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Effect of Cognitive Styles on Senior Secondary Students' Interest and Achievement in Biology in Benue State, Nigeria

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ABSTRACT

The study investigated the effect of cognitive styles on senior secondary students' interest and achievement in Biology in Benue State, Nigeria. The study was guided by 2 research questions and 2 hypotheses. The research design for the study was ex-post-facto. The total population of the study was 66, 586 Senior Secondary Two (SSII) students (36052 males and 30534 females) from 301 co-educational schools in Benue State. The sample for the study was 398 SSII students (181 males and 217 females). Three instruments were used for the collection of data. The instruments are: Group Embedded Figures Test (GEFT), Biology Interest Inventory (BII), and Biology Achievement Test (BAT). Data collected was analyzed using mean and standard deviation to answer research questions while hypotheses were tested using t-test at 0.05 level of significance. The decision rule for the acceptance or rejection of the hypotheses was based on the P – value. A hypothesis of no significant difference was rejected for any item whose P- value was less than 0.05 while it was not rejected for any item whose P- value was greater than or equal to 0.05. The findings revealed a significant difference in mean interest rating of field dependent and field independent male and female students in Biology. The findings also revealed a significant difference in mean achievement of field dependent and field independent students in Biology. However, there was no significant difference in mean achievement of field dependent and field independent cognitive styles of male and female students' in Biology. The study recommended that teachers should have adequate knowledge of dominant cognitive style category in their classes as this could facilitate and ensure more meaningful learning as well as serve as a guide for selection of teaching methods that would boost students in the subject. Also there is every need for identifying students cognitive styles in the teaching and learning process for a more inclusive and effective learning.

Keywords: Cognitive styles, Interest and Achievement

Introduction

The field of Biology holds a paramount place in the modern world. Biology is a branch of science that deals with the scientific study of living things, their relationship with one another, and with the natural environment, among others (Abdullah, 2022; Mardonov, 2019). The field helps in the understanding of the living world and the way its many species (including humans) function, evolve, and interact. It is important that much attention be given to the study of Biology since it holds much importance in our daily lives. So far, the Nigerian universaities have put a benchmark of a credit in Biology as a prerequisite for gaining university admission in courses such as medicine, pharmacy, engineering, and nursing among others. Summarily, Biology is a very crucial aspect of science, education, and life as a whole. Therefore, every nation must give high level of priority to the subject and its study.

Biology as a secondary school subject serves as a fundamental and indispensable component of the science curriculum, offering students with a comprehensive understanding of the living world. The subject provides a unique gateway for students to understand the intricate mechanisms governing life, from the molecular and cellular levels to the broader ecosystems as well as compulsory subject requirement for studying medicine and allied courses (Isma'il & Lukman, 2022; Oyovwi, 2021; Edeh & Martha, 2020; Chukwuemeka & Dorgu, 2019; Badmus & Omosewo, 2018). The objective of teaching Biology at the secondary school level is to prepare students to acquire adequate laboratory and field skills in the subject, meaningful and relevant knowledge, and the ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture, as well as researchable and functional scientific attitudes (National Educational Research and Development Council (NERDC), 2009).

Therefore, the teaching and learning of Biology can be effective if students are allowed to contribute in the process. According to Eze *et al.* (2020), the learner or student is a central factor in determining whether meaningful learning will take place or not. This may include his background, interest, motivation, age, sex or gender, personality and so on (Andrews et al., 2023). In a similar view, Iji *et al*. (2017) listed factors responsible for the low achievement of students in sciences to include use of inappropriate teaching methods, lack of instructional materials, inadequate number of qualified teachers and inability to identify the cognitive styles of learners. Eriba *et al*. (2021) also argued that students' achievement may be low when the teaching method is inappropriate to students' cognitive styles. Knowledge of students' cognitive styles could be used to predict what kind of instructional strategies or methods would be most effective for a given individual and learning task. However, the situation in most classrooms in Nigeria is that teachers have

little or no knowledge of students' cognitive style. For the purpose of clarity, the concepts of cognitive style, interest and academic achievement are explained in subsequent paragraphs of this discourse.

