

UNIJERPS
Unizik Journal of Educational Research and Policy Studies VOL.16 (3);
https://unijerps.org
2023 Impact Factor:* 6.834;** 2022 ***Impact Factor: 5.156; ***2021 Impact Factor: 5.641; 2020 Impact Factor: 5.355.***
Indexing and Impact Factor URL: http://sjifactor.com/passport.php?id=21363
July-December, 2023

EFFECTS OF INTERPRETATION CONSTRUCTION-BASED TEACHING METHOD ON ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL BIOLOGY STUDENTS IN AWKA SOUTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE

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ABSTRACT

The main purpose of the study was to determine the effects of interpretation construction-based teaching method on academic achievement of secondary school biology students in Awka South Local Government Area of Anambra State. Four research questions and four null hypotheses guided the study. The design of this study is quasi-experimental, specifically, a pre-test, post-test, non-equivalent control group research design involving the use of intact groups. This study was carried out in public secondary schools in Awka South Local Government Area of Anambra State. The population of the study is 4,811 respondents comprising 2,580 male and 2,231 female Senior Secondary year two (SS2) students in the in the 18 public secondary schools in Awka South Local Government Area of Anambra State. The sample of the study is made up of 253 SS2 biology students made up of 153 males and 100 females which are chosen by multi-stage sampling procedure. A researcher-developed instrument titled "Biology Achievement and Interest Tests (BAIT) was used for data collection. The face and content validity of BAIT was established by the researcher through the use of experts. The questionnaire were pre-tested with 30 SSII students in Awka North LGA. The data collected from the students' responses to the items of the instrument were used to determine the reliability of the instrument. The reliability of the items on part B (achievement) was established using Kudder Richard (K – R20) method. Eight sets of lesson plan prepared by the researcher were used to teach students. Four sets for the experimental group and four sets for the control group. Measures were taken to control extraneous variables that were likely to affect the results of the experiment. Biology teachers in the selected schools were recruited to assist in teaching the students. Data generated in the study were collated and analyzed using means scores and standard deviations to answer the research questions. The hypotheses were tested at 0.05 level of significance using ANCOVA (analysis of covariance). Findings indicated that the biology students after exposure to interpretation construction-based teaching method recorded a higher biology knowledge mean score of $\bar{X}$=71.43 than before the exposure which is $\bar{X}$=61.65 and that male biology students gained higher biology knowledge mean difference scores of ($\bar{X}$=3.75) after exposure to interpretation construction-based teaching method than the females. It was also found that male biology students gained higher biology knowledge



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mean scores of ($\bar{X}$=5.4) than females ($\bar{X}$=1.5) and that the biology students recorded a higher interest in biology mean difference scores of ($\bar{X}$=71.89) after exposure to interpretation construction-based teaching method than before exposure to interpretation construction-based teaching method ($\bar{X}$=61.21). The following recommendations were made based on the findings of the study: teachers should use interpretation construction-based teaching method to teach students in biology; government should provide adequate instructional materials for secondary school students in biology as way of encouraging teachers to employ interpretation construction-based teaching method in teaching their students; government should employ qualified and competent teachers to teach biology using the interpretation construction-based teaching method; government and school administrators should ensure adequate supply of facilities in schools to ensure good application of interpretation construction-based teaching method in teaching the students; the Biology teacher should employ appropriate methods and skills in relation to the topic they wish to deliver in biology lessons and also in relation to the interpretation construction-based teaching method; and that the biology teachers should realize that cooperative learning through interpretation construction-based teaching method is more productive than competitive learning through interactive in nature.

Keywords: Effect; Interpretation Construction; Teaching Method; Academic Achievement; Biology Students

Introduction

Education is an important process through which men preserve their culture. School is a special institution which has been entrusted with the responsibilities of young ones, and teaching is the main activity through which schools discharge their duties and attain their objectives. If teaching is done effectively, schools, successfully, achieve their goals. Many efforts have been made to study teaching and improve it in order to make it realise pre-determined goals. Teaching involves setting appropriate learning expectations for students, and, for that purpose, includes selection and sequencing of activities or kinds of interactions that would lead to expected learning.

