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WILL INDIGENOUS SCIENCE-BASED INSTRUCTIONAL STRATEGIES IMPROVE BIOLOGY STUDENTS' INTEREST AND ACHIEVEMENT

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Abstract
The study investigated the efficacy of indigenous science –based instructional strategy on Biology students' interest and achievement. The purpose was to find a solution to poor achievement of students in the subject in external examinations which has been linked to poor instructional methods used by teachers. Two coeducational schools were selected by Multistage sampling technique from Isoko South local government area of Delta state and randomly assigned to treatment groups. The experimental group was taught ecological concepts using the indigenous science –based strategy while the control group was taught using lecture approach. A 50-item Biology Achievement Test with reliability coefficient of .72 and 15-item Biology Interest Scale (.82) were used to collect data after 15 periods of 45minutes teaching in each class. The Mann Whitney U test (U = 898.00; P = 0.007) showed a significant difference in the interest in biology of both groups while the t-test revealed a significant difference in the achievement of students at the 0.05 alpha level. The study concluded that indigenous science –based strategy improves students' interest and achievement in ecology concepts and recommended the introduction of culturally relevant pedagogy to draw cultural relevance for indigenous people studying sciences in non-western cultural settings.

Introduction

Biology is a life science that helps learners develop scientific literacy which citizens need to understand scientific issues that affect national growth and development. Its importance is appreciated when considering the immense benefits of scientific literacy in creating a scientifically literate society where policies and programmes of scientific origin are understood, accepted, and

applied. Biology provides modern knowledge that meets the need of society through relevant and functional content, method, process, and application (FRN, 2004). According to the West African Examination Council secondary school syllabus, the objectives of studying biology at the secondary school level in Nigeria include understanding structures and function, acquisition of problem-solving skills and scientific skills.

To achieve these objectives, teachers are expected to adopt p instructional effective and diverse strategies in implementing the curriculum. The curriculum of secondary school biology in Nigeria places emphasis on laboratory techniques, field studies, and guided discovery with focus on conceptual thinking and acquisition of science process skills (NERDC, 2008). Effective teaching and learning of biology are expected to produce students that can solve their personal problems and that of society. This can only occur when students learn meaningfully. Studies on science instruction (biology) in Nigeria have revealed that the dominant instructional approach used by teachers is the conventional lecture method (Onu, et al 2020; Oyelekan, Igbokwe & Olorundare, 2017; Omorogbe & Ewansiha, 2013; Paris, 2014).

Reasons advanced for this include its simplicity and ease of use in large classes often associated with secondary school biology classes in Nigeria. The method has also been blamed for the perennial poor achievement, loss of interest, and poor retention of learned materials among students Ojukwu, 2016, Chou & Zou 2020). It may therefore not be out of place to speculate a connection between this method of teaching and the dwindling achievement in the West African Examinations Council (WAEC) achievement results in Biology between 2017 and 2019. The chief examiners' reports show that there was a fall in the mean (31 and 31) and standard deviation (0.91 and 11.92) in 2016 and 2017 (28 and 29) as well as in 2018 and 2019 (9.43 and 9.00) respectively. The reports attributed the decline to candidates' inability to properly interpret questions and present answers logically, systematically, and convincingly; poor drawing skills, shallow understanding of most concepts in Biology, inability to relate features to functions, and incorrect spelling of many biological terms. The report blames these inadequacies on ineffective teaching methods that do not lead students to a meaningful understanding of the concepts but encourage memorization and regurgitation of superficial knowledge.

The role played by the ecosystem and cultural world of the science learner in the successful learning of science was a focus of anthropological and psychological researchers (Aikenhead and

Jegede, 1999; Costa, 1995; Marosi, Ayraamidou & Galani, 2021; Banks 2019; Dickson et al. 2015; Arar et al., 2019). The significant influence of culture, demographics, and ecosystem on education generally, and science learning in particular, has been a huge area of research (Marosi, Ayraamidou & Galani, 2021; Banks 2019). Achievement gaps recorded in science education was attributed to the experiences of minority students from different cultural backgrounds (Dickson et al. 2015; Arar et al., 2019). The challenge before science educators and researchers today is to bridge achievement gaps in science learning by decimating barriers due to location, ethnicity, culture, and race. Ayraamidou & Galani (2021) focused on multiculturalism, especially in this era of international migration that has led to a change in the ecoculture, sociopolitical environment, and by extension classroom dynamics.