The Concept of Cognitive Style

Cognitive style refers to an individual's preferred way of thinking. According to Imam and Ahmed (2020), it deals with how an individual processes information and it reflects the manner or mode of cognition of an individual, that is, the way an individual filters information, process stimuli, and conceptually organize his environment. Khandagale (2016) described cognitive style as the way an individual filters information, process stimuli and conceptually organize the environment so that the environment takes on a psychological meaning. It describes the way of constructing knowledge of an individual and personality dimensions. Cognitive styles are thought to be relatively stable strategies, preferences, and attitudes which determine an individual's typical modes of perceiving, remembering and problem-solving (Abubakar, in Eriba *et al*., 2021). Armstrong and Peterson in Eriba *et al*. (2021) posit that cognitive style is the individual differences in people's preferred way of processing (perceiving, organizing, and analyzing) information using cognitive brain-based mechanisms and structures. Understanding cognitive styles of students would help to improve learning and creativity among them and account for individual differences in how students approach task.

Cognitive researchers have identified a number of cognitive styles. For instance, Witkin (1962) identified two cognitive styles to include 'field dependence and field independence', Paivio (1971) mentioned two cognitive styles to include 'verbalizer and visualizer' while Kagan (1964) identified two cognitive styles as 'impulsivity and reflexivity'. Field dependence and field independence are probably the most well-known styles since literature abounds them. Field dependent learners are those who are most affected by their environment. They are inclined to overall field learning and are less able to view things separate from the overall environment whereas the field independent learners conduct an analytical procedure and are more likely to break a model into different sections and details and tend to depend on their inner knowledge and analyze problems all by themselves without reference to the environment (Onyekuru, 2015).

Field dependent and field independent learners process information differently and may require different teaching strategies and materials. Knowledge of students' cognitive styles could be used to predict what kind of instructional strategies or methods that would be most effective for a given individual and learning task. Moreover, in a single class, there are both field dependent and field independent learners. The teacher therefore has to select appropriate instructional strategies and materials that could be suitable for both field dependent and field independent students in learning Biology.

The Concept of Interest

Biology being a subject that enables man to know much about himself as well as his environment, ought to be made interesting to students so as to boost their interest in the subject. According to Hornby (2020), interest is an activity or subject that one enjoys or spends free time doing or reading. It refers to students' expressed desire, willingness and curiosity to study Biology in preparation for a possible future career in a science field. Interest is believed to be an important variable in learning because when one is interested in an activity, one becomes desirous, willing and curious to study Biology and achieve high in it. Abakpa in Okwara and Upu (2017) see interest as an energizer of learning without which meaningful learning may not take place. Without interest and personal efforts in learning Biology by the students, they can hardly achieve greatly in the subject (Haruna, 2021).

The Concept of Academic Achievement

Academic achievement is an important education variable that expresses the success and failure of a teaching and learning process, and the extent educational goals are attained. However, students' academic achievement in sciences particularly Biology has been low. Many factors have been shown to have significant effect on students' interest, cognitive load, and achievement in Biology. Research report from Lambert and Etim (2022) found that students' achievement in Biology at the secondary school certificate examination is low. While this has been attributed to shallow knowledge of the subject, Atamonokhai (2017) stated that in spite of the attempts made by researchers to improve on the teaching and learning of science subjects, particularly Biology, the achievement of students still remain low. According to Haruna (2021), the teacher's knowledge of subject matter, qualification and teaching strategies, go a long way in influencing students' interest and achievement in Biology. The United Nations Educational Scientific and Cultural Organization (UNESCO) in Bassey *et al* (2017) pointed out that the low interest and achievement of students in Biology may be influenced by gender (males and females) imbalance leading to the problem which now constitutes a major research focus across the globe.

Gender has continued to be an issue of concern in science education research. Gender is a socio-cultural construct whereby a society ascribes different roles, values, and attitudes to males and females. It refers to males and females. Okeke (2016) defined gender as the socio-cultural constructed characteristics and roles which are ascribed to male and female by the society. It is a culturally determined trait associated with males and females. According to Nzewi in Aniaku and Nwankwo (2024), an individual grows and is socialized into the society to fit into certain roles prescribed by the society as masculine or feminine such as behaviour, belief, value, and roles.

A number of studies have verified gender influence on students' interest and achievement in difficult concepts in Biology. This has led to series of divergent views. Many research findings in Nigeria have shown that boys perform better than girls in Biology generally despite the fact that they are put under the same classroom situation (Alabi *et al*., 2024). Salami et al (2018) indicated that female students often exhibit higher interest and achievement in Biology. Similarly, Ashwe (2018) showed that female students performed significantly better than their male counterparts. Meanwhile, other research

findings have debunked the idea of gender differentiation in ability. This school of thought believes there is no disparity in the performance of both boys and girls (Gbodi & Laleye, in Ashwe, 2018).

