IMPACT OF SSCSA MODEL OF SCIENCE - TECHNOLOGY - SOCIETY INSTRUCTIONAL STRATEGY ON GENDER PERFORMANCE OF SECONDARY SCHOOL BIOLOGY STUDENTS IN FUNTUA EDUCATION ZONE, KATSINA STATE, NIGERIA

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Abstract
The study investigated the impact of SSCSA Model of Science-Technology – Society Instructional Strategy on Gender Performance of Secondary School Biology Students in Funtua Education Zone, Katsina State, Nigeria. The Study adopted a non-randomization control group, pre-test post-test, quasi-experimental design. The population of the study consisted of 9,062 public senior secondary school biology students of SSII. One secondary school served as experimental while the other served as control. The sample size of the study was 296 SS II biology students. 131 students assigned to the experimental group and 165 assigned to the control group (61 boys and 70 girls for experimental group while 97 boys and 68 girls for control group). Biology Achievement Test (BAT) was the instrument used for data collection. After validation, the reliability co-efficient of the instrument using PPMC was estimated at r = 0.78. The findings revealed that there was no significant difference in the performance mean scores of males and females biology students taught using SSCSA model. STS instructional strategy was hence considered as a gender friendly model and so recommended to be used for teaching biology in both single sex and co-educational secondary schools for improved performance.
Keywords: SSCSA Model, STS, Gender, Performance.

Introduction

Science has contributed in no small measure to the development and comfort of the modern world. For any nation to attain the status of self-reliance, science must be an important component of knowledge to be given to all citizens irrespective of race, creed or sex. Indeed, science is recognized as a foundation upon which the bulk of the present day technological breakthrough is built and so the Nigerian citizens should pursue science, technology and mathematics education (STME) to prevent it from been perpetual slaves to the developed world. The prestige and political power of any nation also resides largely in its level of scientific performance. Science can be defined as a systematic study of the structure and behavior of the physical and natural world through observation, experimentation and testing of theories against the evidence obtained, that is, study through the scientific process or methods (Bichi, 2012). It can also be defined as the pursuit of application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence that can be verified in science laboratories (Bashir, 2024).

Technology on the other hand is simply defined as the application of scientific knowledge for practical purposes especially in industries. Or the application of scientific knowledge to the practical aims of human life or as it is sometimes phrased, as the change and manipulation of

human environment, for the benefit of mankind. The word Biology is of Greek origin, coined from 'Bios', meaning 'Life' and 'Logus' meaning study. Hence, Biology is the study of life. It can also be defined as the study of plants and animals (Micheal, 2015). Ali (2021) defined Biology as the study of living things that concerns itself with the study of structure, behavior, distribution, the origin of plants and animals and their relationships with the environments. Biology is conceptualized as a unique life subject, which deals with animates and in-animates objects, including their structure, function, growth, origin, evolution and distribution. Biology as a science subject, has many branches notably zoology; study of animals and botany, the study of plants. Biology has other branches such as ecology, microbiology, evolution, genetics and many others. Biology serves as a core-requisite or a core subject to many science disciplines such as human medicine, food technology, and agriculture, pharmacy, and veterinary medicine and health education. It is reflected as a requirement for admission into science based courses at universities, colleges of education, polytechnics and other tertiary institutions.

According to Mohammed (2008) the best and most effective places of teaching science and technology to the students of any nation are the primary and secondary schools. This means primary and secondary school science teachers in Nigeria have an important role to play in laying solid foundation for successful take-off of science and technology, which could be through different approaches to the teaching and learning of science. One of the goals of the National Policy on Education (FME 2013) is to ensure that students are able to strive effectively in modern age of science and technology. Therefore, science subjects are made to be among the core subjects that are being taught in Nigeria secondary schools. Therefore, studies on different strategies of teaching science to secondary school students to enable them meet the goals of the National Policy on Education is necessary. According to Nwagbo (2001), one of the goals of teaching science is to produce students who experience the richness and excitement of knowledge about the natural world which occur from natural curiosity. Despite the important position of Biology among other science and science related disciplines, students' performance has consistently been below expectation (Jibrin, 2011). Biology concepts according to Orlu (2013) can sometimes be difficult particularly when describing ideas that are abstract or cannot be fully comprehended by learners for the first time. Research findings by West African Examination Council, (WAEC, 2010, 2015) in Bashir (2024) have shown that a number of concepts in biology which include genetics, evolution and ecology contain topics that seems difficult for biology students to understand.

There are several models of STS instruction and according to Okorafo (2002), one of the models for developing STS strategy is the search-solve-create-share-and act model "SSCSA".

