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INFLUENCE OF COGNITIVE STYLES ON STUDENTS' ACHIEVEMENTS IN BIOLOGY IN SENIOR SECONDARY SCHOOLS IN ANAMBRA STATE

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Abstract

The study investigated the influence of Cognitive styles on students' achievements in biology in senior secondary schools in Anambra State. One research question and one null hypothesis tested at 0.05 level of significance guided the study. A causal comparative design and a population of 10,206 (SSII) biology students in government owned secondary schools were used. Simple random sampling technique was used to obtain a sample of 265 SS11 biology students

from six sampled schools. Two instruments were employed for data collection namely: Group Embedded Figure Test (GEFT) and Biology Achievement Test (BAT). GEFT was used to assess the cognitive styles of students as either field – dependent or field independent, GEFT a standardized instrument with a reliability of 0.89 on a test re-test method. BAT was face and content validated by to biology educators and two experts in Measurement and Evaluation from the Science Education Department, University of Nigeria, Nsukka. The reliability coefficient of BAT was established using Cronbach Alpha and gave 0.86. Data were analyzed with mean and standard deviation to answer the research question while one –way Analysis of variance (ANOVA) was used to test the null hypothesis. Results showed among others that cognitive styles of dependence – independence significantly influenced the achievements of students in biology.

Introduction

Biology is a science subject which aims at equipping students with appropriate scientific skills, attitudes, competences and ability to apply scientific knowledge to every challenges of life. The result of Senior Secondary three students (SSIII) in Senior Secondary Certificate Examination (SSCE) in biology shows very poor performance, making for the need to improve biology teaching and learning in Nigeria. Statistics from the West African examination Council (WAEC,2010; 2011; 2012) revealed that students failed to obtain grades at credit level and above which could qualify them for university admission in biology and other science – related disciplines, (Chief Examiner’s Report, 2010). Student’s poor achievement in biology has been linked to a number of contributing factors among which are incompetent mode of teacher’s delivery of the subject, inadequate use of instructional materials and ill- equipped biology laboratories, (Nwagbo, 2009). Teachers’ in Many Nigerian secondary schools do not apply appropriate science strategies as identified and recommended to be effective for science instruction, (Norom, 2009). Incompetent mode of teachers’ instruction may lead

to inadequate development of intellectual and thinking skills among students. Therefore, the need to improve science teaching and learning in Nigeria, since the achievement of students in biology is still not impressive.

The field – dependent – independent cognitive styles has been identified as one of those psychological constructs that may mediate treatment and achievement in biology. Brenner (1997) defined cognitive styles as an individual's characteristic mode of perceiving and organizing information in the environment. It is also the way an individual acquired and uses knowledge. Luke (1998) added that cognitive styles reflects an individual's preferred way of actively processing and transforming information categorizing new knowledge, and integrating it within the memory structure. There are different dimensions of cognitive styles. The cognitive styles' variables considered in this study are that of field – dependence (FD) and field independence (FI). Study by Witkin, Moore, Good Enough & COX (1977) revealed that students who are field – dependent learning styles tends to be global in the analysis of learning situations and have difficulty in breaking information into isolated parts; perceive an item as discrete from its background; nor can they impose structure when it is lacking in content. Field – dependent learners may prefer more direct instruction or definition of the material in situations that involve restructuring abilities. They also seem to be incidental learners in social contexts and have difficulty using initiation. Conversely, students that are field – independent learning style tends to be more analytic, solve complex problem and isolate facts. They can separate relevant elements from a distracting or confusing background. They prefer working alone, flexible in learning situations and self – reliant, reflective, task – oriented and concerned with mastery of concepts.

Some of the results of related studies showed that field independent learners are generally more superior than their field dependent counter parts in academic achievement (Okwor & Tartiyus, 2006). However,

there is paucity of research on the influence of cognitive styles on achievements in biology. Most of the studies in Nigeria that are directly concerned with biology achievements investigated the influence of other factors than cognitive styles. Therefore, this study investigates the influence of cognitive styles on students' achievement in Biology.

