact class from each of the schools was picked for the study. The sample sizes were 62 and 57 for the experimental and control groups respectively.

Aside the stimulus instrument which was the teachers' instructional guide on metaphor teaching strategy, two response instruments namely the Genetic Achievement Test (GAT) and the Group Embedded Figure Test (GEFT) were utilised in gathering data for the research. The GAT was a 50 multiple choice test items with four options A-D which was prepared by the researcher in line with the revised version of the Bloom's taxonomy of educational objectives. The questions for the GAT were drawn from transmission and expression of characters in organisms, chromosomes, the basis of heredity and probability in genetics. The GEFT was a standardised test instrument developed by Witkin, Oltman, Raskin and Karp (1971). It was made up of three major sections and was used in classifying students into different cognitive styles. The original version of GEFT consisted of three sections. The first section consisted of the bio-data of respondents, while the second and third parts were made up of an example and 20 embedded figure items respectively. This instrument was adapted to include name of schools, while the figures originally placed at the back of the instruments are moved to the front part such that the students could easily look at the shapes and locate them accordingly in the figures provided.

The reliability of the response instruments were ensured by administering the instruments to 30 students who shared similar characteristics with the respondents by conducting a trial test using the test-retest method within a period of two weeks interval. The reliability indices of the GAT and GEFT were 0.78 and 0.81 respectively.

### Research Ethics

In this study, copies of informed consent forms that contained detailed information about the research were given to the students to take home for their parents to indicate their willingness to allow their wards to

take part in the research. All the participants that participated in the study were assured that all information provided shall be treated with utmost confidentiality. All other ethical issues such as: anonymity, confidentiality, risks, benefits and rights of volunteers were carefully spelt out for the participants. Furthermore, the personalities of the participants were not disclosed at any stage of the research. The researchers also informed the participants that the lessons would take place inside their classrooms at the particular time it was scheduled to hold in the school time table. Consequently, no risk was envisaged on their personality during the course of the study since they were most likely to benefit more in terms of obtaining good grades in Biology in WASSCE and any other public examination required for admission into higher institutions of learning. The researchers ensured that all studies cited were referenced, paraphrased as much as possible and also subjected to plagiarism test to ensure a high level of originality of the article.

**Data Analysis**

Data collected during the course of the research were analysed using both descriptive inferential statistics. The research questions were answered using mean and standard deviation, while the hypotheses were tested using ANCOVA at 0.5 level of significance

**RESULTS**

Results are considered to be an integral section in any research, hence the research findings based on data analysis are presented below.

**Research Question 1**

Is there any difference in the achievement of senior secondary school Biology students in genetics when taught using metaphor and conventional instructional strategies?

Table 1 shows the mean gain scores of students in each of the groups that participated in the study. The mean gain score of students that were taught genetics with the use of metaphor was 8.29, while the students taught with the conventional instructional strategy had a mean gain score of 4.21. This result suggests that metaphor enhanced the achievement of students in genetics than the conventional method of teaching.

**Table 1: Mean Gain Scores of Students’ Achievements for Both Experimental and Control Groups**

Group	Group Statistics	Pretest	Posttest	Mean gain Scores	Difference
Metaphor	N	62	62		
	Mean	29.48	37.77	8.29	
	Std Dev.	6.43	7.82		
Control	N	57	57		4.08
	Mean	26.91	31.12	4.21	
	Std Dev.	7.40	7.82		

**Hypothesis 1:** There is no statistically significant difference in the achievement of senior school students taught genetics using metaphor instructional strategy and those taught using the conventional teaching strategy.

The ANCOVA test output in Table 2 reveals that there was a statistically significant difference in the achievement of students in taught genetics with the use of metaphor and those exposed to conventional method,  $F_{(1,118)} = 16.80, p < .00$ . Hence, hypothesis 1 was rejected which implies that there is a statistically significant difference in the effects metaphor and conventional instructional strategy on the achievement of senior school students in genetics.

**Table 2: Summary of Analysis of Covariance (ANCOVA) of Mean Scores of Students Taught Genetics with Metaphor and Conventional Method**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	
Corrected Model	4222.620 <sup>a</sup>	2	2111.310	53.423	.000	.479
Intercept	3802.815	1	3802.815	96.224	.000	.453
Pretest	2903.181	1	2903.181	73.460	.000	.388
Treatment	664.099	1	664.099	16.804	.000	.127
Error	4584.371	116	39.520			
Total	243612.000	119				
Corrected Total	8806.992	118				

*P* < 0.05

Further analysis was carried out to identify the direction of the significant difference in the students' achievement by making use of Bonferroni post hoc analysis. The result of the analysis presented in Table 3 reveals that the students exposed to the use of metaphor, with the highest mean score accounted for the significant difference. The mean gain difference between the metaphor group and the conventional group was 4.81. This result, thus, indicated that Metaphor Instructional strategy improved students' achievement in genetics more than the conventional method.

