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Effects of Scaffolding Instructional Strategy and Cognitive Learning Styles on Students' Achievement in Genetics in South Senatorial District, Sokoto State, Nigeria

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ABSTRACT
This study compared the Effects of Scaffolding Instructional Strategy, Cognitive Learning Styles and Intelligence on Students' Achievement in Genetics in South Senatorial District, Sokoto State, Nigeria. Quasi-experimental, non-equivalent pretest and post-test control group design was employed for the study. The population of the study comprised 5,207 SS1 students in public coeducational schools in South Senatorial District, Sokoto State, Nigeria. The sample of the study comprised 125 SS 1 students from two intact classes randomly selected from public coeducational science secondary schools in Sokoto State, Nigeria. Two instruments were employed for data collection, namely; Students' Cognitive Learning Style Questionnaire (SCSQ) and Genetics Achievement Test (GAT). The reliability of SCSQ was determined using Cronbach Alpha and the coefficient obtained was 0.77 and the reliability of GAT was determined using Kuder-Richardson formula 21 (KR_{21}) and this yielded a reliability coefficient of 0.79. Mean and Standard Deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance. The findings of this study revealed that Scaffolding Instructional Strategy is more effective than Conventional Method. Also, the findings revealed that students taught Genetics concept using Scaffolding Instructional Strategy in the Field Independence (FI) group achieved better than Field Dependence (FD) group. Based on the findings of the study it was recommended that scaffolding instructional strategy should be used by Biology teachers in teaching Genetics.
Keywords: Achievement, Cognitive Style, Genetics, Scaffolding Instructional Strategy

INTRODUCTION

Genetics is the study of heredity and variation in living organisms. The passing on and expression of traits or characters from parents to offspring is termed heredity or inheritance. Heredity or inheritance may give rise to differences among individual organisms, this is term hereditary variations (Latta, 2010; Mader, Umeh, 2011; Nworgu, 2012; Tian, 2014 and Bayers, 2015). The genetical knowledge acquired by man enable him to embark on series of technologies for his utilization such as the selection of different strains of plants or animal species for the purpose of cross breeding to improve the structure, function, or yield of organism for economic importance to human life. The knowledge has enabled geneticists to determine blood groups paternity there by leading to counselling of patient, finger prints detection often used in crime detection, production of test tube baby, rhesus factors in sex determination, drugs and medical preparations obtained from animal tissues and other organic sources for human utilization. It has also enabled geneticist to discovered diabetes, sickle cell anemia, human DNA, blood group of individual donors and recipients using genetics crossing and agglutination or blood transfusion in human beings (Mader, Umeh, 2011; Simon, 2015 & Mader, 2016).

The problems associated with low achievement in genetics are students' lack of interest and inability to retain most genetics concepts learnt, as identified by (Nworgu, 2012; Stephen, 2014) which according to them, can be traced to both teachers and students related problems. Studies revealed that low achievement in genetics has been attributed to attitudinal problem of students, superstitions belief, cognitive and socio-economic problem of teachers, administrative policy makers and instructional strategy among others (NECO, 2018; Stephen, 2014).

Scaffolding is an instructional strategy that emphasizes the teaching of new skills by engaging students collaboratively in tasks that would be too difficult for them to complete on their own. The teaching strategy emphasizes on the role of teachers and other more skillful persons in supporting the learner's development and providing support structures to get to that next stage or level (Nonye & Nwosu, 2011). The instructional strategy originated from Lev Vygotsky socio-culture theory and his concept of Zone of Proximal Development (ZPD). His socio-cultural theory spelt out that social interaction plays an important role in the development of cognition. In his view, the learner does not learn in isolation, rather learning is strongly influenced by social interactions, which take place in meaningful contexts.

Scaffolding as an instructional strategy depends heavily on the ideas that learners come to any educational setting with a great deal of pre-existing knowledge, some of which may be incorrect. It is the process of building on what a learner already knows that makes scaffolding an effective instructional technique. According to Olson and Prath (2000) and Casem (2013), in scaffolding instruction, a more knowledgeable person provides scaffolds to facilitate the learner's development. These can be in the form of support which may include resources, a compelling task, templates, and guides, guidance on the development of cognitive and social skills. The scaffolds facilitate a students' ability to build on prior knowledge and internalize new information. The activities provided in scaffolding instruction are just beyond the level of what the learner can do alone. An important aspect of scaffolding is that the scaffolds are temporary. Ibritam, Udofia, and Onweh (2015) asserted that as the learners' abilities increases, the scaffolding provided by the more knowledgeable person is progressively withdrawn. Finally, the learner is able to complete the task or master the concept independently.

