EFFECTS OF COLLABORATIVE PROBLEM-SOLVING INSTRUCTIONAL STRATEGY ON SECONDARY SCHOOL STUDENTS' INTEREST IN DIFFICULT CONCEPTS IN BIOLOGY IN BENUE STATE, NIGERIA

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Abstract
This study investigated the effects of collaborative problem-solving instructional strategy on secondary school students' interest in difficult concepts in Biology, in Benue State. Two research questions guided the study, while two hypotheses were formulated and tested. The study adopted quasi-experimental design and the population comprised 8,511 senior secondary two students from which a sample of 270 SSII students was selected from four public schools using multistage sampling technique. Data were obtained using Biology Interest Inventory (BII). The instruments were variously validated and subjected to reliability analysis using Kuder-Richardson formula 21(KR_21) for BAT, while Cronbach Alpha was used for BII. Biology performance test yielded a reliability of 0.85 while BII yielded 0.79. Data collected were analysed using Mean, profile graph and Standard Deviations to answer research questions while analysis of covariance (ANCOVA) was used to test the hypnoses at 0.05 level of significance. The findings of the study revealed that there is significant difference in mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method (F1,175) = 0.323; p = 0.003 < 0.05); there is no significant difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy (F1, 87 = 1.927; p = 0.169 > 0.05). Based on the findings, it was recommended among others that Biology teachers could use collaborative and individualized problem-solving instructional strategy to improve interest of their students in Biology irrespective of gender.

Keywords: Collaborative problem-solving instructional strategy, Discussion strategy, Difficult concepts, Biology, Interest and Gender.

Introduction

The importance of science has been recognized all over the world. Adolphus, Alamina and Aderonmu (2013) argued that the economic, technological and social-well-being of nations of the world as well as future development of both human and material resources depend on science. Science is relevant in every facets of life of living organisms. That is why science is valued by the society .The application of science helps to satisfy many basic human needs thereby improving the standard of living. Valenti (2014) emphasized that scientific knowledge in the area of health services has found cure for a number of diseases including cancer. Relatedly Valenti (2014) asserts that science is often justified to the public as a driving force for huge economic growth which is anchored on the production of clean form of energy. Most of the tools, technologies and medicines we use in the contemporary world are products or by-products of research from pens to rockets and from aspirin to organ transplantation (Jordan, 2012).

The gains of science cannot be achieved without proper education of the younger generation. It is pertinent to find the best way of teaching science for the attainment of educational goals. Odoh (2012) declared that the foundational concern of the contemporary science teaching is on how to make the teaching and learning of science more effective and meaningful to the individual and the society at large. Studies on how students learn science have revealed new ideas and innovative instructional approaches that have proved effective. Samba, Achor and Negedu (2016) have opined that Science educators have always sought for ways to make teaching and learning of science very easy and interesting to both teachers and learners. Examples include: the use of analogue, inquiry, cooperative learning, problem-solving and constructivism (Epstein, 2013). It is therefore a call for the use of instructional strategy that emphasize students-centered application of learning materials in sciences and biology in particular. Science is made up of two broad branches which are the physical sciences and the Biological sciences. The physical sciences are Physics and Chemistry while biological sciences deal with biology.

Biology is the science of life of living organisms and their interactions with the environment. It is expected that every student should offer one science subject in which case most of the students prefer biology. This underscores the importance of biology as key to the study of many other subjects. The West African Examinations Council (WAEC, 2019) in its report declared that, more students enroll for biology at senior secondary school level than physics and chemistry owing to its importance. Other reports by the WAEC Chief Examiner have indicated poor performance due to poor interest in the subject (WAEC, 2018; 2019). Agaba (2013) explains that biology as one of the courses of study in science education curriculum and a core subject in senior secondary school in Nigeria is very important because it forms the foundation for many fields of study. It is important not only for studying the behaviour of living things, but to benefit human beings and that, it equips the learners with the basic knowledge and skills that are essential in the study of medicine, pharmacy, nursing, brewing, microbiology and other related disciplines.