In the context of non-western cultures and ecologically disadvantaged people, there is a subtle feeling of school science as foreign knowledge due to its approach, contextualization, and presentation. There is a notion (Aikenhead & Jegede, 1999; Adam, et al, 2012; Adebayo, et al, 2022) that if achievement statistics need to change and equity in science learning achieved, science must be taught in culturally relevant methods that minimize the foreign posture and uncertainties which science learners in non-western contexts feel. While some learners can navigate and adjust with some efforts between both worldviews, some experience hindrances that either slow down or completely impede their success in science. Aikenhead and Jegede (1999) after a review of Phelan, Davidson, and Cao (1991) explained that the ease with which learners of science are able to navigate and transit from one culture (microculture) to another is dependent on the closeness of the relationship between the cultures (that of the science learner and the western culture to which school science belongs), and the amount of help they receive from the school (classroom and the teacher). This in turn determines the degree of success in science that they achieve. The success of the cross-cultural migration cognitively is termed border-crossing (Aikenhead & Jegede, 1999) and can only occur when science learners are able to resolve cognitive conflicts arising from the differences between their micro worlds and that of school science.

The role of the school (by implication) the science teacher in effecting seamless resolution of this conflict implicates the effectiveness of science delivery strategies which is adopted by the teacher. Such science teaching strategies should be able to help bridge the gap between the two cultures which over 90% (Costa, 1995; Seiler, 2011; Brown & Crippen, 2016; Banner, 2016; Crawford, & Capps, 2018) of the non-western science learners struggle to navigate (migration from their own

culture to that of science) by making them culturally relevant. The culturally relevant pedagogy refers to the use of materials, ideas, and beliefs from the students' environment and technology in delivering science knowledge such that science learners from culturally different contexts are able to transit smoothly into the culture of school science and make sense of it by integration. This is the dimension of this study.

Students' interest is an important factor in science learning (Renninger & Hidi, 2015) as it plays an important role in persistence in doing science (Graham, Frederick, Winston, Hunter, & Handelsman, 2013; Renninger & Hidi, 2015). Pacifici and Thomson (2011) report that pre-medical school students are motivated more by their quest to help others than by their interest in learning science. Leonard (2010) suggests that making the teaching and learning of concepts more relevant to students' lives and immediate environment may help them see the value of science and in turn develop a better interest in its study. Atran (2007) suggests the development of culturally relevant activities as part of the biology curriculum to help students make sense of what they learn. James (2006) had earlier in his study of cultural values and perception of science and technology, argued that appropriate alternative approaches to Biology education and practice can have a positive effect on students' achievement in Biology.

Onowugbeda et al (2023), Ajayi et al (2023) and Ugwu and Divou (2016) reported the efficacy of culturally sensitive and context- specific pedagogy in enhancing biology students' emotional attachment to the learning of the subject leading to higher achievement. Noteworthy also is Bathgate and Schunn (2016) who reported that intensity of interest and breath of interest are separate factors and influence science learning separately. While intensity of interest predicts classroom engagement and preferences of optional science subjects, breath of interest predicts science choices but not science classroom engagement. The PISA analysis results by Höft and Bernholt (2019) from a longitudinal study indicate a significant increase in science interest and environmental awareness, but a decrease in science enjoyment and scientific competency for students. The findings also suggest that instructional approaches may hinder students from developing genuine interest in learning science with a note of warning to science and environment educators and policy makers to reassess their teaching methods and prioritize fostering a true passion for science among students. Understanding key variables that moderate students' development of interest in science is of immense importance in improving students' interest in

science and science engagement among coastal natives in a nonwestern culture like South-South Nigeria.