Many researchers including Ifelunni (2019); Idika (2017); Bruno (2015) and Onyekuru (2015) have conducted researches on students' cognitive styles. These researches have not answered the question of effect of field dependent and field independent cognitive styles on interest and achievement in Biology. Therefore, there is need to ascertain if field dependent and field independent cognitive styles affect learners interest and achievement in Biology.

Statement of Problem

In science learning particularly Biology, students in secondary schools are expected to develop sustained interest and attain high academic achievement, given the subject's vital role in understanding life processes and its relevance to careers in pharmacy, nursing, biotechnology, and medicine among others. A strong interest in Biology boosts students' motivation, engagement, and participation, while high academic achievement indicates a mastery of content. When effectively taught, Biology helps to instill in learners the basic science process skills necessary for national development. However, the current reality in many public secondary schools in Benue State is worrisome. Students' interest in Biology appears to be declining, with many perceiving the subject as abstract, difficult, and disconnected from real-life applications. This diminishing interest in Biology has contributed significantly to low achievement in the subject in public examination.

An observation made by the researcher indicates that the failure of teachers to identify students' cognitive styles and adopt suitable teaching strategies may have been the cause of low achievement in Biology. Thus, the major purpose of this study is to investigate the effect of cognitive styles on senior secondary students' interest and achievement in Biology in Benue State, Nigeria.

Purpose of the Study

The general purpose of this study is to investigate the effect of cognitive styles on senior secondary students' interest and achievement in Biology in Benue State, Nigeria with the following specific objectives as 1. Ascertain the effect of field dependent and field independent students' interest in Biology; 2. Find out the effect of field dependent and field independent male and female students interest in Biology; 3. Ascertain the effect of field dependent and field independent students' achievement in Biology; 4. Find out the effect of field dependent and field independent male and female students achievement in Biology.

Research Questions

The study was guided by the following research questions:

1. What is the difference in mean interest rating of field dependent and field independent students in Biology?
2. What is the difference in mean interest rating of field dependent and field independent male and female students in Biology?
3. What is the difference in mean achievement of field dependent and field independent students in Biology?
4. What is the difference in mean achievement of field dependent and field independent male and female students in Biology?

Hypotheses

The following hypotheses were formulated for the study and tested at 0.05 level of significance.

i. There is no significant difference in mean interest rating of field dependent and field independent students in Biology.

ii. There is no significant difference in mean interest rating of field dependent and field independent male and female students in Biology.

iii. There is no significant difference in mean achievement of field dependent and field independent students in Biology.

iv. There is no significant difference in mean achievement of field dependent and field independent male and female students in Biology.

Methodology

The research design for the study was ex-post-facto. According to Emaikwu (2021), it is a research design that is appropriate where it is not possible for the researcher to directly manipulate the independent variable. The total population of the study was 66, 586 Senior Secondary Two (SSII) students (36052 males and 30534 females) from 301 co-educational schools in Benue State. The sample for the study was 398 SSII students (181 males and 217 females). Three instruments were used for the collection of data. The instruments are: Group Embedded Figures Test (GEFT), Biology Interest Inventory (BII), and Biology Achievement Test (BAT). Data collected was analyzed using mean and standard deviation to answer research questions while hypotheses were tested using t-test at 0.05 level of significance. The decision rule for the acceptance or rejection of the hypotheses was based on the P – value. A hypothesis of no significant difference was rejected for any item whose P- value was less than 0.05 while it was not rejected for any item whose P- value was greater than or equal to 0.05.

Results

Research Question 1: What is the difference in mean interest rating of field dependent and field independent students in Biology?

Table 1: Mean and Standard Deviation of Interest Rating of Field Dependent and Field Independent Students in Biology

	Groups	N	Mean	Std. Deviation
Interest	Field Dependent	194	2.90	.97
	Field Independent	204	3.32	.77
Mean Diff.		**398**	**0.42**	

Table 1 shows the mean and standard deviation of field dependent and field independent students' interest rating in Biology, which the mean of field dependent is 2.90 with standard deviation of .97 and the mean of field independent is 3.32 with standard deviation of .77. The mean difference of field dependent and independent students' interest rating is 0.42. This implies that the mean interest rating of students in field independent is slightly higher than that of field dependent, with a low standard deviation in field independent than in field dependent.