Teaching is an intimate contact between a more mature personality and a less mature one which is designed to further the education of the latter (Morrison, 2014). Teaching is an arrangement and manipulation of a situation in which there are gaps and obstructions which an individual will seek to overcome and from which he will learn in the course of doing so (Brubacher, 2014). Teaching is a system of actions intended to produce learning (Smith, 2015). Teaching is a form of interpersonal influence aimed at changing the behaviour potential of another person (Gage, 2015). Teaching is a system of actions involving an agent, an end in view, and a situation including two sets of factors those over which the agent has no control

(class size, size of classroom, physical characteristics of pupils, etc.) and those that he can modify (way of asking questions about instruction and ways of structuring information or ideas gleaned) (B.O. Smith, 2014). Teaching is defined as an interactive process, primarily involving classroom talk which takes place between teachers and pupils and occurs during certain definable activities (Edmund Amidon, 2015). According to (Clarke, 2015). Teaching is the task of a teacher which is performed for the development of a child (Green, 2015). Aurobindo (2016), have defined it as "The first principle of true teaching is that nothing can be taught". In the words of English and English (2016) "The teaching is the art of assisting others to learn. It includes the providing of information (instruction) and of appropriate situation, conditions or activities design to facilitate learning". The focus of this study is on biology.

Biology is the natural science subject and amongst the compulsory subjects taught at the senior level in the secondary school curriculum in Nigeria. The subject is essential for many fields of learning contributing to the national economy such as medicine, agriculture, biotechnology, and nursing (Ghumdia & Adams, 2017). Learning biology equips learners with knowledge and skills that help them to face challenges in society especially those related to common diseases, pollution, and genetics. Furthermore, Biology subject leads to self-understanding and to how the body works (Kareem, 2018), hence deserves due consideration in school curricula as well as an emphasis on the teaching-learning continuum. It is, therefore, important that schools utilize effective methods to teach this subject so that students achieve the planned objectives.

However, despite the importance of biology as a subject, and being at the core of the senior secondary education curriculum in Nigeria, the performance in biology subject has remained persistently poor for years. Statistics show that only 30.5%, 37.1%, 48.1% and 53.7% students for 2012, 2013, 2014 and 2015 years respectively passed national examination in biology (Opara, 2011). As a consequence, few students are selected to pursue Biology in advanced secondary education which contributes to the meagre pool of biologists in Nigeria. Hence, it was important to investigate the underlying factors to this poor performance in biology in secondary education in Nigeria.

Students' poor performance has partly been ascribed to poor teaching methods adopted by teachers (Jepketer, 2017; Jolif, 2018; Nghambi, 2014). For instance, in the delivery of the curriculum content in secondary schools, studies have revealed that secondary teachers including Biology teachers mostly rely on the conventional methods that are mainly lectures, and sometimes few demonstrations to convey ideas and facts in the teaching and learning process (Blyth, 2010; King'arru, 2014). In these methods, it was observed that teachers dominated the class during the instruction process by transferring the

knowledge with little or without inputs from the students. Students are passively involved, implying they just listen and receive information from their instructors. Indeed, teacher-centred methods limit students' participation, deep understanding of the concept, and creativity, hence seen to be poor in influencing students' achievement as compared to other alternative teaching strategies like Collaborative Learning Strategies, Instructional Technology Strategies, and Inquiry Strategies (Chowdhury, 2016). Therefore to improve performance in biology it is important to transform the teaching approaches. One way to do this is, as is the focus of this paper, is to use interpretation construction-based teaching method in the teaching and learning process.

There has been a consistent poor achievement in Biology as shown by the West African Examination Council (WAEC) annual reports of (2010-2015). Many scholars have therefore tried to find the ways and means of improving student's achievements in Biology. They have, therefore, looked at many factors and carried out some empirical studies on the impact of these factors on performance of students.

