AFRICAN JOURNAL OF STUDIES IN EDUCATION

VOL. 9 NO. 1 APRIL, 2013

ISSN: 0189 – 241 X

OPTIMIZING STUDENTS PROBLEM-SOLVING AND DECISION-MAKING THROUGH A SCIENCE-TECHNOLOGY-SOCIETY CURRICULUM FOR PEACE AND SECURITY

Moemeke, Clara D. (Ph.D), Onyeagu,Friday. O (Ph.D)
Department of Curriculum Studies and Educational Technology
College of Education, Agbor.

The study investigated the effect of an STS curriculum on students problem-solving and decision- making abilities in issues of peace and security in four secondary schools in Delta state. Eight intact classes consisting of 480 JSS II students (males 249, females 231) formed the sample of this number,240 students each belonged to the experimental and control groups respectively. A pre-test and posttest control group design was adopted and treatment lasted for ten weeks of one hour per week. Data was collected using two instruments adapted from Umoren (1991). Decision-Making Ability Test (DMAT) and Test of Problem Solving Ability (TOPSA) showed significant difference in students' problems solving and decision - making ability in peace and security issues in favour of the experimental group. Male students also showed superiority in the two variables over females. It was concluded that the STS curriculum could be a launching pad for promoting problem-solving and decision-making among learners early in life. Recommendations were offered towards adequate implementation of an integrated STS curriculum in secondary schools in Delta state.

Introduction

Many nations of the world including Nigeria are facing various crisis situations ranging from internal to external evasion from neighbours. Every nation has become more security-conscious than ever before. Maintenance of national integrity and territorial safety dominates executive council meetings while security receives the highest budgetary votes in most nations' annual allocation. The belief is that no nation can develop sustainably in an atmosphere of chaos, insecurity and apprehension. The impact of this on national economy as well as in national and international mobility is tremendous. In spite of these huge allocations and efforts towards safe-guarding a nations' citizenry, stories of woes have persisted over time. The 21st century youth desire a climate of peace to be able to harness their potentials. Education (most importantly, the curriculum) has remained the most potent tool for reaching the youth and children. The impact which the curriculum makes on the learners as well as how they in turn view their learning in relation to the society is worthy of understanding by all so as to permit a restructuring of the psyche of the youth towards peace, security and national development. The rationality of their decision and development of skills for solving their individual and societal problems are necessary for peaceful existence and co-habitation in a multiethnic, multi-religious Nigeria.

Science, Technology and Society

The interplay between science, technology and society has been a subject of study for many decades now (Ogunniyi, 1986; Umoren 1991). The advent of science and technology and their continuous development has not only restructured society but has eroded most traditional society's values as well as eased previous societal pains and introduced new ones. Despite all these, there has been increasing calls for greater relevance of science and technology to modern Nigerian society (Bryant, 2003). Science, technology, and society (STS) relate to the study of how social, political and cultural values affect scientific research and technological innovation and how these in turn affect society, politics and culture (Wikipedia,2011). The goals of science education demand that the learner should:

- Draw a link between science, technology, the society and how they affect him
- Understand the relationship between technology and social change
- Understand the challenges posed by science and technologic activities
- Understand the value of using a scientific approach in solving problem and by implication understand his world.

According to Umoren (1991) science and technology do not only modify the world's physical environment but also colour our perception and influence our decision about issues and events. They also impinge on man's decisions in relation to economic, environmental, ethical and moral dimensions of life (Kumar and Chubin 2000); The key goals of STS worldwide are:

1. Seamless integration of economic, ethical, social and political aspects of scientific and technological developments into the science curriculum
2. Engaging of students in examining a variety of real world issues and grounding scientific knowledge in such realities as global warming, genetic engineering, animal testing, deforestation practices, nuclear testing and different world legislations
3. Enabling students to formulate a critical understanding of the interface between science, society and technology
4. Developing students' capacities and confidence to make informed decisions and to take responsible actions to address issues arising from the impact of science on their lives.

Science education of the 21st century must equip the learner with fundamental science knowledge needed for interaction with science, technology and his world. Individuals need to be able to rationally evaluate their actions, decision and thoughts so as to solve their individual societal problem as well as those created or accentuated by scientific and technological endeavours (Moemeke, 2010). It is expected that the science curriculum should provide avenue for learners of science to acquire literacy in science for the improvement of their lives and impact on society. The implication of this is that science should not be learnt as

a separate entity alienated from other disciplines but should form an integral part of literacy cluster which individuals require in order to live a life of relevance. A relevant science curriculum and learning should therefore enable learners to acquire

1. Knowledge of facts, concepts, theories, principles and laws about science
2. Understand the relationship between science,technology and how they affect and are affected by society
3. Skill in problem solving and scientific investigation
4. A favourable and positive attitude towards science, scientific attitudes and science knowledge.

The relationship between science and technology has been copiously explored in which technology rests largely on science as a social institution while scientific activities progress through the development of technology.Modern technology is thus the commercial exploitation of science involving organizing for productive and sale of new commodities or services while science generates information and knowledge for technology to evolve.