Collaborative learning are anchored on the foundations and ideas of constructivist learning models. The process in which the learner constructs his own understanding is what Epstein (2013) referred to as constructivism. Eka (2012) opined that, the current thinking about teaching is that, it is an active and constructive process in which the teacher assumes the role of a strategic planner, making decisions about the content and the appropriate instructional strategy. Teachers should therefore make it a duty to ensure that the current best practices are applied in the process of teaching. Problem-solving is one of the instructional strategy of a constructivist model of learning. Adolphus (2018) asserts that it is a structural education model in which large and small group discussions can be organized. This is a learning model that brings to bear and attempts to relate prior knowledge with that of the actual problem in question. It requires the use of cognitive abilities such as reasoning, thinking, power of observation, discrimination, generalization, imagination, ability to infer and draw conclusion, try out novel ways as well as experimenting (Adolphus, 2018). In line with this, Adolphus (2018) discussed problem-solving and explained that the process involves identification of a problem (preparation), definition and exploration (incubation), action (illumination) and look back (verification). This is summarized in figure 1.

Previous studies (Adolphus, Alamina & Aderunmu, 2013; Aluko & Olorundare, 2017) have demonstrated that collaborative problem-solving learning strategy is suitable for improving learning outcomes in sciences.

Interest is the feeling of wanting to give your attention to something or wanting to be involved with and to discover more about something. One's interests are the activities that he/she enjoys doing and the subjects that one likes to spend time learning. It is the quality that makes a learner thinks that something is interesting. Interest is an important factor in learning because when one becomes interested in an activity, one is likely to become more deeply involved in that activity. Interest is a subjective feeling of concentration or curiosity over something. A number of factors can lead to poor interest especially in learning activities. Such poor interest could be as a result of the following: students' negative attitude to anything they considered difficult; their perception of other people such as teachers, peers and even parents; their perception about certain concepts vis-à-vis cultural bearing; improper instructional strategy and poor background in sciences. A student is most likely to do well in a discipline of interest.

Difficult concepts in biology are those concepts that students cannot understand easily. Students generally experience difficulties in sciences including biology which most students consider simple because of its low mathematical content (Umar, 2011). Certainly, there are two ways to this. Either the teacher finds such concepts difficult to teach or the students find the concepts difficult to learn. This is why the lack of understanding may not come from students alone but the fact remains that some of the concepts are not easy to learn.

Discussion method is an approach to teaching in which the teacher assumes the position of a strategic planner but dominates the process of teaching while allowing the students to also participate in the process. Discussion method is a variety of forum for open ended collaborative exchange of ideas between the teacher and students for the purpose of furthering students' thinking, learning, problem solving, understanding or literacy appreciation. In this study, discussion method is adopted as a conventional method to be compared with collaborative and individualized problem-solving instructional strategy as control. Participants present multiple points of view and respond to the ideas of others while reflecting on their own ideas in an attempt to build their knowledge (Tharp & Gallimore, 2017).

Gender has become a contemporary variable for science educators as well as researchers in other disciplines owing to its effect on science teaching (especially biological sciences), interest, learning and performance. Jirgba, Eriba and Achor (2018) have revealed that, gender is another relevant issue in the learning of science and technology, since the social expectations that prescribe how males and females think, act and feel differs. These authors further stated that, gender differences in science achievement has been a major concern in science education and science educators seek to provide avenues for achieving gender equity for sustainable development.

Studies already embarked upon in science education by Odoh (2012, Ode; Tartenger, 2022) have indicated that gender among other factors may be responsible for the difficulty in students' perception. Since gender effect on biology interest has not been determined in the study area, this justifies why it is considered in this study. Researchers including Odoh (2012), Okwu and Akor (2012) have worked on

collaborative or cooperative learning but specific research on problem-solving are scarce in the study area. It is against this backdrop that this study sought to provide empirical evidence on the effects of collaborative problem-solving instructional strategy on students' interest in difficult concepts in biology at senior secondary schools in Benue State.