The factor considered in the present study is the impact of two teaching methods: (practical and demonstration) on secondary school student's performances in Biology. The methods being considered are the practical and the lecture methods. These two (2) methods encourage co-operative learning between the teacher and the learners. Johnson and Johnson (2015) were of the opinion that co-operative learning experiences promoted higher achievement among the students. Although most studies have stressed on students' participation and interaction as being very important factors of achievement, there may, however, be other alternative contributing factors and teacher's method of teaching is definitely one of them.

Jonassen (2016), states that pedagogy is a different way by which a teacher can teach. Teaching method therefore, is the act or science of being a teacher, generally referring to strategies of instruction or style of instruction. Science is an activity-oriented subject. The way it is thought is important in helping the students acquire basic scientific knowledge, skills and attitude to solving different problem in life. Biology being a science subject, therefore involve the teacher using methods that will give the students opportunity to be actively involved.

It is a well-known fact that no skilled teacher ever uses just one method of teaching Shield (2015), pointed out that good teachers follow no one method, instead he/she uses whatever methods and materials that seems to be best for the particular combination of individual situations.

This research work is focused mainly on practical and lecture methods of teaching. Practical method involves teaching and learning using practical work. By 'practical work' we mean tasks in which students observe or manipulate real objects or materials or they witness a teacher demonstration practical enhance the learning

of scientific knowledge. Give insight into scientific method and develop expertise in using it. The lecture method is a pedagogical method whereby the teacher formally delivers a carefully planned expository address on some particular topic.

It is important to bear in mind the significant differences between the research laboratory and the teaching laboratory (or classroom); and between research scientists exploring the boundaries of the known and students trying to come to terms with already accepted knowledge.

In the context of teaching scientific knowledge, practical work is best seen as communication, and not as discovery. According to Wirschner (2015), lecture method is a teaching method that a teacher diverse a pre-planned body of knowledge to students, the teacher is active while the students are passive. These methods are usually employed in tertiary institution e.g Universities, Colleges of education and Polytechnics.

According to Mayer (2015), Lecture methods are done to give a formal talk to a group of people, often at universities. It provides an opportunity to learn new explanation of tasks from a different perspective. A teacher may use lecture method ideas in a science class. Lecture may be used in the circumstance of proving conclusively a fact, as by reasoning or showing evidence.
For instance, the classroom teachers after conduct formative and summative tests, to evaluate students mastering of course content and provide grades for students and parents. This relative achievement of secondary school students is an example that has internal and external impact depending on the method adopted by the teacher.

According to According to Mayer (2014), a lecture method (from the French lecture, meaning reading) is an oral presentation intended to present information or teach people about a particular subject, for example by a university or college teacher. Lectures are used to convey critical information, history, background, theories, and equations. A politician's speech, a minister's sermon, or even a businessman's sales presentation may be similar in form to a lecture. Usually the lecturer will stand at the front of the room and recite information relevant to the lecture's content.

According to According to Wirschner (2014), lecture method of teaching is the oldest teaching method applied in educational institution. This teaching method is on way channel of communication of information. Students' involvement in this teaching method is just to listen and sometimes pen down some notes if necessary, during the lecture, combine the information and organized it. According to According to Mayer (2016), though lectures are much criticised as a teaching method, universities have not yet found practical alternative teaching methods for the large majority of their courses. Critics point out that lecturing is mainly a one-way method of communication that does not involve

significant audience participation but relies upon passive learning. Therefore, lecturing is often contrasted to active learning. Lectures delivered by talented speakers can be highly stimulating; at the very least, lectures have survived in academia as a quick, cheap, and efficient way of introducing large numbers of students to a particular field of study. It is in the light of the above that the need to examine the effect interpretation construction-based teaching method on secondary school student performance in biology cannot be over emphasized.