Sanga (2004) sees Indigenous Knowledge (which is bedrock of this culturally relevant pedagogy) as a knowledge that is particular to a language or culture. Viewed from same dimension Ogunbumi and Olaitan (1998) and Taruna (2017) conceived indigenous knowledge as reflects of the natives own thinking about how their physical world is classified. This view of Ogunbumi and Olaitan (1998) is in harmony with Casagrande (2004) that Biology as a discipline is not only a body of systematic knowledge, a method, a process, or a way of investigating but also a way of thinking. Culturally relevant pedagogy can assist science (biology) students in exploring the differences between culture and Biology as well as help students make sense of what they are learning in the dual contexts of culture and school science. Brown and Crippen (2016) showed that teachers who engaged in activities such as critically examining their practices, evalu ating culturally responsive exemplars, and justifying the use of responsive instructional strategies were more likely to develop a robust understanding of culturally responsive teaching and make meaningful connections between students' experiences and science instruction. The study propos es a set of design and theoretical conjectures for preparing culturally responsive science teachers through professional development.

Efforts to indigenize science instruction have been made through use of mother tongue in science instruction (Fassi, 2017; Brown & Crippen, 2016; Yahannes, 2009). Fafunwa's (1986) mother tongue approach to science instruction was built on the assumption that meaning are found to be intimately connected with linguistics (Levinson, 2003; Gay, 2013). According to Levinson, if the models representing ideas have meaning and if meaning are psychological entitles (as semantics theorist thought), then it follows that speakers of different languages convey different meaning even when they are referring to some objective state of affair in so far as the grammatical structures of the language, they speak differ from one to another. Western model transmitted in Igbo, Yoruba, Hausa or whichever language is still western and may be perceived as alien. The purpose of the study is thus to determine if the use of indigenous knowledge strategy within the culturally relevant pedagogy framework in teaching Biology concepts will produce higher achievement and improve the interest of senior secondary school Biology students compared to those taught with lecture method.

Hypotheses

The following hypothesis were generated and tested at 0.05 level of significance:

1. There will be no significant difference in the mean interest score of student taught Biology concepts with culturally relevant science pedagogy and those taught with lecture method.
2. There will be no significant difference in the mean achievement score of students taught Biology with culturally relevant science pedagogy and those taught with lecture method.

Theoretical Framework

The theory on which this study is guided is Ley Vygotsky social constructivism theory of learning which explains the cultural basis of cognition (Wheatley,1999). Vygotsky's Pedagogical idea emphasizes the interplay of culture and social context in the construction of knowledge (learning) and understanding of events in the social setting of which the learning takes place. To social constructivists, meaningful learning is culture-bound and grows out of social encounters (Oladejo et al, 2021; Gay, 2013). Seen in this sense, it means that the knowledge a student acquires in school links with the learning acquired through everyday experience. The role of the social Context is to scaffold the learner and provide hints and help that foster co-construction of knowledge while interacting with other members of the society (Jegede & Aikenhead, 1999). Effective science learning is believed to take place in a situation where there is harmony in the cultural experience of the learner as determined by the school, the home and the community in which learning takes place. When There is such harmony, science instruction tends to Support learners' view of the world, leading to enculturation (Jegede & Aikenhead, 1999; Jegede, Fraser & Okebukola, 1994; Adeola, 2020; Adam, 2019). This, as explained by Jegede and Aikenhead, (1999) brings about successful border crossing from the prior knowledge they hold due to their cultural experiences to the new experiences in school science. While school science concepts and methodologies are western in origin, science in general is human, domain -specific and culturally defined.

Methodology

The study adopted a quasi-experimental pre-test post-test control group design involving one experimental and one control group. The variables in the study include the teaching method (culturally relevant (Indigenous) instructional strategies and the conventional Lecture method)

which are the independent variables while the dependent variables are the students' scores in achievement and interest in biology.