Search: Under the search stage, topics are selected for study from textbooks, demonstrations, minds-on-hands-on activities, field trips. TV exposure or community events issues or problems. After some brainstorm activities on some ideas, issues, or problems, personal or societal, the students will come up with a list of ideas in question format for possible selected as the search focus e.g. discussing about the problem of rusting, what process are responsible for this? What substances are involved in the processes? What are those substances made of

and how do they exist? Another example is the examination of natural fruits, ripe and unripe. Finding out their taste and why the taste and what are preset in the fruits – ripe and unripe etc.

Solve: At the solve stage, students apply previously learned information or experience from the search state in solving or answering those searching questions. And in finding solution to those questions, emphasis is laid on the use of research methodology, which could be descriptive, experimental or correlation approach.

***Create*:** From the solving phase, the students will come up with designs in form of charts, graphs, write ups etc, for presentation as possible solutions to the issue or problems being investigated. This state is known as the creative stage and from this stage, the students will move to the sharing stage.

***Share**:* At this stage, the student come up with their respective creations, findings and discovered solution for sharing with other groups. This is the time of communicating their individual and group findings, interacting with their fellow students, sharing ideas in a co-operative manner. This could be oral or written reports, song video tapes, poetry and other verbal or non-verbal means of communications.

Act: The problem solving will then be completed by an action from the students based on their findings: for example, a group of students might defend a point of view before their class, or write a letter to a local authority based on the findings about the locality or come up with a product like soap, margarine, bleach etc. these their new interest or level of under sanding may, and in most cases do lead to new questions for new explorations an subsequent actions.

Another model of STS is the IEPESA model. This model encourages students in problem solving and decision taking through the process of – Invitation - Exploration – Proposing Explanation - Solutions and finally taking Action. The invitation stage is similar to the search stages. Here, the students are invited by the STS teacher (researcher) to observe their surroundings for point of curiosity, ask questions, consider possible responses to question etc. The exploration (the solve stage) is where students are encouraged into brainstorm activities, looking for information's, collect, organize and analyze information or data using problem – solving strategy. The proposing explanation and solutions is the create and share stages. Here, the students bring forward their collected information from the exploration, review and criticize the propounded solutions. Use their group evaluation and assemble multiple solutions and then determine appropriate answers which will be integrated into a solution with existing knowledge and experience. The final stage which is taking action is where students apply their wealth of knowledge and experiences acquired through the exploration and group explanations in solving problems. Another model that could be used in an STS classroom is the Jurisprudential Model (JPM). This model was developed by Oliver and Shaver (1966) for social studies. According to Joyce and Weil (1986), the model encourages students to study cases involving social problems in areas where public policy discussions actions were needed.

It is from this original model that the Jurisprudential model was constructed, taking into consideration all the expectations and criteria for STS issues. Six phases are recognized in this model, and they are:

a. ***Orientation*** of the Student to the issues on decision making, their impact and roles that students will play in taken decisions.
b. ***Students*** identifying and defining the issues that they are studying. Here student draw from the knowledge acquired in phase one to identified values as well as raising questions about the opposing view(s)
c. Students *synthesize* the research information from phase II into arguments supporting their assigned point of view. During this phase, the students establish the violation of the value by using factual information for support. They prove the undesirable or desirable consequences of a position and clarify the value conflict with analogies. The relevancy of each of the factual assumptions was tested, determine the consequences and examining their factual validity. It is during this phase that the students prepare for a public discussion of the issue that they are studying.
d. The Public meeting. The fourth phase of the JP STS model involves the students in mock public meeting. This meeting involves all students presenting their different sides of the issue being studied. And several students should be selected to be the board of arbiters during the public meeting. It is the students on the board who initiate and oversee the meeting with the aid of the teacher.
e. Provides the opportunity for the students to clarify *a*nd reach a consensus on the issue(s) that they are studying. It is at this time that students come together collectively and cooperatively to identify possible solutions to the problems that they encountered. The students relying on the information's they gained from debating the issues. With their peers, information's from their own research information's through traditional classroom strategies and those shared from other groups, the students reach a consensus on the final and acceptable positions on the issues for the next final phase.

The final phase of this model, involves the students in becoming involved in societal or personal issue by the taking a course of action on the issue. Here the students are giving the opportunity to apply the investigation skills and action strategies in solving problems in or outside the classroom.