Statement of the Problem

Investigations on the work of science teachers have shown that, various methods and strategy of instruction have been applied in an attempt to improve the teaching and learning of Biology. Some of such instructional strategy include lecture method, questioning, discovery method, concept-mapping, discussion and cooperative learning among others. Despite this, interest in biology has remained poor. As a result of this, it is the concern of stakeholders in education including teachers, curriculum planners, parents and students about the continued poor performance of students in both internal and external examinations in our country. It is therefore necessary to find new ways of improving instruction for the benefit of the learners. Specifically, certain concepts in biology perceived to be difficult have also contributed to this deteriorating performance and interest of learners as students could not comprehend such concepts. It is against this background that Ebutu (2015) have advocated for innovative ways of improving the way students learn Biology at senior secondary school level. A number of instructional strategy such as lecture method, discussion method, concept mapping, cooperative learning and many more have been utilized in an attempt to improve interest in learning. So far, and to the best of the researcher's knowledge, no study has been done specifically on the effects of collaborative problem-solving instructional strategy on secondary school students' interest in difficult concepts in biology. This study therefore, attempts to answer the question: What is the effect of collaborative problem-solving instructional strategy on senior secondary two students' interest in difficult concepts in biology?

Purpose of the Study

The purpose of this study was to find out the effects of collaborative problem-solving instructional strategy on secondary school students' interest in some difficult concepts in biology.

Specifically, the study sought to:

i. Find out the effect of collaborative problem-solving instructional strategy on the mean interest ratings of students in some difficult concepts in Biology.
ii. Determine the difference in interest ratings between male and female students taught difficult concepts in Biology using collaborative problem-solving instructional strategy

Research Questions

The following research questions guided the research.

1. What is the difference in the mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method?
2. What is the difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy?

Hypotheses

The following null hypotheses (Ho) were tested at 0.05 level of significance.

1. There is no significant difference in the mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method.
2. There is no significant difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in biology using collaborative problem-solving instructional strategy.

Research Method

This study adopted a quasi-experimental design; specifically a non-equivalent, non-randomized, control group involving a pretest-posttest was used. Because of the experimental nature of this research, it is not feasible to randomly compose and group students as this will also bring about the disturbance of already existing class arrangement. The intact classes in the sampled schools were therefore used. Quasi-experimental design is a school friendly design which does not disrupt the structures of already existing classes. The target population of this study was all the 4,620 senior secondary two students offering Biology in Benue educational Zone C, comprising 2,661 males and 1,959 females. The sample for this study comprised 270 SS II Biology students in six schools selected from Benue educational Zone C using multi-stage sampling technique.

Two main instruments were developed and used for this study by the researcher. The instruments was Biology Interest Inventory (BII). In addition, twelve lesson plans prepared by the researcher was used for instruction in the study area. The Biology interest inventory (BII) was adapted from Nwafor and Okoi (2018) and modified by introducing the concepts perceived to be difficult in Biology with particular focus on Ecology, Ecosystem, Energy flow and Cells and organelles. This consists of two sections. Section A, sought for the bio-data of respondents while section B, is a 30-items questionnaires on topics of Ecology, Ecosystem, Energy flow and Cell and cellular organelles. This was based on a modified four-point Likert scale type structured as strongly Agree (SA)-4points, Agree (A) – 3 points, Disagree (D) -2 points and Strongly disagree (SD) – 1 point but in reverse order for negative items. This instrument was administered while the scores obtained were analyzed to rate the interest of students in Biology.

Eight lesson plans were prepared altogether in line with the perceived difficult concepts in Biology selected and taught. That is, Ecology, Ecosystem, Energy flow in nature, Cells and cellular organelles. Four lesson plans each were prepared for collaborative problem- solving instructional strategy and discussion method of instruction respectively. The BII was first submitted to the supervisors alongside with the twelve lesson plans. Corrections were made based on their comments. The instrument was then given to two experts in science education; from Benue State University Makurdi and one expert in measurement and evaluation from Federal University of Agriculture Makurdi for validation. The validators were requested to check the suitability, clarity of language and relevance of the objectives, scope and coverage of the test items and most importantly to check for face and content validity.