One thousand nine hundred and forty-eight senior secondary school one students from all 19 public senior secondary schools in Isoko South Local Government Area of Delta State in 2020/2021 academic session participated in the study. Multi-stage random sampling technique was employed in selecting schools for the study. In the first stage, stratified random sampling technique was used in selecting co-educational schools from all the schools in the local government while simple random sampling technique by balloting was used to select two co-educational schools and two intact classes (one from each coeducational school) and in assigning the classes to groups. The experimental group was taught basic ecological concepts with indigenous knowledge instructional strategies for 5 weeks (15 periods of 45 minute each) while the control group was taught same concepts for the same period but with lecture method in a pretest posttest control group design format.

Experimental treatment

Indigenous science –based instructional strategy.

This is the experimental treatment in this study. It is an indigenous instructional strategy in which emphasis is on co-creating knowledge that is rooted in social and cultural context. Lessons were student- centred and in stages. In the first stage, the teacher gives the students the topic to be studied to reflect on its relevance to their environment. He then takes the students out to observe the ecosystem of their immediate environment to make sense of the meaning of certain concepts related to ecology. Students also ruminate on local beliefs about their environment and why it must be preserved. This becomes a basis for classroom discussions. At the next stage of the lesson, both teacher and students draw practical inspiration from what they observed from the environment to and suggest/give examples relevant to the topic being learned. The teacher helps them draw science interpretation of their contributions. The teacher clears up misconceptions and erroneous beliefs and summarizes the content of the topic while constantly drawing reference from the earlier observations and contribution made by students. The teacher then gives the group assignment in preparation for the next lesson. The peculiarity of the pedagogy I that knowledge domiciled in the context of the locality becomes the basis for locating and clarifying the science knowledge.

Control Group

The concepts taught are the as that of the experimental group except that the lecture method in which the teacher gives out the content to the students systematically after which the students copy down the teacher prepared note or the board summary.

Data was collected using a 50-item multiple choice Biology Achievement Test on Basic Ecological Concept (definition of ecological concepts, biomes, population studies, ecological factors and functioning ecosystem) drawn from SS1 Biology scheme of work used in Delta State. The reliability of the achievement test was found by KR 21 to be .72. The Biology Interest Scale (BIS), a 15-item scale constructed by the researchers in a four- point Likert format of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) was used to collect data on interest. Its reliability was found by Cronbach alpha to be 0.82.

Results

The results of this study are presented in tables as shown below.

Null Hypothesis one: There is no significant difference in the mean interest score of students taught Biology concepts using indigenous knowledge instructional strategies and those taught with lecture method.

Table 1: Manny Whitney U test Analysis for BIS Ranks of Experimental and Control Group

Group	N	Mean Rank	Sum of Ranks	U	P value
Experimental	48	59.39	3029.00	898.00	.007
Control	50	43.61	2224.00		
Total	98				

At significance of $P \leq 0.05$

Table 1: Table 1 shows the calculated U = 898.00 with a P value of 0.007 which is less than 0.05 indicating that there is a significant difference between the interest score of students taught using indigenous knowledge instructional strategies and those taught with conventional lecture method, The null hypothesis is therefore rejected. This means that there is a significant difference in the mean interest score of the students taught with the two strategies.

Null Hypothesis two: There is no significant difference in the mean achievement score of students' taught Biology concepts using indigenous knowledge instructional strategies and those taught with lecture method.

Table 2:

t-test analysis of the post-test scores of experimental and control groups

Group	N	Mean	SEM	Df	t	Sig(2-tailed)
Experimental	48	36.25	.53	96	15.204	.000
Control	50	24.58	.55			

At significance of $P \leq 0.05$

Table 2 shows the calculated t = 48.17 (P = 0.000) at alpha level of 0.05 indicates that there is a significant difference in mean the achievement score of students taught biology concepts using indigenous knowledge instructional strategies and those taught with lecture method. The null hypothesis is therefore rejected. This implies that the mean achievement scores of the students varied according to the groups.