Academic performance is a variable in this study. According to Musa (2000) performance is the outcome or result produced by students as reflected in their examination scores. Obochi (2018) defined performance as what students are able to gain in a senior secondary school examination (SSCE) after completion of the secondary school instruction. Also Ogunboyede (2003) has further defined academic performance as when teachers spend large amount of time in the direct teaching of mathematics, science and social sciences rather than in music, arts or social awareness. Gender - related differences in learning and performance is the main factor for consideration in this study. It is also one of the major goals for reform in Science Education i.e. to evolve a science programme for every child to participate actively and learn maximally irrespective of sex, social background and abilities (Gadzama, 2012). Gender is a human characteristic that might determine or affect academic achievement in general (Ahmad, 2008). Reported studies in the last three decades showed that girls have low academic performance when studying science. Students often report having different experiences with science in and

out of school based on gender. These trends are important because, although both females and males enroll in secondary institutions and earn higher grades in science and engineering courses, significantly more males than females majored in the natural sciences or engineering (Green, 2009).

One of the problems that attract public concern in Nigeria today is the gender gap in academic performance of student's in schools. This observable disparity has been blamed on a number of factors, including social, mode of teaching, and cultural stereotyping. The importance of examining performance in relation to gender is based primarily on the socio-cultural differences between girls and boys. Some vocations and professions have been regarded as men's (engineering, arts, crafts and agriculture) while others have been regarded as women's (catering, typing, nursing). In fact, parents assign tasks like car washing, grass cutting, and home repair to the boys (Ahmad 2018).This study intends to look into the effect of STS instructional strategy on performance of biology students to find out whether there is any significant difference between boys and girls.

Statement of the Problem

The consistent poor performance and negative attitude towards science attest to the fact that science teaching procedure among many other factors hasn't been properly done. Hence, the concepts been taught are not properly understood because improper science teaching has led to poor performance in science subjects. Therefore, science teaching needs appropriate method of instruction that will best achieve the aim of science teaching, thus improving the performance and enhancing the positive attitude towards science subjects. This is supported by Ibraheem (2004) who explained that the teacher and his method of teaching may have been the major course of student poor academic performance in Biology as many teachers still prefer using the "chalk and talk" method of teaching known as lecture method. Also in support of this Lakpini (2006) expressed the view that teachers shy away from activity-based teaching methods and rely on the teaching methods that are easy but most often inadequate and inappropriate for science teaching. This makes students to achieve poorly in secondary school subjects especially biology which may eventually affect the student's overall academic performance. Result from studies indicated that innovative teaching method such as STS approach, guided discovery; cooperative learning and inquiry methods were more effective than the Conventional method.

The 2010-2020 WAEC results showed a failure rate amongst the candidates in biology in Nigeria. The trend has been consistent for the past number of years, according to the Chief Examiners Annual Reports of the West African Examination Council. Also, NECO 2010 – 2020 showed that for seven out of the ten years analysis, less than 50% pass at credit level. Researchers have attributed the failure to a number of factors. One of the isolated factors is teacher's consistent use of teaching methods which does not lead to meaningful learning of science concepts and their applications to solve problems. Despite the adoption of new approaches to teaching like child centered, problem-based or project-based method, inquiry method of teaching and others, the approach to teaching has predominantly remained unchanged as teachers persistently use traditional method to teach science Abdullahi (2005).

Failure rate in science at SSCE continued to be a source of worry to curriculum planners, educationist, parents and the entire society. A number of reasons has been identified as being responsible for this high failure rate. Prominent among these reasons are the teachers use of inappropriate teaching strategy. Usman (2000) and Danladi (2003) noted that as a result of the constant use of lecture method in teaching, the performance of students in science remains poor. Obochi (2018) opined that with the new National Policy on Education, some advocates are pointing accusing fingers to poor teaching methods which involve emphasis on memory. And so Educational researchers call on researchers to search for new approaches to science teaching which will provide opportunity for even low achievers to do better. They asserted that students learn and perform better when they are made to explore and evaluate learned materials on their own.

STS approach has the feature of relating learning to an application in the real world thereby making learning relevant and more interesting as the students could establish relationship between concepts taught and their use in personal and societal life. The present study seeks to establish how STS instructional Strategy can be used by teachers in understanding the concepts they teach which may likely lead to improved students achievement. Therefore, the researcher intends to find out the effects of STS instructional strategy on gender academic performance in biology.

Objective of the Study

1. To determine the academic performance of SS2 biology male and female students exposed to SSCSA model of STS instructional strategy and those taught using conventional method in Funtua education zone.

Research Question

1. What is the difference in academic performance of male and female SS2 biology students exposed to SSCSA model of STS instructional strategy and those taught using conventional method in Funtua education zone?

Hypothesis

1. There is no significant difference in performance mean scores between male and female SS2 biology students taught using SSCSA Model of STS instructional strategy and those taught using lecture method in Funtua education zone.

