

Effects of Science, Technology, Society (STS)-Approach on Achievement of Students in Integrated Science: A Recipe for Women Education and Conflict Resolution

Negedu, S.A.¹, Mathew, B.A.², Ogah, S.³, Gadzama, B. I.⁴, Abuh, P.Y⁵ & Haruna, G.G⁶

Department Of Science Education¹, Integrated Science Department², Physics^{3&5} and Mathematics⁶
Kogi State University, Anyigba, Nigeria¹

Kogi State College Of Education, Ankpa, Nigeria^{2, 3, 5&6}

Federal College of Education (Technical) Potiskum, Yobe, Nigeria⁴

Abstract

The paper investigated the effects of STS-approach on achievement of students in Junior Secondary Schools in Integrated Science in Ankpa Local Government Area of Kogi State, Nigeria. Two objectives, two research questions and two hypotheses guided the study. A quasi-experimental design was used for the study. Forty items Integrated Science Achievement Test (ISAT) instrument was administered to treatment and control groups in their intact classes during the pretest and posttest. The population of the study was 320 JSS 2 students in 4 co-educational schools in the area of the study. Stratified random sampling technique was used to select two classes of 40 students each from each of the 4 co-educational schools involved in Ankpa Local Government Area of Kogi State, Nigeria. Students were also stratified based on gender. The research questions were answered using means and standard deviation. The hypotheses were tested at 0.05 level of significance using analysis of co-variance (ANCOVA). The findings among other things revealed that STS- approach enhanced achievement among students than conventional approach in integrated science. Based on the findings, the recommendations that were made among other things include; the need for teachers to use inquiry based strategies such as STS-approach to develop in individuals among other things decision making skills that will equip women for participation in decision making process in managing conflicts in the society.

Keywords: STS-approach, achievement, integrated science, women education and conflict

I. Introduction

The roles of science and technology span over a wide range of areas such as agriculture, health care delivery, information, communication and transportation among other things. Science according to [11] is a systematic process of obtaining verifiable and testable knowledge about nature and natural occurrences utilizing careful observations and experiments. On the other hand, technology is a practical application of science in solution of problems encountered in the environment. Science and technology are therefore, verifiable tools for socio-economic development of modern society. Technology is the application of scientific principle and knowledge to production. He further adds that science produces knowledge while technology produces wealth [6]. Thus, science is the “know why” while technology is the “know how”. According to [10], there are four major components of technology identified as techniques, knowledge, organization and products.

1. The techniques refers to the system of complex physical components (machines and equipment) required to produce goods and services.
2. The knowledge refers to the know-how and skills applied to the technique (hardware) in order to produce goods and services (software).
3. The organization refers to the managerial component that is needed to combine the technique and knowledge to ensure efficiency in the production process. The products of technology are goods and services for the society. From the forgoing, it can be seen that technology and science are complimentary to each other.

Science and technology are meaningless without the society, because the product of science and technology are for the society. [15] defined society as a group of human beings bound together for self-maintenance and self-perpetuation and sharing their own institution and culture. It is the need of the society especially in materials terms that pave ways for science and technology to come into play. The societal framework is built on political, cultural, economic, interest and values, aesthetic, social, philosophies and ideologies [8]. Based on these components, every society chooses what it needs. In this case, the type of science and technology that suits it's educational needs. Although much of our world has been developed by science and technology, yet to a large extent, the society, based on its goals and aspirations still shapes or determines the kind of science and technology it needs. Thus, it is the inter-relatedness among science, technology and society that led to the adoption of the term science, technology, society (STS) [5]; [2]. Science, technology and society (STS) refers to integration of different discipline, which has science and technology components that are geared towards solving real problems in the society. They further noted that STS stresses the importance of using scientific techniques to help individuals in the society to construct out meaning of events or situation they encounter from time to time. This view by [16] and those of other advocates shows that STS focuses on real world problems such as pollution, malnutrition, overpopulation and diseases among other things, require redress using techno-scientific approach [1]; [16]. Thus, relationship among Science, Technology and Society (STS) can be diagrammatically expressed as shown by [12]. Thus, the inter-relationship portrays technology as the hand - made of science in the service of the society.

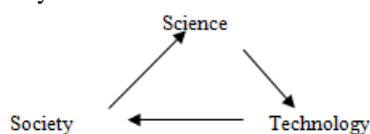


Figure 1: Inter-relationship among STS

The Science Technology and Society approach is to ameliorate the problems in science teaching and learning. According to [16], STS-Approach means involving learners in learning activities such as questioning and discussion among other things on issues that deals with developing decision and problem solving skills. It attempts to integrate the different discipline of science and to improve on the drawbacks of the conventional approach in science teaching. The relevance of any programme (in this case, the integrated programme in Nigeria) should also be considered in relation to the learning strategies involved; in this case, the STS-approach. [4] defined the integrated science as an approach to the teaching of science in which concepts and principles are presented so as to express the fundamental unity of scientific thought and void of premature or undue stress on the distinction between the various scientific fields. In summary the term integrated as it applies to integrated science means that the course is devised and presented in such a way that the child; gains the commonality of approach to problem of scientific nature; gains an understanding of the role and function of science in everyday life in the world he or she lives and gains the concept of the fundamental unity of science.