The validators observed that the BII needs to be refocused on Biology rather than the teacher and method and that some items were double barreled. The items for BII were also reduced from 42 to 30. They also advised that items number 17, 18, 21, 28, and 29 should be restated as they do not appear to measure interest and that undecided (U) should be expunged from BII as it is no longer acceptable in research. The validators' comments, suggestions and recommendations were adequately used to improve the quality of the instrument. A trial test was carried out to determine the reliability of the research instruments and feasibility of the research design. The trial test schools selected were not part of the schools in which the research was carried out. The BII was administered to 20 SSII students and their scores were subjected Cronbach Alpha. The BII yielded 0.79 reliability coefficient. The researcher obtained permission in writing from the principals of the selected schools in the study area to enable him carry out the research. Four Biology teachers from the sampled schools were used as research assistants. At the commencement of the exercise, two research assistants were trained on the use of collaborative problem-solving instructional strategy while the two others were trained on the use of discussion method of instruction. Two intact classes were assigned to the experimental groups while two classes were assigned to the control groups. The instrument was administered to the students at the beginning of the treatment exercise and the scores obtained were recorded as pretest scores. The treatment lasted for six weeks before the administration of posttest. Mean and standard deviation were used to answer the research questions, while the Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 significant level. The choice of ANCOVA was based on the fact that the study used a quasi-experimental design of pretest posttest to determine the equivalence of the experimental and control groups and to take care of the possible lack of initial equivalence in groups, since intact classes are involved.

Results

Research Question One

What is the difference in mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method?

Table 1: Mean and Standard Deviation of Interest Ratings of students taught Biology using Collaborative Problem-solving Instructional Strategy and Discussion Method

Strategy		PreBII	PostBII	Mean gain
Collaborative Problem-solving Instructional Strategy	Mean	2.65	3.62	0.97
	N	90	90	
	Std. Deviation	0.28	0.40	
Discussion method	Mean	2.58	2.58	0.00
	N	90	90	
	Std. Deviation	0.23	0.21	
Mean difference				0.97

Table 1 shows the difference in the mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method. The Table shows that 90 students were taught Biology using collaborative problem-solving instructional

strategy and 90 students were taught using discussion method. The Table reveals that the mean interest ratings of students taught Biology using collaborative problem-solving instructional strategy was 2.65 with standard deviation of 0.28 during pre-test and 3.62 with standard deviation of 0.40 in post test. While the mean interest ratings of students taught Biology using discussion method was 2.58 with standard deviation of 0.23 during pre-test and 2.58 with standard deviation of 0.21 in post- test, Table 4 further shows that the mean gain of students that were taught Biology using collaborative problem-solving instructional strategy was 0.97 and those of students taught Biology using discussion method was 0.00. The difference in the mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method was 0.97 in favour of students taught Biology using collaborative problem-solving instructional strategy.

Research Question Two

What is the difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy?

Table 2: Mean and Standard Deviation of Interest Ratings of Male and Female Students taught Biology using Collaborative Problem-solving Instructional Strategy

Gender		**PreBII**	**PostBII**	**Mean gain**
	Mean	2.51	2.61	0.10
Male	N	52	52	
	Std. Deviation	0.21	0.34	
	Mean	2.69	2.71	0.01
Female	N	38	38	
	Std. Deviation	0.35	0.42	
Mean difference				0.09

Table 2 reveals the difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy. The Table shows that 52 male students and 38 female senior secondary two students were taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy. The Table reveals that the mean interest ratings of male students taught Biology using collaborative problem-solving instructional strategy was 2.51 with standard deviation of 0.21 during pre-test and 2.61 with standard deviation of 0.34 in post test. While the mean interest ratings of female students taught Biology using collaborative problem-solving instructional strategy was 2.69 with standard deviation of 0.35 during pre-test and 2.71 with standard deviation of 0.42 in post test, Table 8 further shows that the mean gain of male students taught Biology using collaborative problem-solving instructional strategy was 0.10 and those of female students taught Biology using collaborative problem-solving instructional strategy was 0.01. The difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in biology using collaborative problem-solving instructional strategy was 0.09 in favour of male students.

Hypothesis One

There is no significant difference in the mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method.