According to Black and McClintock (2006) cited in Akachukwu and Okoli (2021), interpretation construction-based instructional strategy (ICOBIS) is a set of belief about learning that emphasizes on students' encounter with authentic issues individually; on constructing interpretations by students in groups; searching for information about the problem in groups and facing different interpretation about the problem in groups. Thus, ICOBIS is a group-based teaching and learning approach in which knowledge is constructed by the learners in groups in an attempt to integrate existing knowledge within the new experiences.

As noted by Akachukwu and Okoli (2021), interpretation construction-based teaching method involves different stages. In the first stage, students were sent out to engage in individual observations. They offer individual interpretation to their observations. The second stage involved interaction with the teachers who noted their misconceptions or previous knowledge. In the third stage, the students were grouped and sent out to engage in group observation. The students gave a group interpretation to the group observation. The students come back again and interacted with the teacher. The teacher then guided the students' learning while engaging them in brief discussions about what they observed. This approach to learning could improve students' achievement.

Statement of the Problem

The popular opinion in Nigeria today is that the standard of Education has fallen short of what it should be. This fall in the standard of education is perceived by many as the inability of the teachers to impact knowledge to the learners, the way they will understand and write well in examinations. Reports by examination councils in Nigeria have disclosed the recurrent and endemic failure of students in both internal and external examinations especially in Biology (WAEC) annual reports; (2010-2015). Agbo (2010), says that ''teachers no more show commitment as they see themselves as most "measure up". Also, Layi, (2004), found out that teacher's lateness to work, absenteeism and poor attitude to work encourage indolence and contribute to poor performance among students. The problem of this study is therefore to investigate the effects of interpretation construction-based teaching method on academic achievement of secondary school biology students in Awka South Local Government Area of Anambra State.

Research Questions

1. What are the mean achievement scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method?
2. What are the mean interest scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method?
3. What differences exist between the mean achievement scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method?
4. What differences exist between the mean interest scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method?

Null Hypotheses

1. There will be no significant difference between the mean achievement scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method.
2. There will be no significant difference between the mean interest scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method.
3. There will be no significant difference existing between the mean achievement scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method.
4. There will be no significant difference existing between the mean interest scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method.

Research Method

Research Design: The design of this study is quasi-experimental, specifically, a pre-test, post-test, non-equivalent control group research design involving the use of intact groups.

Area of the Study: This study was carried out in public secondary schools in Awka South Local Government Area of Anambra State. The state has 21 local government areas distributed in three senatorial zones. It is one of the local government areas in the State. The Awka South LGA is at Awka Town and it is one of the 21 existing LGAs of the state comprising the towns of Amawbia, Ifite-Akwa, Ezinato, Ishiagu, Mbaukwu, Nibo, Nise, Okpuno, Umuawulu, under its administration. The area is Urban

and highly populated, and inhabitants are Igbo speaking. Inhabitants of the towns in the area are mainly traders, artisans, civil servants, bankers, medical doctors and other professionals.

Population of the Study: The population of the study is 4,811 respondents comprising 2,580 male and 2,231 female Senior Secondary year two (SS2) students in the in the 18 public secondary schools in Awka South Local Government Area of Anambra State.

Sample and Sampling Techniques: The sample of the study is made up of 253 SS2 biology students made up of 153 males and 100 females which are chosen by multi-stage sampling procedure. First, only the public co-educational secondary schools were chosen by purposive sampling technique. Out of 15 public co-educational secondary schools in Awka South Local Government Area of Anambra State, four (4) co-educational secondary schools were selected by simple random sampling technique through balloting with replacement. Two schools were randomly assigned into experimental group and the two other schools were assigned control group. In each of the schools selected, one intact class was randomly drawn by simple balloting. All the students in each of the four classes will be used for the research.