[15] defined achievement as the act of doing something successful. One of the issues at stake in education in recent time is students' achievement; it is measured in relation to teaching and the overall success of an academic programme. Studies by [9] have shown that students' achievement in integrated science has been poor. This she noted was due to poor teaching approach, lack of facilities and poor socio-economic background among other factors. Thus, if the teaching approach correlates with achievement, there is need to try interactive strategy such as the STS-approach to know whether it will enhance learners' achievement in integrated science or not. Another issue of contention in Nigeria today is the issue of gender discrimination against females. This problem cut across almost every segment of the society including the educational system. This problem has been blamed on several factors such as social, cultural and religious beliefs. In recent times, educators have express diverse views about the influence of gender on achievement especially in science subjects. While some are of the view that males do better than females, others disagree with this view. Rather, they argued that achievement is a factor dependent on several factors such as socio-economic background, teaching method and attitude among other things [11].

In a report by [14], statistics of result in Nigeria by subject, grade and sex revealed low enrolment and achievement of girls for science subjects. In a study by [9], revealed insignificance differences between male and female achievement among female especially in science. Thus, against this backdrop, there is the need to undertake this study to determine the extent STS-approach will affect achievement among students' in integrated science. According to [15] conflict is referred to as hostile engagement between two or more parties. Conflict is one of the global challenges in the 21st century. The level and nature of conflicts varies from place to place and the dimension depends on the nature of factors responsible for such conflict. Whether at home, school,

work places, so long as there is conflict, safety of lives and properties cannot be guaranteed and there can be no meaningful development. Reports have shown that conflict in many places is caused by selfishness, poverty, religious bigotry, tribalism, greed and bad governance among other things. [13]. Thus, in this paper, there is the need to explore the use of STS approach as a veritable tool for equipping women for participation in decision making process and in conflict resolutions in the society.

The purpose of the study: The study was guided by the following objectives.

1. To determine the effect of STS-approach on achievement in Integrated Science among JSSII students.
2. To determine the effect of STS-approach on achievement of male and female in integrated science among JSSII students.

Research Questions: The following set of research questions were used for the study.

1. What is the effect of STS-approach and conventional approach on achievement of students' in integrated science?
2. What is the interactive effect of STS-approach on achievement of male and female students' in integrated science?

Hypotheses: The study was guided by the following hypotheses. The hypotheses were tested at 0.05 level of significance.

H01: There is no significant difference between the mean scores of students taught integrated science using STS-approach and those taught using conventional approach.

H02: There is no significant difference between mean scores of male and female students taught integrated science using STS-approach.

II. Research Method:

This study employed a quasi-experimental design. The design was found suitable for the study because it involves experimental and control groups and the use of intact classes. The population of the study consisted of all the junior secondary school year 2 students (JSS2) drawn from the 15 co-educational schools in the area of study. The JSS2 students were used for the study because the study considered the use of topics drawn from 2 syllabus only. The study was limited to four (4) Secondary Schools in Ankpa Local Government Area of Kogi State. It covered junior secondary school two (JSSII) students. Simple random sampling was used to select four schools out of 15 co-educational schools from the area of the study. Students were also stratified based on gender. Also, two classes of JSSII were randomly selected in each of the 4 schools, and were assigned to treatment and control groups. The entire sample consisted of 320 students. Also, four teachers, one each, from the four selected schools were involved in the study. The teachers were exposed to teaching, using lesson plans on STS-approach and conventional approach in integrated science lessons.

Instrument: The instruments for the study include Integrated Science Achievement test (ISAT). The ISAT is a 40 item multiple choice test developed by the researcher to test the students' achievement on selected STS related topics in integrated science curriculum. The ISAT items were drawn from topics which include; nutrition, water, waste disposal and pollution in different proportion in ratios 14;6;8 and 12 respectively. The highest score that can be obtained on ISAT is 40 and lowest is 0. The topic includes nutrition, water, waste disposal and pollution. Both ISAT instrument was face validated by three experts in Science Education. The Kuder-Richardson (KR-20) was used to obtain the reliability co-efficient of 0.72.