**Table 3: Bonferroni Post Hoc Analysis Showing the Source of the Significant Difference in the Achievement of Students in the Metaphor and Conventional Instructional Strategies**

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>	95% Confidence Interval for Difference <sup>b</sup>	
					Lower Bound	Upper Bound
Metaphor Group	Conventional	4.81	1.17	.00	2.49	7.14
Conventional	Metaphor	-4.81*	1.17	.00	-7.14	-2.49

Based on estimated marginal means

\*. The mean difference is significant at the .05 level

**Research Question 2**

Is there any difference in the achievement of field-dependent, field-neutral and field-independent students' taught genetics using metaphor?

The mean gain score of field-dependent, field-neutral and field-independent students exposed to metaphor instructional strategy is as shown in Table 4. The field-dependent students recorded the highest mean gain score (20.40), followed by the field-neutral (16.55) and lastly the field-independent students with a mean gain score of 10.66. The difference between the mean gain score of the field-dependent and field-neutral students was 3.85, while the mean gain difference between the field-neutral and field-independent students taught genetics using metaphor was 5.89. This suggests that the field-dependent students benefitted most from the use of metaphor instructional strategy while the field-independent students had the least gain.

**Table 4: Mean Gain Scores of Field-Dependent, Field-Neutral and Field-Independent Students taught Genetics using Metaphor Instructional Strategy**

Group	Group Statistics	Pretest	Posttest	Mean gain Scores	Difference
Field Dependent	N	54	54		
	Mean	29.00	47.37	20.40	
	Std Dev.	6.42	7.91		3.85
Field Neutral	N	6	6		
	Mean	32.33	47.67	16.55	
	Std Dev.	4.63	9.07		
Field Independent	N	2	2		
	Mean	34.00	54.00	10.66	
	Std Dev.	11.31	2.83		5.89

**H02:** There is no statistically significant difference in the achievements of field-dependent, field-neutral and field-independent senior school students taught genetics using metaphor

The one-way ANCOVA test output in Table 5 reveals that when  $F_{(2,58)} = .45$ ,  $p = .64$ . Hence, the null hypothesis which states that there is no statistically significant difference in the achievement of students taught genetics with the use of metaphor instructional strategy based on their cognitive styles, was not rejected. This implies that a statistically significant difference does not exist in the achievement of field-dependent, field-neutral and field-independent students taught genetics with the use of metaphor instructional strategy.

**Table 5: Summary of Analysis of Covariance (ANCOVA) of Mean Scores of Field-Dependent, Field-Neutral and Field-Independent Students Taught Genetics with Metaphor**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	$\eta^2$	$p^2$
Corrected Model	1038.87 <sup>a</sup>	3	346.29	7.22	.00		.27
Intercept	1787.85	1	1787.85	37.25	.00		.39
MetaphorPre	954.09	1	954.09	19.88	.00		.26
MetaphorScore	43.50	2	21.75	.45	.64		.02
Error	2783.84	58	48.00				
Total	144376.00	62					
Corrected Total	3822.710	61					

a. R Squared = .272 (Adjusted R Squared = .234)

**H03:** There is no statistically significant interaction effect of metaphor and cognitive styles on senior school students' achievement in genetics

Table 6 reveals the F-value 0.45 with a p-value of 0.638 when computed at 0.05 alpha level. Since the p-value (0.638) obtained is greater than alpha level (0.05), the null hypothesis three is not rejected. Thus, there was no statistically significant interaction effects of metaphor and cognitive styles on the achievement of students taught Genetics ( $F_{(2,58)} = 0.453$ ,  $p > 0.05$ ). This implies that the use of metaphor does segregate amidst students of varying cognitive styles.

**Table 5: Analysis of Covariance showing the Interaction Effects of Metaphor and Cognitive Styles on the Achievement of Students taught Genetics**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1038.872 <sup>a</sup>	3	346.29	7.22	.000
Intercept	1787.851	1	1787.85	37.25	.000
Pretest	954.088	1	954.090	19.88	.000
CogStyles	43.497	2	21.75	.45	.638
Error	2783.838	58	47.99		
Total	144376.000	62			
Corrected Total	3822.710	61			

a. R Squared = .272 (Adjusted R Squared = .234)