Instrument for Data Collection: A researcher-developed instrument titled "Biology Achievement and Interest Tests (BAIT) was used for data collection. Consultation with experts in biology and knowledge gained from the review of related literature guided the researcher in developing the instrument. The instrument has two parts; A and B. Part "A" contained items on personal data of the respondents (i.e. gender, school). Part "B" contained items in biology with five response options of A, B, C, D and E. Similarly, Part B of the instrument contained items on students' interest in biology with four-point response options of SA (Strongly Agree); A (Agree); D (Disagree) and SD (Strongly Disagree). The BAIT was used for the pre-test and post-test. Lesson plan written by the researcher was used for teaching the students in both groups.

Validation of the Instrument: The face and content validity of BAIT was established by the researcher through the use of experts. To do this, copies of the instrument together with purpose of study, research questions and hypotheses were given to one expert in biology, one expert in curriculum and one expert in measurement and evaluation, all from Nnamdi Azikiwe University, Awka. They were asked to examine the instrument in terms of content relevance, item clarity and coverage of the aspect under investigation. The experts' suggestions guided the construction of final draft.

Reliability of the Instrument: The questionnaire was pre-tested with 30 SSII students in Awka North LGA. This was done with the assumption that the school and subjects of the study are similar and

comparable with those to be used in the final study.

In order to do this, copies of the instrument was administered on a group of thirty (30) SSII students by the researcher and research assistants on face – to – face basis and were collected on the spot. The data collected from the students' responses to the items of the instrument were used to determine the reliability of the instrument. The reliability of the items on part B (achievement) was established using Kudder Richard (K – R20) method. The reliability value was reported in the work. On the other hand, Cronbach Alpha's internal consistency measure was used to establish the reliability of interest in biology on a four-point scale. The value was also reported in the work. Hence, the instrument was considered reliable for the study.

Experimental Procedure: Eight sets of lesson plan prepared by the researcher were used to teach students. Four sets for the experimental group and four sets for the control group. This was covered under a total of eight (8) periods, periods (i.e. 80 minutes) for each lesson.

Control of Extraneous Variables: The following measures were taken to control extraneous variables that are likely to affect the results of the experiment:

a. Instruction of research assistants was carried out by the researcher. The instruction was done in such a way as based on the strategy for the study in and the teaching plan.

b. To avoid experimental bias and to maintain homogeneity of instruction, the training of the research assistants was done by the researcher with common lesson plan.

c. The time for post-test was not be too long after treatment to avoid forgetting what they had learned.

d. The pre-test items were reshuffled and renumbered before they were used for post-test to reduce the influence of the pre-test on their response to the post-test.

Method of Data Collection: Training of Research Assistants: Biology teachers in the selected schools were recruited to assist in teaching the students. Since they are teachers already, the training given to them involved giving them instructions and procedures to be followed in assisting the researcher to present the lessons to the students using interpretation construction instructional method. Instructional materials were made available to them so as to ensure that the knowledge they impart is adequate and uniform. The instrument was administered for the pre-test by the researcher and research assistants in the selected schools on face to face basis. At the end of the teaching programme, copies of the same questionnaire were served to the participants. This time, however, the items were reshuffled, and administered to the subjects in the groups by the researcher and research assistants so that there was no influence of the pre-test on their response to the post-test.

Method of Data Analysis: Data generated in the study were collated and analyzed using Statistical Package for Social Sciences (SPSS) version 15. Means scores and standard deviations were used to answer the research questions. The differences between the pre-test mean and post-test means were regarded as the mean difference scores and were used to answer the research questions. The hypotheses were tested at 0.05 level of significance using ANCOVA (analysis of covariance).

Results and Discussion

This chapter presented the analyses of data generated from the study according to research questions and hypotheses. The summaries of major findings of the study were also presented.

Research Question 1: What are the mean achievement scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method?

Table 1: Mean achievement scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method (n = 253)

Study Groups	N	$\overline{X}$	SD	$\overline{X}$ Difference
Pre-Test	253	61.65	16.55	
Post –Test	253	71.43	14.71	9.78

The data in Table 1 showed the biology knowledge mean difference scores $\bar{X}$= 9.78 of the students after exposure to interpretation construction-based teaching method. The findings of the study showed that the post-test biology knowledge mean score X=71.43 of the students was higher than their knowledge mean score $\bar{X}$= 61.65 before exposure to interpretation construction-based teaching method. This means that the biology knowledge of the students improved after the exposure to interpretation construction-based teaching method.