Research Question 2: What is the difference in mean interest rating of field dependent and field independent male and female students in Biology?

Table 2: Mean and Standard Deviation of Interest Rating of Field Dependent and Field Independent Male and Female Students in Biology

GENDER	**N**	**Group Embedded Figures Test**			
		Field Dependent		**Field Independent**	
		Mean	**Std. Deviation**	**Mean**	**Std. Deviation**
Male	181	3.04	.95	3.91	.30
Female	217	2.71	1.04	3.29	.78
Mean Diff.		**0.33**		**0.62**	

Table 2 shows the mean and standard deviation of field dependent and field independent male and female students' interest rating in Biology, which male has the mean of field dependent and independent of 3.04 and 3.91 with standard deviation of .95 and .30 respectively. The female has mean of field dependent and independent of 2.71 and 3.29 with standard deviation of 1.04 and .78 respectively. Both male and female mean result showed that field independent has the highest mean (male =3.91 and female =3.29). This implies that the mean interest rating of gender in field independent is higher than that of field dependent, with a low standard deviation in male field independent than in female field independent.

Research Question 3: What is the difference in mean achievement scores of field dependent and field independent students in Biology?

Table 3: Mean and Standard Deviation of Field Dependent and Field Independent Students Achievement in Biology

	Groups	N	Mean	Std. Deviation
Achievement	Field Dependent	194	21.27	.97
	Field Independent	204	22.38	.77
Mean Diff.		**398**	**1.11**	

Table 3 shows the mean and standard deviation of field dependent and field independent students achievement in Biology, which the mean of field dependent is 21.27 with standard deviation of .97 and the mean of field independent is 22.38 with standard deviation of .77. The mean difference of field dependent and field independent students' achievement is 1.11. This implies that the mean achievement of students in field independent is higher than that of field dependent students, with a low standard deviation in field independent than in field dependent.

Research Question 4: What is the difference in mean achievement scores of field dependent and field independent male and female students in Biology?

Table 4: Mean and Standard Deviation of Field Dependent and Field Independent Male and Female Students Achievement in Biology

GENDER	**N**	**Group Embedded Figures Test**			
		Field Dependent		**Field Independent**	
		Mean	**Std. Deviation**	**Mean**	**Std. Deviation**
Male	181	21.28	4.47	26.45	2.81
Female	217	21.25	4.59	22.15	4.31
Mean Diff.		**0.03**		**4.3**	

Table 4 shows the mean and standard deviation of field dependent and field independent male and female students' achievement in Biology, which male has the mean of field dependent and independent of 21.28 and 26.45 with standard deviation of 4.47 and 2.81 respectively. The female has mean of field dependent and independent of 21.25 and 22.15 with standard deviation of 4.59 and 4.31 respectively. Both male and female mean result showed that field independent has the highest mean (male =26.45 and female =22.15), with a low standard deviation in male field independent than in female filed independent. This implies that the mean achievement of gender in field independent is higher than that of field dependent.

Discussion of Findings

The findings revealed a significant difference in mean interest rating of field dependent and field independent students in Biology. The observed difference in students' interest rating in Biology is an indication of cognitive style effect. The finding directly addresses the research objective which sought to ascertain the effect of field dependent and field independent students' interest in Biology. It also provides an answer to the corresponding research question by establishing the difference in interest of students in Biology. The findings also revealed a significant difference in mean achievement of field dependent and field independent students in Biology. However, there was no significant difference in mean achievement of field dependent and field independent cognitive styles of male and female students in Biology. The finding directly addresses the research objective which sought to ascertain the effect of field dependent and field independent students' achievement in Biology. It also provides an answer to the corresponding research question by establishing the difference in students' achievement in Biology.

Conclusion

From the study, the cognitive styles of students indicate a significant effect on their interest and achievement in Biology. Therefore, since teaching and learning are goal oriented, it is important that in the teaching and learning of Biology, the cognitive styles of students be placed at the forefront of the instructional process. This will help to improve their interest and achievement in Biology.

Recommendations

1. Teachers should have adequate knowledge of dominant cognitive style category in their classes as this could facilitate and ensure more meaningful learning as well as serve as a guide for selection of teaching methods that would boost achievement in the subject.

2. There is every need in identifying students interest in the teaching and learning process for a more inclusive and effective learning.

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