## Discussion

This study investigated the effect of the use of metaphor instructional strategy on senior school students' achievement in genetics. The finding from the study revealed that students that were exposed to metaphor instructional strategy achieved significantly better than their counterpart that were taught using the conventional teaching strategy. This result could be attributed to the fact that students that were exposed to metaphor instructional strategy were able to relate better the abstract genetic concepts with what they are familiar with, hence, performed significantly better than students taught using the conventional teaching approach. The implication of this is that metaphor instructional strategy can be employed by Biology teachers to teach genetics and other hard-to-teach concepts in Biology. The finding is in line with those of Adesina (2019) who examined the effect of metaphor instructional strategy on students' performance in cell Biology and reported that the use of metaphor enhances students' performance in cell Biology. The finding is also similar to those of Aje, Bello, Adeoye and Sulaiman (2021) who also reported that the use of metaphor instructional strategy improves students' performance significantly in cell Biology. In similar vein, the result is in line with the findings of Awofodu (2016) who observed that metaphor instructional strategy enhances students' achievement in ecology better than the conventional method of instruction. The finding is also similar to those of Tsipi (2016) who observed that students exposed to metaphors of the categorisation A is B in which the comparison is covert, achieved significantly better than their counterparts exposed to metaphors of the categorisation A is like B.

Another finding from the study revealed that the Achievement of field-dependent, field-neutral and field-independent students that were exposed to metaphor was also found not to be statistically significant. One plausible reason for this finding might not be unconnected with the fact that metaphor allows students to think critically and also assist students to form mental images of abstract genetics concepts. This implies that field-dependent, field-neutral and field-independent students all benefitted from the use of metaphor instructional strategy, and as such, the strategy can be used in mixed class that consists of students with different cognitive styles. The finding of this study is in line with those of Okoronka and Wada (2014) who observed that there was no significant difference in the achievement of field-dependent and field-independent students that were taught basic Physics concept using analogy. The result, however, is contrary to those of Ashiru and Sadiq (2016) who reported that there was a significant difference in the achievement of field-dependent and field-independent students taught abstract Biology concept.

Further finding from the study revealed that the cognitive styles of the students and the metaphor instructional strategy does not have a joint effect on the achievement of the senior school students in genetics. One possible reason for this finding may be due to the fact that the students were able to personalize their learning by using what they are familiar with to figure out abstract genetic concepts. The implication of this finding is that the instructional strategy can be utilised in a mixed cognitive style classroom effectively since the possibility of the two variables having a joint effect will need further tests to be affirmed. This finding is similar to those of Abdulrahim (2018) who affirmed that there was no significant interaction effect between treatment and cognitive styles. The finding is however contrary to those of Sudarman, Kuswandi and Dwiyoogo (2016) who reported in their study that there was significant interaction between treatment and cognitive styles on students' learning outcomes.

## Conclusion and Implications

The study focuses on assessing the effects of use of metaphor instructions on senior school students' achievement in genetics. The study concluded that metaphor instructional strategy is an effective strategy that could be employed by teachers for teaching genetics. This is because the findings of the study revealed that students taught genetics using metaphor instructional strategies achieved significantly better than students exposed to the conventional method of teaching. It was also concluded that cognitive style of the students does not have significant effect on the achievement of students since all the students irrespective of their cognitive style benefitted immensely from the teachers' use of metaphor instructional strategy. Based on the data analysed, it was concluded that there was no joint effect between students cognitive styles and metaphor instructional strategy on students achievement in genetics.

The main limitation of this study was that it adopted a quasi-experimental approach and as such intact classes were utilised and the data collected were purely quantitative data. Future researchers can utilise mixed method approach, that would allow for the collection of both quantitative and qualitative data

respectively. The second major constraint of this study was that the concept taught was genetics (Biology of heredity) and as such limits the researcher to only the Senior School III students because Biology of heredity is one of the major topics that was expected to be taught.

Despite the limitations highlighted, the research is still of great significance because it showed the efficacy of metaphor instructional strategy in evoking conceptual change and also enhancing students' achievement in genetics. Similar studies could be replicated by future researchers using other hard-to-learn and hard-to-teach biological concepts. Textbook authors can also start incorporating metaphors in their textbooks as it could afford the students the opportunity of relating what they are familiar with to the abstract biological concepts they are not familiar with. Curriculum planners can also start listing use of figures-of-comparison as a unique instructional strategy teachers can utilise in their classrooms in making difficult concepts more easier to comprehend by the students.

## Recommendations

The following recommendations were considered appropriate based on the conclusions of this study:

1. Metaphor instructional strategy should be utilised by teachers and students to enhance effective teaching and learning of genetics and other biology concepts since it is a potent tool that can easily bring about conceptual change among the learners.
2. Teachers should adopt the use of metaphor instructional strategy in their teaching so as to cater for the diverse ways through which students' process information based on their cognitive styles.

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