Cognitive learning style is a psychological construct which is concerned with how an individual learns, thinks, solve problems, remembers and relates to others. It represents the individual differences in the various subcomponents of an information-processing model of three main cognitive processes: perception, memory and thought. Cognitive learning style is considered to be personality dimension that influences attitudes, values and social interaction. It is an individual characteristic mode of perceiving and processing information in the environment (Hall, 2000). An individual is either Field-independent (FI) or Field-dependent (FD). A Field-independent (FI) cognitive learning style learner is described as analytic, competitive, individualistic, task-oriented, internally referent, intrinsically motivated (self-study), self-structuring, detail oriented and visually perceptive, prefers individual project work and has poor social skills; while Field-dependent (FD) cognitive learner is described as global (wholistic), group-oriented, sensitive to social interactions and criticisms, externally motivated, externally referential, not visually perceptive, a non-verbal and passive learner who prefers external information and group projects (Hall, 2000; Calcaterra, Antonetti & Underwood, 2005; Guisande, Paramo, Tinajero & Almedida, 2007).

Cognitive process styles affect how one stores knowledge and retrieves it when the need arises (Tinajero & Paramo, 2000). The students' cognitive styles may hinder or facilitate the acquisition of knowledge in Science, Technology and Mathematics (Okwo & Otuba, 2007). The achievement of students with different cognitive learning styles in a given task will determine how effective the teacher is in delivering instruction that are related to the tasks and whether the objectives of the learning is achieved.

Literature Review

Casem (2013) studied the effects of scaffolding strategy on students' performance in Mathematics. The study revealed that the students taught mathematics concepts through scaffolding performed better than those taught through lecture method. Equally, Olatubosun (2013) investigated the effects of using scaffolding strategy on the academic achievement of

students in integrated science in Junior secondary school (JSS). Results showed that students exposed to scaffolding strategy performed significantly better than their counterparts who were exposed to the traditional method. Akani (2015) conducted research on the effects of instructional scaffolding on the achievement of senior secondary students in Chemistry. The result obtained revealed that there is a significant difference in the mean score of students exposed to scaffolding instructional strategy and conventional method of instruction.

Ibritam, Udofia, and Onweh (2015) conducted a study to determine the difference in students' achievement in Block-laying and concreting using Scaffolding and Demonstration instructional methods in technical colleges. The result showed that there is no significant difference in the mean achievement scores of the students taught using scaffolding instructional strategy and those taught using instructional demonstration method. Uduafemhe (2015) undertook a study to determine the comparative effects of scaffolding and collaborative instructional approach on secondary school students' psychomotor achievement in Basic Electronics. Findings revealed that instructional scaffolding and collaborative instructional approaches are effective in improving students' achievement in Basic Electronics. However, the collaborative instructional approach was more effective than instructional scaffolding strategy. Adamu (2017) studied the effects of Analogy and scaffolding instructional strategies on senior secondary school Physics students' academic achievement. The two experimental groups were taught using Analogy and Scaffolding instructional strategies while the control group was taught using the lecture method. The finding of the study showed that there is a significant effect of treatment on students' academic achievement.

Atsumbe, Owodunni, Raymond and Uduafemhe (2018) carried out a study to determine the effects of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics. Results revealed that a collaborative instructional approach is more effective in improving student achievement in Basic Electronics than a scaffolding instructional approach. Also, gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches. It was concluded that the collaborative instructional approach is a viable teaching method for improving students' achievement in Basic Electronics. Joda (2019) carried out a study to determine the effect of instructional scaffolding strategy on senior secondary school Biology Students' academic achievement and retention of concepts. The findings show that the students taught with instructional scaffolding strategy have significantly higher academic achievement than those taught with lecture method. Pandhu (2018) investigated the effect of Instruction with Scaffolding on achievement in Science in relation to cognitive styles and intelligence. The results revealed that, the achievement of the group through scaffolding instructional strategy was found to be significantly higher than the group taught through traditional method of teaching; the difference of achievement was not significant at two levels of cognitive styles and that the achievement gain score of high intelligence group were significantly higher in comparison to low intelligence group.

Studies by Bassey, Umoren and Udida, (2013); Agboghoroma, (2015); Okoye, (2016); Owoduni, Sanni, Nwokolo and Igwe, (2016); Ezeugwu, Nji, Anyaugbunam, Enyi and Eneja, (2016); Idika, (2017); Musa and Samuel, (2019); Samuel and Musa (2019) and Agu and Samuel (2019) in their various researches reported that there is a difference between the mean achievement of Science and Mathematics students with analytical (FI) cognitive styles and those with relational and inferential (FD) cognitive styles while Ndirika (2013), opined that ability levels have no significant effect on the achievement of students. Also, Okereke (2011), Anidoh and Eze (2014) reported that cognitive styles and gender have influence of students' achievement. Panhdu (2018) investigated the effect of instruction with scaffolding on school students'achievement in science in relation to cognitive styles and intelligence, the result revealed that cognitive styles and intelligence affect students' achievement. Nevertheless, there is no specific study on Effects of Scaffolding Instructional Strategy and Cognitive Learning Styles on Students' Achievement in Genetics in South Senatorial District, Sokoto State, Nigeria, hence the need for this study.