Research Question 2: What are the mean interest scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method?

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Table 2: Mean interest scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method (n = 253)

Study Groups	N	$\overline{X}$	SD	$\bar{X}$ Score Difference
Pre-Test	253	61.21	11.13	
Post –Test	253	71.89	10.47	10.68

The data in Table 2 showed the mean difference scores of ($\bar{x}$ = 10.68) in the biology knowledge of the students before and after exposure to interpretation construction-based teaching method. The findings of the study showed that the post-test of biology knowledge score of ($\bar{x}$ =71.89) of the students was better than their mean score of ($\bar{x}$ = 61.21) before exposure to interpretation construction-based teaching method.

Research Question 3: What differences exist between the mean achievement scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method?

Table 3: Mean Achievement Score Differences of male and female students taught Biology using Interpretation Construction-Based Teaching Method and those taught using Lecture Method (n = 253)

Gender	N	Pre-Test $\overline{x}$	Post-Test $\overline{x}$	(X) Difference
Male	153	55.6	60.00	4.4
Female	100	57.85	63.75	5.9

Data in Table 3 showed that the male students recorded pre-test biology knowledge mean of $\bar{X}$=55.6 and posttest biology knowledge mean of $\bar{X}$ =60.00 with mean difference of $\bar{X}$ =4.4. In the same vein, the female students recorded pre-test biology knowledge mean of $\bar{X}$=57.85 and posttest biology knowledge mean of $\bar{X}$=63.75 with mean difference of $\bar{X}$=5.9.

Research Question 4: What differences exist between the mean interest scores of male and female students taught biology using interpretation construction-based

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teaching method and those taught using lecture method?

Table 4: Mean Interest Score Differences of male and female students taught Biology using Interpretation Construction-Based Teaching Method and those taught using Lecture Method (n = 253)

Gender	N	Pre-Test $\bar{x}$	Post-Test $\bar{x}$	$\bar{X}$ Difference
Male	149	66.33	71.8	5.4
Female	104	60.86	62.36	1.5

Data in Table 4 showed that biology students who are males recorded pre-test biology knowledge mean of $\bar{X}$=66.33 and posttest biology knowledge mean of $\bar{X}$=71.8 and those who are males recorded pre-test interest in biology mean of $\bar{X}$=60.86 and posttest interest in biology mean of $\bar{X}$=62.36. The table showed the mean difference of ($\bar{X}$=3.9) in favour of male biology students.

Testing Null Hypotheses

Hypothesis 1: There will be no significant difference between the mean achievement scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method.

Table 5: Summary of ANCOVA Analysis of the Difference Between The Mean Achievement Scores Of Students Taught Biology Using Interpretation Construction-Based Teaching Method And Those Taught Using Lecture Method. (n=253)

Source of variation	**Sum of squares**	**Degree of Freedom**	**Mean squares (Variance Estimate)**	**F-ratio**	**P-value (0.05)**
Corrected model	201.53(a)	2	12.36	31.90	0.01
Intercept	2332.01	1	180.09	98.24	0.004
Biology Knowledge scores	214.23	2	12.31	4.05	0.002
Error	1212.4	250			
Total corrected	6215.01	253			
Total	3221.02	252			

a = R squared = 31 (Adjusted R. Square=28)

Table 5 shows the summary of ANCOVA analysis of testing the null hypothesis of no significant difference between the mean achievement scores of students taught

biology using interpretation construction-based teaching method and those taught using lecture method. The table shows the F-value of 4.05 with a corresponding P-value of 0.02 at 2 degree of freedom. This implies that the biology knowledge of the students before and after exposure to interpretation construction-based teaching method differed.