Discussion of Results

This study investigated the effect of indigenous knowledge instructional strategy on Biology students' interest and achievement among senior secondary school (SS1) biology students in Delta State. Research has established that students have low interest towards Biology (Pacific & Thomson, 2011). The result of this study revealed that there is a significant difference in the interest in Biology among students exposed to indigenous knowledge instructional strategies and those exposed to lecture method with the indigenous knowledge instructional strategies enhancing high interest in Biology learning among students. The observed effect of indigenous knowledge instructional strategies could be related to the students' familiarity with the practices and materials they were taught with. The introduction of indigenous scientific processes has also improved the interpersonal relationship between the students as there was ample opportunity for collaboration and interaction with one another during the indigenous scientific process. This result agrees with the findings of Abonyi (2002) and Obiekwe (2008) who reported high learning outcome from indigenous knowledge instructional strategies.

Null hypothesis two showed that the students in the experimental group taught Biology (basic ecological concepts) using the indigenous knowledge instructional strategies performed significantly better than their counterparts in the control group who were taught same concept using lecture method. This suggests the effectiveness of the indigenous knowledge instructional strategies at enhancing learners' achievement over lecture method. This could be because the indigenous knowledge instructional strategies involve practices which learners are familiar with. The introduction of such activities in classroom interaction gave rise to a novel situation that influenced the learners' inquisitiveness towards learning. The students' familiarity with the practices provided them with the required link to which they anchored learning. Thus, the practices acted as prior knowledge which Jegede and Akienhead (1999) stressed was necessary for meaningful learning. The finding of this study is supported by those of Ugwu and Divou (2016), Onowugbeda et al (2023) and Ajayi et al (2023) who studied integration of indigenous knowledge and practices into various science subjects (Biology and Chemistry) teaching and students' academic achievement. Their findings revealed that students taught chemistry using indigenous knowledge and practices had higher academic achievement than those taught using the conventional approach. They argued that the higher performance by the group taught using indigenous knowledge and practices was because the group was able to link what they were taught to their day-to-day activities especially if they are relevant to their classroom modern science.

The relatively poor performance of students in the control group is an indication of the ineffectiveness of lecture method of teaching, even though it has been the most adopted among teachers. The poor performance attributed to lecture method was because it only appeals to learners' auditory sense (Onu, et al 2020; Oyelekan, Igbokwe & Olorundare, 2017; Omorogbe & Ewansiha, 2013; Paris, 2014). Thus, learners who are weak in cognition learn better by doing rather mere listening. They thus will not benefit from lecture instruction which demands rote learning and memorization. The indigenous knowledge instructional strategies on the other hand, involved students in out of class observations that relate classroom science to everyday practices of the learner which they previously did not understand as scientific. The use of these strategies had influenced the inquisitiveness of the students and had motivated them to learn. This position is supported by Taruna (2017), who argued that meaningful learning that yields good academic performance takes place when teaching is structured alongside good instructional conditions that

promotes active participation of learners in the learning process as in the indigenous instructional strategy.

Conclusion

The use of indigenous knowledge instructional strategies in the teaching and learning of biology in the secondary school has significant impact on the students' achievement and interest in Biology. It is therefore concluded that the use of indigenous knowledge instructional strategies significantly improves students' achievement and interest among students in Delta State.

The following conclusions were drawn from the findings of the study:

1. The use of indigenous knowledge instructional strategies in teaching Biology concepts to secondary school students improves their interest in the subject.
2. The use of indigenous knowledge instructional strategies in teaching Biology concepts to students at the secondary education level enhances students' performance.
3. Students taught using indigenous knowledge instructional strategies perform better than their counterparts who were taught with lecture method.
4. Indigenous knowledge possessed by learners, and which has good relationship with scientific knowledge are beneficial in domesticating appropriate science knowledge leading to meaningful learning.

Recommendations

Based on the findings derived from the study the following recommendations are suggested:

1. Teachers should adopt the indigenous instructional strategy in teaching concepts that have both cultural and classroom relevance in biology. This will enable them to draw link between school science and certain cultural practices with scientific connection.
2. Teachers should be trained in the use of indigenous strategies through organized workshops, seminars, and continuing teacher improvement procedures both at pre-service and in-service levels.
3. Government agencies and professional associations whose responsibility is to design and review the curriculum for secondary school should incorporate and emphasize the use of indigenous knowledge instructional strategies in teaching of senior secondary

schools Biology and other science subjects. This will reduce the alien view of science held by some non-western science learners and thus demystify science.

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