Finding strategies to maintain students' achievement and retention in learning genetics and improving their problem solving skills is important for national development. So far, the instructional strategies employed in teaching genetics have not improved students' achievement and motivation in the subject to a considerable extent. As a result, developing

better strategies of teaching genetics has become one of the core issues that scholars deal with in Biology education.

Objectives of the Study

The purpose of this study was to investigate the effect of Scaffolding Instructional Strategy on students' cognitive learning styles and achievement in Genetics in Sokoto State, Nigeria. Specifically, the study sought to:

1. determine the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy and conventional method.
2. determine the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy and conventional method.

Research Questions

1. What are the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy and conventional method?
2. What are the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy and conventional method?

Hypotheses

H_{O1}: There is no significance difference between the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy with those taught using conventional method.

H_{O2}: There is no significance difference between the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy with those taught using conventional method.

METHODOLOGY

Quasi-experimental, non-equivalent pretest and post-test control group design was employed for the study. The population of the study comprised 5,207 SS1 students in public coeducational schools in South Senatorial District, Sokoto State, Nigeria. The sample of the study comprised 125 SS 1 students from two intact classes randomly selected from public coeducational science secondary schools in Sokoto State, Nigeria. The experimental group I (n=60 (FI=28, FD=32)) and control group (n=65 (FI=28, FD=37)) were taught using Scaffolding Instructional Strategy instructional strategy and conventional method respectively for six weeks. Students' Cognitive Learning Style Questionnaire (SCSQ) and Genetics Achievement Test (GAT) were used as instruments for data collection. The Students' Cognitive Learning Style Questionnaire (SCSC) was adapted from Robert Wyss (2002) Cognitive Style Checklist, it consists of 18 simple statements SCSQ is a rated using a four-point Likert scale. The options are; Strongly agreed (SA) = 4 points, Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagreed (SD) = 1 point. The questionnaire was used to categorize students based on their cognitive styles. Those who will score 1-36 will be categorized as field dependent and those who will score 37-72 will be categorized as field independent. GAT consisted of 30 multiple choice achievement test items with 4-options A-D designed to measure students' achievement. The instrument was subjected to content and face validity by two experts in Usman Fodio University, Sokoto and one from Nasarawa State University, Keffi. The reliability of SCSQ was determined using Cronbach Alpha and the coefficient obtained was 0.77 and the reliability of GAT was determined using Kuder-Richardson formula 21 (KR_{21}) and this yielded a reliability coefficient of 0.79.

Experimental Procedure

During the first week of the experiment, the students were divided into Field independent (FI) and Field dependent (FD) using SCSQ thereafter, a pretest was administered. The treatment lasted for six weeks. The control group was taught using the conventional method. The last one week was used for the administration of posttest after treatment using GAT. This made a total of eight weeks.

DATA ANALYSIS/RESULTS

Mean and Standard Deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance.

Research Question One

What are the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy and conventional method?

Table 1. Mean Scores and Standard Deviations of Field Independent Students taught Genetics using Scaffolding Instructional Strategy and Conventional Method

Field Independent		Pre-test	Post-test	Mean Difference
SIS	Mean	10.93	15.43	4.50
	N	28	28	
	Std. Deviation	2.071	2.080	
CM	Mean	10.50	11.11	0.61
	N	28	28	
	Std. Deviation	1.139	1.449	

Table 1 reveals that for the field independent students taught Genetics using the field trip, the mean score for the pre-test is 10.93 and for the post-test is 15.43 with a mean difference of 4.50 and for the field independent students taught Genetics in the conventional method, the mean score for the pre-test is 10.50 and for the post-test is 11.11 with a mean difference of 0.61.

Hypothesis One

There is no significance difference between the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy with those taught using conventional method.

The data to test this hypothesis is presented in Table 2.

Table 2. ANCOVA Result of Field Independent Students taught Genetics using Scaffolding Instructional Strategy and Conventional Method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	261.637	2	130.818	39.997	.000
Intercept	213.253	1	213.253	65.202	.000
Pretest	.190	1	.190	.058	.810
FIinSISnCM	255.257	1	255.257	78.044	.000
Error	173.345	53	3.271		
Total	10293.000	56			
Corrected Total	434.982	55			

Table 2 reveals a significant difference in the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy and conventional method. F = ratio of 78.044 was obtained with associated exact probability value of 0.000 ($F = 78.044$; $P = 0.000 < \alpha = 0.05$). Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the Scaffolding Instructional Strategy group produced a significant effect on the post-test achievement scores of students when covariate effect (pre-test) was controlled. This indicates that there was a significant difference in the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy and conventional method. This indicates that there was a significant difference in the mean achievement scores of field independent students taught Genetics using Scaffolding Instructional Strategy and conventional method in favour of the Scaffolding Instructional Strategy group.