Hypothesis 2: There will be no significant difference between the mean interest scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method.

Table 6: Summary of ANCOVA Analysis of No Significant Difference Between The Mean Interest Scores Of Students Taught Biology Using Interpretation Construction-Based Teaching Method And Those Taught Using Lecture Method (n=253)

Source of variation	Sum of squares	Df	Mean squares	F-ratio	P-value (0.05)
Corrected model	250.8	2	12.44	24.89	0.01
Intercept	2322.2	1	160.84	194.3	.003
Biology Interest score	262.4	2	12.24	3.64	0.041
Error	3340.1	250			
Total corrected	33.40.1	253			
Total	3436.1	252			

a = R squared = .26 (Adjusted R Squared =.21)

The data in table 6 above showed that the F-ratio was 3.64 with p-value of 0.041. The ANCOVA analysis therefore indicated significant difference in the mean interest scores of students taught biology using interpretation construction-based teaching method and those taught using lecture method before and after exposure to interpretation construction-based teaching method. Hypothesis 2 is therefore significant.

Hypothesis 3: There will be no significant difference existing between the mean achievement scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method.

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Table 7: Summary of ANCOVA Analysis of Biology Knowledge Mean Scores of Students According to Gender (n=253)

Source of variation	Sum of squares	Degree of Freedom	Mean squares (Variance Estimate)	F-ratio	P-value (0.05)
Corrected model	343.02(a)	2	11.42	24.88	0.01
Intercept	2053.11	1	149.7	77.09	0.005
Gender score	205.14	2	12.63	3.99	0.031
Error	1232.01	250			
Total corrected	5392.1	253			
Total	3111.01	252			

a = R squared = 43 (Adjusted R Square = 32)

Table 7 shows the ANCOVA summary of biology knowledge mean scores of the students according to gender. There was significant difference among the mean scores on biology knowledge of male and female students before and after exposure to interpretation construction-based teaching method df =2; F-ratio =3.99; p=0.031). P-value is less than the F-ratio, hypothesis 3 is therefore significant.

Hypothesis 4: There will be no significant difference existing between the mean interest scores of male and female students taught biology using interpretation construction-based teaching method and those taught using lecture method.

Table 8: Summary of ANCOVA Analysis of Interest in Biology Mean Scores of the Students According to Gender (n=253)

Source of variation	Sum of squares	Df	Mean squares	F-ratio	P-value (0.05)
Corrected model	206.31	2	12.02	21.61	0.01
Intercept	1531.5	1	160.82	79.03	0.003
Gender scores	204.21	2	12.05	3.11	0.002
Error	1112.32	250			
Total corrected	501.02	253			
Total	3112.06	252			

a= R Squared = 34 (Adjusted R Square = 38)

Table 8 showed the ANCOVA summary of interest in biology mean scores of male and female research participants. The data in the table showed that the F-value was 3.11 while the p-value was 0.002. The ANCOVA analysis therefore indicated significant

difference in interest in biology mean scores of the male and female students. The hypothesis was therefore significant.

Summary of Major Findings

Based on data analysis, the following major findings were made:

1. The biology students after exposure to interpretation construction-based teaching method recorded a higher biology knowledge mean score of $\bar{X}$=71.43 than before the exposure which is $\bar{X}$=61.65.
2. Male biology students gained higher biology knowledge mean difference scores of ($\bar{X}$=3.75) after exposure to interpretation construction-based teaching method than the females.
3. Male biology students gained higher biology knowledge mean scores of ($\bar{X}$=5.4) than females ($\bar{X}$=1.5).
4. The biology students recorded a higher interest in biology mean difference scores of ($\bar{X}$=71.89) after exposure to interpretation construction-based teaching method than before exposure to interpretation construction-based teaching method ($\bar{X}$=61.21).
5. Males biology students gained higher interest in biology mean difference scores of ($\bar{X}$=71.2) after exposure to interpretation construction-based teaching method than the females.
6. Biology students who were males recorded higher interest in biology mean scores ($\bar{X}$=18.6) than female biology students ($\bar{X}$=8.08).
7. There was a significant difference ($p<0.05$) in the biology knowledge mean scores of biology students before and after exposure to interpretation construction-based teaching method.
8. There was a significant difference ($p < 0.05$) in the knowledge mean scores of male and female biology students after exposure to interpretation construction-based teaching method.
9. There was significant difference ($p < 0.05$) in the interest in biology scores of male and female biology students after exposure to interpretation construction-based teaching method.