Procedure for data collection: First, all students involved in the study were pre-tested using ISAT instrument. There was no prior lesson taught to treatment and control groups before the pre-testing. The result of the pre-ISAT scores was collated before actual treatment began. The second phase involved teaching STS related topics integrated science with STS-approach to treatment group. The same topics were taught with conventional approach to control group. Both treatment and control groups were taught differently mode of lesson plans for 4 weeks to JSSII students involved in the study. Before the commencement of teaching, the researcher undertook a training workshop for the teachers in the selected schools on the use of STS-approach in teaching integrated science lesson for two days. Again, both treatment and control groups were tested using ISAT instrument at the end of 4 weeks teaching session. The post-ISAT scores were also collated like those of pre- ISAT scores. These were subjected to analysis.

III. Method of data analysis:

The research questions were answered using mean and standard deviation computed from the data generated from the pre and post ISAT scores. The research hypotheses were tested at 0.05 level of significance using analysis of co-variance (ANCOVA).

Analysis: Data answering research question 1

Table 1: Mean and standard deviation scores of Experiment and control group data on ISAT.

Groups	N	Pre-test score		Post-test score		Gain score on mean
		Mean	SD	Mean	SD	
Experimental group	160	16.83	55.98	22.31	5.56	5.98
Control group	160	16.21	6.12	16.84	5.10	0.12

Table 1. Shows that experimental group recorded a higher posttest mean achievement score than control group. This shows that there is an improvement in achievement of students taught with STS-approach than those taught with conventional approach.

Data answering research question 2

Table 2: Mean and standard deviation scores of Experimental group taught using STS-approach by gender on ISAT.

Groups	N	Pre-test score		Post-test score		Gain score on mean
		Mean	SD	Mean	SD	
Experimental Male	84	17.31	6.51	23.12	5.88	5.81
Experimental Female	76	16.29	5.98	21.42	5.10	5.13

Table 2. Shows that both male and female experimental group recorded a higher post test mean score. This shows that there was improvement in gender achievement as a result of being taught with STS-approach. Also, the table shows that the experimental post-ISAT mean scores of male (23.12) was higher than experimental post ISAT mean score of females (21.42). Thus, STS-approach achievement in favour of male than female in integrated science lessons.

Test of Hypotheses: Analysis of co-variance (ANCOVA) was used to test the significance of the differences between the mean scores in hypotheses 1-2

Table 3: Table 7: Test of between Subjects Effect of Mean Achievement for Students Exposed to STS approach and Conventional method

Source	Sum of Square	DF	Mean square	F-ratio	Sig.
Achievement	938.50	1	938.50	105.80	0.05
Method	367.60	1	367.60	41.44	0.05
Error	0.02	1	0.02	0.02	
Total	1383.48	156	8.87		
Corrected Total	2689.80	159			

Table 3. Shows that the teaching method (STS-approach), main effect was significant at (P<0.5) because the calculated F-value of 41.44 is greater than the critical value of 3.84. Hence the null hypothesis is rejected. This shows that there is a significant difference in the achievement scores in favour of students taught using STS-approach than those taught with conventional approach in integrated science.

Table 4: Test of between Subjects Effect of Mean Achievement Scores for Male and Female Students Exposed to STS approach

Source	Sum of Square	DF	Mean square	F-ratio	Sig.
Achievement	588.61	1	588.61	62.80	0.05
Gender	27.61	1	27.61	2.90	0.05
Error	4.76	1	4.76	0.50	
Total	718.39	76			
Corrected Total	1339.3779				

Table 4. Shows the calculated F-value (2.90) is lesser than the critical F-value (3.84). Hence, the null hypothesis is not rejected. This shows that there is no significant difference between mean scores of male and female taught using STS approach in integrated science.

IV. Discussion:

The discussion of results and findings are presented as follows. The data in Tables 1 and 3 provided answers for research questions 1 and hypothesis 1 respectively. The data in Table 1 shows that experimental group post-test score (22.31) was greater than control group post-test (16.84). This shows that there is difference between the mean achievement tests scores in favour of students taught with STS-approach than those taught with conventional approach in integrated science. The data in Table 3 shows that the null hypothesis is rejected, as the F-calculation value (41.44) is greater than the critical value (3.84) at 0.05 level of significance. This revealed that there is significant difference between mean achievements of students' taught with STS-approach and those taught with conventional approach. This shows that STS-approach enhanced achievement than conventional approach in integrated science. This finding is in agreement findings in previous study by [9] that students taught with inquiry approach did significantly better in achievement than those taught with conventional approach in biology. Thus, STS-approach enhanced achievement than conventional approach because students' were involved in activities like discussion, investigation among other things which ensured their understanding of integrated science concepts. The data in the 2 and 4 provided answer for research question 2 and hypothesis 2 respectively. Table 2 shows that the post-test mean score of male (23.12) was higher than the post-test mean score of female (21.42). This shows that both male and female achievements were enhanced when taught with STS-approach in integrated science. Also, the data shows that the post achievement scores of male were higher than those of females taught with STS-approach. This shows that STS approach enhanced achievement of male than female in integrated science.