Research questions

One research question guided the study:

1. What is the influence of cognitive styles on the mean achievement scores of students in biology?

Hypothesis

One null hypothesis was formulated to guide the study and was tested at 0.05 level of significance.

Ho1: *Cognitive styles have no significant influence on the mean achievement scores of students in biology.*

Research method

The study was a causal comparative design. The study was carried out in Anambra State. This area was chosen because of time constraint. The population consisted of all the senior secondary two (SS11) biology students numbering 10,206 biology students in government – owned secondary schools in Anambra State. The sample of the study consisted of 265 SS11 biology students drawn from six sampled schools in Nnewi education zone of Anambra State. Simple random sampling technique was used. Two instruments were employed for data collection namely Group Embedded Figure Test (GEFT) and Biology Achievement Test (BAT). GEFT is a non – verbal speed test published by Witkin Ottman, Raskin & Karp (1971); it is a test of student's ability to find a simple form where it is hidden within a complex pattern. Hence, it is used to assess the cognitive style of students as either field – dependent or field independent. GEFT has a

score range of 0 to 18, a student that scored 0 to 6 is classified as field – dependent (FD) while 7 to 12 as field intermediate (F int) and 13 to 18 as field independent (FI). GEFT is a standardized instrument and according to Witkin, Moore, Oltman (1971), it has a satisfactory reliability of 0.89 on test – re-test over a three year period.

BAT is a forty multiple – choice objective test developed by the researcher. Each item has 5 – option lettered A –E. the test was based on the units of study in SS11 biology Curriculum used for the study. This was used to assess the students' achievements in biology. BAT was face validated by two biology educators and two experts in Measurement and Evaluation from the Science Education Department, university of Nigeria, Nsukka. For content validity the table of specification ensured content validity. The reliability of BAT was determined by administering it on 30 SS11 biology students of a secondary school outside the area of study. The Cronbach Alpha method was used to analyze the scores and the result gave a reliability of 0.86 indicating that BAT is reliable.

The method of administration of the instrument was on the spot administration with the help of two research assistance to ensure a 100% return. The GEFT instrument was first administered to the students. The students were made to understand the instructions very well before working through the instrument. BAT was administered last. The scripts from each students were collected, marked and the scores used for analysis.

The research questions were analyzed using mean and standard deviation, while Analysis of variance (ANOVA) was used to test the null hypothesis at 0.05 level of significance.

Result

The findings of the study were presented sequentially, according to the research question and hypothesis.

Table 1: Mean Achievement scores of students' and standard Deviation on the influence of cognitive styles in biology.

Groups	Cognitive styles	N	X	SD
COG style 1	Field dependent (FD)	70	21.51	6.80
COG style 2	Field Intermediate ((INT)	52	24.50	5.94
COG styles 3	Field Independent (FI)	143	26.18	6.04
Total		265	24.64	6.52

Table 1, shows that group 1 of field dependent (ED) cognitive style students had a mean achievement scores of 21.51 and standard deviation of 6.50. Field intermediate (F, INT) cognitive style students group 2 had a mean achievement score of 24.50 and standard deviation of 5.94, while field independent (FI) cognitive style students group 3 had a mean achievement score of 21.18 and standard deviation of 6.40

Table 2: one – way Analysis of variance (ANOVA) on mean Achievement scores of students' cognitive style in Biology

Source	df	Sum of Squares	Mean squares	F Sig	Decision
Between Groups	2	1027.8763	513.9383	13.2188	0000S
Within Groups	262	10186.3878	38.8793		
Total	264	11214.2642			

Data on table 2 shows that mean achievement scores of students' cognitive style in biology differed significantly from each other. This is shown by the calculated F – value of 13.2188, which is significant at 0000 but is not significant at 0.05 level of probability. Therefore,

the null hypothesis of no significant influence of cognitive styles on mean achievement scores in biology is rejected. This suggests that there is a significant influence of students' cognitive styles on mean, achievement scores in biology.