Discussion of Findings

The study findings show that the use of interpretation construction-based teaching method had a significant effect on the students' achievement in Biology. This concurs with Adejo (2015) who indicated that the interpretation construction-based teaching method was effective on students' understanding of scientific knowledge. Also, the results agree with Opara (2011) who revealed that students exposed to the interpretation construction-based teaching method scored higher on the test composed in the selected units of biology than students exposed to the traditional method. Moreover, the results are in line with Annan et al. (2019) who found that students taught using the interpretation construction-based teaching method did better on the biology test than those taught using the lecture method. This implies that with the use of the interpretation construction-based teaching

method students may understand the biological concepts better since the conceptual understanding is developed based on the evidence from the experiences and not transmitted directly from the teacher.

On the other hand, the study revealed that female students performed better than males in the post-test. The pretest showed that male students performed slightly higher than their counterpart female students. This may suggest that in this class, male students were more interested in biology and showed to be good at it than female students. Probably, it is for this reason that they were even more interested in the biology class activities that made them do even better in the post-test than female students.

These findings are inconsistent with Opara (2011) who indicated that males scored high than females when taught some selected units of biology using the interpretation construction-based teaching approach. He explained that this was probably because pictures in books and models for teaching were gender biases favoring boys than girls. However, the reason stipulated is not associated with the examined method. Also, the study results were contrary to those by Adejo (2015) who found that the post-test mean scores of males and females in the conceptual understanding of the selected topics of chemistry subject were not statistically significant with the use of interpretation construction-based teaching method. So, Adejo confirmed that the interpretation construction-based teaching method had no impact on gender. The contradicting findings suggest that there is a need for more research on the effects of interpretation construction-based teaching method on students' performance by gender. Future research may therefore examine how girls and boys get engaged with interpretation construction-based teaching method learning activities and how this may affect their interests and performance.

Conclusion

The use of the interpretation construction-based teaching method was seen to be an effective approach for teaching biology and other science subjects. This method improved students' achievement and interest as seen in the findings of the study and other earlier similar findings. It helps students to internalize the understanding of the concepts since students pass through series of activities to come up with knowledge.

Recommendations

The following recommendations were made based on the findings of the study:

1. Teachers should use interpretation construction-based teaching method to teach students in biology.
2. Government should provide adequate instructional materials for secondary school students in biology as way of encouraging teachers to employ interpretation construction-based teaching method in teaching their students.

3. Government should employ qualified and competent teachers to teach biology using the interpretation construction-based teaching method.
4. Government and school administrators should ensure adequate supply of facilities in schools to ensure good application of interpretation construction-based teaching method in teaching the students.
5. The Biology teacher should employ appropriate methods and skills in relation to the topic they wish to deliver in biology lessons and also in relation to the interpretation construction-based teaching method.
6. Biology teachers should realize that cooperative learning through interpretation construction-based teaching method is more productive than competitive learning through interactive in nature.

Acknowledgements

This research work was funded by TETFund under the Institutional Based grant (TETF/DR/CE/UNI/AWKA/IBR/2022/VOL.1) awarded to **Dr. Chikendu, Rebecca Ebonam** of Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State. The researcher is grateful to TETFund, Abuja, for the full funding of the research. The researcher's gratitude goes to the Management of Nnamdi Azikiwe University and the Director, TETFund Implementation Committee, Nnamdi Azikiwe University for their contributions to the study.

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