Table 4 revealed that the null hypothesis is not rejected. This is because the F-calculated value (2.90) is greater than the critical value (3.84). This shows that there is no significant difference between male and female achievement. Based on the discussions, the following observations were made.

1. The use of STS approach significantly enhanced students' achievement than conventional approach in integrated science.
2. Male students taught with STS-approach did better in achievement than female students in integrated science.

Implication: The findings in the study revealed that the use of STS-approach in teaching enhanced achievement among students in integrated science. Therefore, this finding have implications for science teachers in the use of more inquiry-based approaches in teaching science subjects like integrated science. This will foster scientific literacy which will prepare individuals in the society for participation decision-making process especially if such decision making and solving societal problems.

Recommendations: The following recommendations were made.

1. Science teachers should intensify the use of inquiry based methods like STS-approach to foster students' interest which could lead to better achievement among students in science and technology based subjects.
2. The government through the ministry of Education should organize workshops periodically to train science teachers in secondary schools. Such training should focus on equipping teachers to acquire new approaches in order to improve science teaching thereby developing scientifically minded literate citizens that are objective and open-minded among other qualities.

3. There is need to encourage science teachers use strategies like the STS approach that fosters both male but female interest in integrated science to enhance better achievement among students not only in integrated science but other science subjects.
4. There is need for curriculum to develop more all gender friendly approaches like the STS approach in order to enhance both male and female participation in science lessons.

V. Conclusion:

The findings among other things revealed that STS-approach enhanced achievement among students than conventional approach in integrated science. Based on the findings, there is the need to promote the use of STS-approach for better achievement among students in integrated science. By this, it is hoped that both male and female will be better equipped with problem solving and decision making skills for adequate participation in decision making process and in resolving conflicts in the society.

References

- [1] Aikenhead, G.S., Ryan, A.G. & Flemming, R.W. (1989). *Views on science, technology, society (VOST)*. Canada: University of Saskatchewan Press.
- [2] Aikenhead, G.S. (1996). *Science Education: Border crossing into the sub-culture of science*. *Studies in Science Education*, 2 (27), 15-47.
- [3] Ajeyalemi, D.A. (1983). A study of intellectual transactions in some chemistry classrooms and implications and implications for Nigeria-based classroom research. *Lagos Education Review*, 3, 5-7.
- [4] Benton, W. (2000). *The encyclopedia Britannica.vol.16*. Chicago: University Press.
- [5] Blunk, S., MacKinnu, E. & Yager, E.R. (1992). Science/Technology/Society as a reform of science education in the elementary school. *Journal of Elementary Science Education*, 4(1), 1-13.
- [6] Ekemode, K.O. (2010). *Enhancement of Agricultural Productivity through Scientific and Technological Development*. Published by the Nigerian association of agricultural educators (W.A.G.R.E.D). Lagos
- [7] Federal Republic of Nigeria (2004). *National Policy on Education (Revised Ed)*. Lagos: Nigerian Education Research Development Council (NERDC) Press.
- [8] Martins, O.O. & Oyebanji, .K. (2000). The effects of inquiry and lecture method on the cognitive achievement of integrated science students. *Journal of Science Teachers Association of Nigeria*, 335 (1&2), 31-35.
- [9] Mbagiorgu, N.M. (2003). *Science: the teachers' perspective. An Introduction to Science Education*. Institute for Development Studies, University of Nigeria, Enugu campus.
- [10] Nwokolo, O. C. (2002). Science and technology education: A Key to poverty eradication. *Journal of Women in Colleges of Education*, 6(2), 12-20.
- [11] Okeke, E.A. (2001). Attracting women into science based occupation: Problems and prospects. *Science and Public Policy*, 3(5), 11-18.
- [12] Teetito, A.E. (1999). Effective use of STS-Approach to science teaching: *A lead paper in proceeding of 1999 National STS Panel Workshop Held at Government Secondary School, Minna, Niger State*. 15th – 20th May, 1999.Pp.21-36
- [13] United Nations (2008). The UN Millennium Development Goal. Retrieved on 20th August, 2013 from <http://WWW.Un.org/millennium goals>.
- [14] West Africa Examination Council (2001-2011). Nigeria statistic of entries and results. Lagos: WAEC.
- [15] Wikipedia (2010). Free-online encyclopedia. Retrieved on 14th Oct. 2011 from en.wikipedia.org/wiki/constructivism.
- [16] Yager, E.R. (1992). The Science/Technology/Society movement in the United States: its origin, evolution and rationale. *Social Education*, 54 (4), 198-200.