To find out the direction of difference a Scheffe post hoc multiple comparison tests between two means at 0.05 level of significance were carried out and presented in table 3.

Table 3: Scheffe post – hoc multiple comparison test between two mean scores of students' cognitive styles at 0.05 level of significance.

The difference between two means is significant if

$$\text{Mean (J) – mean (I)} \geq 4.4090 * \text{RANGE}^*$$

SOQRT (1/4 (i) + 1/N (J) with the following value(s) for RANGE
3.48

*Indicates significance differences which are shown in the lower triangle

Mean COG STYLE

21.51	field de (FD) Grp 1
24.50	field INT (F,INT) Grp 2*
26.19	field Indep (F1) Grp 3*

*Indicates group significant difference at 0.05 level of significance.

The result in table 3 revealed that students mean achievement scores in each cognitive style group differed significantly from each other. The field dependent (FD) group had a mean score of 21.51 which differed significantly from group 2 and group 3 respectively. The field intermediate (F,Int) group 2, had a, mean score of 24.50 which differed significantly from, group 1 and group 3 respectively. While the field independent (F1) group 3 had a mean score of 26.19 which differed significantly from group 2 and group 1 respectively. This

implies that field independent (F1) group3, performed better than field intermediate (F,Int) group 2, and the intermediate group 2, performed better than field dependent (FD) group 1 in biology achievement test. Therefore, cognitive styles had a significant influence on students' mean achievement scores in biology.

Discussion

From the test of the hypothesis it was observed that the mean achievement scores of students' cognitive styles in biology differed significantly from each other.

Therefore, the null hypothesis of no significant influence of cognitive styles on mean achievement scores in biology is rejected (calculated F – Value of 13.2188, which is significant at 0.0000 which is not significant at 0.05 level of probability. The results suggest that there is a significant influence of cognitive styles on mean achievement scores in biology. Thus, field dependent (FD) scored 21.51, field intermediate (F, Int) scored 24.50 and field – independent (F1) 26.19, their mean achievement scores in biology differed significantly. The field – independent (F1) mean achievement scores were higher than those of field intermediate (F, Int) and the field intermediate mean achievement scores were higher than those of field – dependent students. This implies that there is a significant influence of cognitive styles on mean achievement in biology.

The finding that students' mean achievements scores in biology were significantly influenced by cognitive styles is agreement with the findings of Okwor and Tartyus (2006) who's studies that the effect of modes of Pictorial adjusts and Cognitive styles were significant with field independent learners performing better in biology objective test than the field dependence ones. The finding that cognitive styles significantly influenced students' academic achievement in biology is not misleading.

Educational implications

The results of this study have obvious implications for teachers, generally biology teachers, students and curriculum planners.

The cognitive styles skills enable the biology teachers to identify the learning needs of the slow learners. This helps to reduce the persistent poor students' achievement in biology among students. This helps the slow learners to work at their pace and be actively involved in the lesson

The skill of cognitive styles can be incorporated into pre-service and in service training of teachers and this would encourage vast improvement of teachers' effectiveness in the classroom.

Recommendations

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

- It is evident that since the adoption of cognitive styles was found to be effective in improving students' achievement in biology, teachers should use cognitive styles to facilitate their Biology teaching.
- The curriculum of teacher education in the country should include the use of cognitive styles in teaching in identifying learners learning problem in order to popularize their effectiveness in teaching biology.
- Schools should organize workshops and seminars internally which will enable teachers and students to share ideas on cognitive styles skills.
- In-service training, workshops and symposia should be organized and made compulsory for practicing teachers to embrace the skills of cognitive styles for effective implementation in teaching and learning process

Conclusion

The results of this study reveal that:

- Cognitive styles of field dependence – independence, significantly influenced the achievement of the students in biology. Field- independent students performed better than their field dependent counterpart. Cognitive styles accounts for 5.21% of the influence on achievement.

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