Table 3: ANCOVA of Interest Ratings of Students taught Biology using Collaborative Problem-solving Instructional Strategy and Discussion Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.180[a]	2	.090	.549	.580	.012
Intercept	9.094	1	9.094	55.383	.000	.389
Collaborative	.134	1	.134	.818	.368	.009
Gender	.053	1	.053	.321	.573	.004
Strategy	**7.519**	**1**	**7.519**	**.323**	**. 003**	**. 571**
Gender * Strategy	.806	1	.806	.035	. 000	. 853
Error	14.286	175	.164			
Total	647.074	180				
Corrected Total	14.466	179				

a. R Squared = .012 (Adjusted R Squared = -.010)

Table 3 reveals that F(1,175) = 0.323; p = 0.003 < 0.05. Since p is less than 0.05, the null hypothesis is rejected. This implies that there is significant difference in mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method. Thus, it can be concluded based on evidence from data analysis that there is significant difference in mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method. The partial Eta square of 0.571 was obtained for the strategy meaning that only 57.1 percent of students' interest ratings can be accounted for by the strategy employed in Biology classes.

Hypothesis Two

There is no significant difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in biology using collaborative problem-solving instructional strategy.

Table 4: ANCOVA of Interest Ratings of Male and Female Students taught Biology using Collaborative Problem-solving Instructional Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.438[a]	2	.219	1.359	.262	.030
Intercept	9.348	1	9.348	57.974	.000	.400
Collaborative	.186	1	.186	1.153	.286	.013
Gender	**.311**	**1**	**.311**	**1.927**	**.169**	**.022**
Error	14.028	87	.161			
Total	647.074	90				
Corrected Total	14.466	89				

a. R Squared = .030 (Adjusted R Squared = .008)

Table 4 reveals that F(1, 87) = 1.927; p = 0.169 > 0.05. Since p is greater than 0.05, the null hypothesis is not rejected. This implies that there is no significant difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy. Thus, it can be concluded based on evidence from data analysis that there is no significant difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy. The partial Eta square of 0.022 was obtained for gender meaning that only 2.2 percent of students' mean interest ratings can be accounted for by their gender in collaborative problem-solving instructional strategy class.

Discussion of Findings

Findings revealed that there is significant difference in mean interest ratings of Senior Secondary two students taught the same difficult concepts in Biology using collaborative problem-solving instructional strategy and those taught using discussion method. This implies that the use of collaborative problem-solving instructional strategy enhanced students' interest more than the discussion method in Biology class. The finding agrees with that of Imoko and Isa (2015) that the use of computer games learning strategy increased pupils' interest in mathematics significantly, as compared with the conventional method. The finding also agrees with that of Okonkwo and Igboegwu (2014) that the instructional game method had a higher post interest mean score than the conventional teaching method. This means that the result is significant at P<0.05, level of significance.

The finding on the use of collaborative problem-solving instructional strategy based on gender revealed that there is no significant difference in the mean interest ratings of male and female senior secondary two students taught the same difficult concepts in biology using collaborative problem-solving instructional strategy. This implies that the use of collaborative problem-solving instructional strategy is gender friendly in boosting students' interest in Biology. The finding agrees with that of Adigun, Adesina, Onihunwa, Irunokhai and Sada (2015) that male students scored slight higher than the females but the difference was however not significant. The findings also agree with that of Suleiman and Egbochuku (2012) that there is no significant difference for female science students. The use of collaborative problem-solving instructional strategy as usual bridged the gender gap as findings have shown that the instructional strategy is gender friendly.

Conclusion

The use of collaborative problem-solving instructional strategy enhanced students' interest in Biology. These strategy have enhanced the learning of Biology because they are learner friendly and have created opportunity for active participation of students with the teacher serving as a guide. Both male and female are capable of engaging in collaborative learning in classroom and even outside the classroom setting as exemplified in the field study of Ecology. Since Biology can be studied both in classroom and field, it is necessary to pay greater attention to the use of collaborative learning where students participate actively. The implications of the findings therefore, are that collaborative problem-solving instructional strategy enhance interest in Biology as a subject. It was concluded that collaborative problem-solving instructional strategy was of great benefit to both male and female students.

Recommendations

Based on the findings of the study the following recommendations were made:

1. Biology teachers should be trained by government through the ministry of education on the use of collaborative problem- solving instructional strategy both in teacher training institutions and in-service training programmes
2. Biology teachers should use collaborative problem-solving instructional strategy to improve academic interest of their students in Biology.
3. Since the findings of this study have revealed both collaborative problem-solving instructional strategy to be gender friendly, Biology teachers should endeavour to give both male and female equal opportunities in learning Biology.

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