Methodology

The study is quasi-experimental using experimental - control pretest and post-test groups design as described by Krejcie and Morgan (1970) and Kerlinger (1973).At the beginning of the study, a Biology Achievement pre-test based on some selected topics (variation and variability) shall be administered to both experimental and control groups to find out equivalence between the two groups. Then the experimental group (EG) received treatment i.e. the STS instructional strategy of teaching using SSCSA approach of STS while the control group was taught the same selected Biology topics (variation and variability) using the conventional teaching method.. Treatment application took four (04) weeks. The population of this study comprises all the year two senior secondary school biology students totaling 9,062 students in Funtua zonal education. Three schools are boys only while two other schools are

girls only and the rest are co-educational. The students offer Biology as one of their basic science subjects. They were already exposed to introductory Biology concepts for one session in SS I. Thus, they have experience in the use of Biology text materials such as modern biology, certificate biology and STAN Biology. The students are academically expected to be average in ability. The average age of the students is 18 years.

Other features common to the target population includes the teaching staffs whom were employed using the same employment criteria, the teaching staff were mostly University graduates of Biology with teaching qualification in education. The two schools selected were co-educational comprising boys and girls so as to enable the researcher to determine the gender related effect on knowledge gain of the Biology concept taught. From each of the school's 50 students were selected randomly by balloting. This was to ensure that every student have equal chances of participating actively in the study. 25 boys and 25 girls making the total of 100 students for the experimental and control groups. The instrument used for this study was: Biology Achievement Test (BAT) for (pretest and posttest). The experimental group is exposed to the SSCSA model of STS teaching strategy while the control group were taught using the traditional conventional method both for the same period of 80 minutes (two periods) per week for 4 weeks.

Results

Research Question: What is the difference in academic performance for male and female SSII biology students exposed to SSCSA Model STS instructional strategy and those taught using conventional method in Funtua education zone?

To answer this research question, descriptive statistics of mean, mean difference and standard deviation were used as follows:

Table 1: Summary of mean and standard deviation of academic performance posttest scores for boys and girls in the experimental l and control groups.

Groups	Gender	N	X	SD	Mean gain score
Experimental Method STS	Male	25	15.53	5.09	5.73
	Female	25	9.80	4.49	
Control conventional method	Male	25	6.00	1.46	0.04
	Female	25	6.40	1.95	

The descriptive statistics revealed that differences exist between the performance of male and female students taught variation with SSCSA model of STS instructional strategy and those taught using conventional method. The computed scores showed that among the male students, the mean performance scores are 15.53 and 6.00 while the mean performance of the female student was 9.80 and 6.4, showing that the male students had higher mean scores than their female counterparts. To find out whether the different mean gain scores are significant, the data is further subjected to inferential statistics of t – test as follows:

HO There is no significant difference between the means scores of boys and girls when taught biology concepts using the SSCSA model of STS instructional strategy.

To determine whether the performance of the boys and girls differed significantly following the respective treatments, the post-test mean scores by gender were subjected to t-test.

Table 2: t-test summary of posttest means scores of the experimental group by gender

Variables	N	X	SD	DF	t-cal	P. Value	Remarks
Boys	25	15.44	3.16	28	0.42	0.680	Not Significant
Girls	25	14.86	4.44				

Not significant at $P \leq 0.05$

Based on the results in table 4.3 the P value calculated is 0.68 higher than the α 0.05 level of significance therefore not significant and the null hypothesis accepted.

Discussion of Findings

This study determined the effects of SSCSA model of STS instructional strategy and the traditional method in the teaching of biology. The hypotheses stated and tested based on the scores of the subject obtained from BAT .Analysis of the data obtained was in accordance with the stated hypotheses. According to hypothesis: There is no significance difference between the mean academic performance scores of boys and girls when variation and variability using SSCSA Model of STS instructional strategy. On the relationship between gender and performance, it showed that there is no significant difference in the post-test mean academic performance scores between the boys and the girls in the experimental group. The implication is that the STS instructional strategy tends to promote homogeneity of performance between the boys and the girls. In other words, the STS instructional strategy is gender friendly as reported by Okorafo (2002), Olorukooba (2002), Mohammed (2008), Tsai (2020) and Bashir (2024).

Conclusion

Based on the findings that emanates from the study, the study concluded that students perform better in biology when taught using the SSCSA Model of STS instructional strategy and that STS instructional strategy is gender friendly in enhancing the performance of both boys and girls in biology.

Recommendations

Based on the findings from this study, the following recommendations were made:

1. Curriculum planners should consider the introduction of STS instructional strategy in the teaching and learning of biology concepts and other science courses. This is because this instructional strategy has the potentials for creating a suitable framework necessary for meaningful learning irrespective of gender.
2. Professional Associations and Educational Research Centres such as Science Teachers Association of Nigeria (STAN), National Educational and Development Council

should carry out researches, organize conferences, seminars and workshops to sensitize the various educational stakeholders on the need for the adaptation of the STS instructional strategy in our secondary schools teaching and learning.

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