Research Question Two

What are the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy and conventional method?

Table 3. Mean Scores and Standard Deviations of Field Dependent Students taught Genetics using Scaffolding Instructional Strategy and Conventional Method

Field Dependent		Pre-test	Post-test	Mean Difference
SIS	Mean	10.91	13.03	2.12
	N	32	32	
	Std. Deviation	2.176	1.379	
CM	Mean	10.59	11.27	0.68
	N	37	37	
	Std. Deviation	1.066	1.347	

Table 3 reveals that for the field dependent students taught Genetics using the Scaffolding Strategy, the mean score for the pre-test is 10.91 and for the post-test is 13.03 with a mean difference of 2.12 and for the field dependent students taught Genetics in the conventional method, the mean score for the pre-test is 10.59 and for the post-test is 11.27 with a mean difference of 0.68.

Hypothesis Two

There is no significance difference between the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy with those taught using conventional method. The data to test this hypothesis is presented in Table 4.

Table 4. ANCOVA Result of Field Dependent Students taught Genetics using Scaffolding Instructional Strategy and Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	56.856	2	28.428	15.555	.000
Intercept	179.983	1	179.983	98.480	.000
Pretest	3.644	1	3.644	1.994	.163
FDinSISnCM	50.174	1	50.174	27.453	.000
Error	120.622	66	1.828		
Total	10258.000	69			
Corrected Total	177.478	68			

Table 4 reveals a significant difference in the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy and conventional method. F = ratio of 27.453 was obtained with associated exact probability value of 0.000 ($F = 27.453$; $P = 0.000 < \alpha = 0.05$). Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the Scaffolding Instructional Strategy group produced a significant effect on the post-test achievement scores of students when covariate effect (pre-test) was controlled. This indicates that there was a significant difference in the mean achievement scores of field dependent students taught Genetics using Scaffolding Instructional Strategy and conventional method. This indicates that there was a significant difference in the mean achievement scores of field dependent students taught Genetics using Scaffolding strategy and conventional method in favour of the Scaffolding strategy group.

DISCUSSION OF FINDINGS

The findings of this study revealed that the achievement of the group through scaffolding instructional strategy was found to be significantly higher than the group taught through conventional method of teaching. This finding is in agreement with the findings of Joda (2019);

Panhdu (2018); Ibritam, Udofia, and Onweh (2015); Casem (2013); Olatubosun (2013); Akani (2015); Uduafemhe (2015) and Adamu (2017) who in their different researches asserted that instructional scaffolding strategy has a better effect on academic achievement.

The findings of this study reveals a significant difference in the mean achievement scores of field independent and field dependent students taught Genetics using Scaffolding Instructional Strategy and conventional method in favour of the Scaffolding Instructional Strategy group and on field independent students. This is in agreement with findings of Samuel and Musa (2019), Musa and Samuel (2019), Agu and Samuel (2019), Idika (2017) Okoye (2016) Agboghoroma (2015) Owoduni, Sanni, Nwokolo and Igwe (2016) Ezeugwu, Nji, Anyaugbunam, Enyi & Eneja (2016), Musya (2015), Bassey, Umoren and Udida (2013), and Okereke (2011) who reported that there is a difference between the mean achievement of students with analytical (FI) cognitive styles and those with relational and inferential (FD) cognitive styles in Science and other related subjects. But in contrast with the findings of Okoye (2016) who in their different researches reported that cognitive styles are not affected by intelligence and that Field Dependence/Independence focuses on the process of learning rather than ability.

The reason for better achievement experienced by the treatment groups could be because the students were captivated, more focused, attentive and interested in what they were doing. This no doubt offered slow learners opportunity to catch up with the fast learners. Basic Science students' achievement could greatly improve if they are allowed to take charge of their learning. Interaction among the students provides a better opportunity to develop cognition. This is in agreement with Kolb's experiential learning theory which states that knowledge is created through the transformation of experience resulting from the combinations of grasping and transforming the experience. It is also in conformity with field dependence/ field independence theory of Witkin, Moore, Goodenough and Cox (1977) who opined that learner's perception or comprehension of information is affected by the surrounding environment

CONCLUSION

The findings of this study have shown that Scaffolding Instructional Strategy is more effective than Conventional Method. Also, the findings revealed that students taught Genetics concept using Scaffolding Instructional Strategy in the Field Independence (FI) group achieved better than Field Dependence (FD) group.

RECOMMENDATION

Based on the findings of the study it was recommended that:

1. Scaffolding instructional strategy should be used by Biology teachers in teaching Genetics.

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