Decision-Making and Problem-Solving in STS Education

One of the traditional goals of science education that has persisted in history is problem-solving. Gagne (1977) conceived problem solving as a process by which the learner discovers a combination of previously learned rules which can be applied to achieve a solution to a novel situation. It is a product of new learning which results from active mental analysis of situations and information already possessed (Moemeke and Omoifo, 2003). The fact that its acquisition can be fostered and strengthened by science instruction has also been copiously investigated (Keys 1994,Omoifo and Moemeke,2002,Moemeke and Omoifo, 2003). The elements of problem solving such as identifying problems, hypothesizing, predicting outcomes and separating and controlling variables are taught as vital steps in science investigative process and are expected to affect the learners' ability to solve personal and social/society problems.

For this to be achieved there has to be a logical extension through appropriate decision making. Decision making begins with gathering of information and examining them so as to make value judgment on the basis of which alternatives will be eliminated and a wise and informed choice made towards a particular situation. Making informed decisions is a point in an individual's thinking and reasoning process when the mind, after a thorough consideration of all possibilities, is able to resolve all controversies, exclude confusion and cut off all alternatives by taking a position which is considered more beneficial in the circumstances of the problem (Moemeke 2010). Self-evaluation of a problem space (Kuhn 1970), arising from proper situation analysis and anchored on effective communication are essential for individuals to operate in a knowledge economy. The ability to make wise decision for solving individual

and societal problem now rank higher than mere natural endowment among nations.

The present day Nigeria is ridden with ethno-religious crisis, intolerance and
mayhem. Some of these acts of banditry are products of individual's inability to analyze, weigh and take self-evaluated decisions of immediate and long run effects of actions. Individuals who are in control of their own actions oftentimes act after careful decision making and concomitant arrival at solutions to individual or mutual problems. On the contrary, a devaluation of and de-emphasis of development of skills in problems solving and decision making put the actions of a majority of a country's nationals in the hands of few negative ideological leaders who cash in on the porosity of their followers' initiatives to cause anarchy and threat to peace and security. Since literature has shown that these important goals of education are teachable, then the STS curriculum might just provide a perfect avenue for their enhancement and acquisition. This is thought to be so because an STS curriculum exposes the learner to science and its off shoot (technology) and consequences of their interaction both for man, his enemies and his environment. It is on this premise that this study is based.

Statement of the Problem

As societies develop, some natural and perceived threats to its continuous growth and development emerge from time to time. Some of these may be man-made or human-aggravated through actions that otherwise were thought to be strength. The multi-ethnic, multi-religious, multi-cultural and multi-social nature of Nigeria as a state which has earned her the name “Giant of Africa” in the 1980's and 1990's is gradually posing a very dangerous threat to her unity, development and continued existence as an entity. While some authors, Getson and Opotow, (2004):Harris and Morrison,2003 and Galtung, (1996) see peace as absence of war and violence, Edikpa (2006) explains peace as the presence of 'wellbeing, social justice, gender equality and human right that are characterized by trust, compassion, calmness and justice'. Conflict and insecurity on the other hand are the direct opposite of peace. Since STS is an integrated approach towards solving man's problems and securing of his existence, the possibility of launching it as a pad for reaching the learners (who are the most vulnerable) for the acquisition of science and technology literacy and an understanding of the implication of their actions is quite instructive. This will come when decisions are well made and solution to problem jointly negotiated and accepted. Since the curriculum is everything that a nation desires for her citizen, and science the application of common sense in solution to man's problem through technology, an adoption of the STS front to reach and entrench peace and security needs exploration. Will the infusion of the STS curriculum help science learners develop effective strategies for problem solving and decision-making in Nigerian secondary schools and enhance acquisition of peace and security awareness? It is believed

that emphasizing those things that are capable of uniting us over those ones that accentuate our difference through the curriculum is .
way of ensuring permanent and lasting peace and security in the Nigerian nation.

Purpose of the Study

The purpose of the study is to identify curricula influences of STS on students problem solving and decision making as a means of achieving peace and security. It is also to find out if the effect is the same for males and females.

Method of the Study

The dependent variables in the study are students' scores in decision- making test and problem-solving tests. The independent variable is the STS curriculum model and sex. Eight intact classes made up of 480 JSSII integrated science students of four schools were selected through stratified random sampling techniques from the 36 upper Basic Schools in Ika Local Government Areas of Delta state. The schools consist of two single sex and six coeducational schools. Out of the 480 JSS 11 students used in the study, 249 were boys and 231 girls. Treatment consisted of teaching experiment. Each intact class in a school was taught using STS curriculum which emphasized the integration of science and technology and the interrelatedness of science and technology on societal issues such as nature of science, nature of technology, students understanding of issues of peace and effect of technology on societies continued existence (safety). The other group consisted of four intact classes which were taught using their normal integrated science curriculum. In the first week of treatment, pretest was administered to the subjects. These are the decision making ability test (DMAT) and test of problem solving ability (TOPSA). After eight weeks, the two instruments were re-administered to both the experimental and control groups. The two instruments were shorter versions of Umoren (1991) decisions making ability test (DMAT) and test of problem solving ability (TOPSA). The reliability coefficients of the shortened instruments were found by KR 21 to be 0.68 and 0.62 respectively.

Results

Table l: Pretest and posttest means of experimental and control groups in decision making and problem solving.

	Experiment		Control	
	DMAT	TOPSA	DMAT	TOPSA
No. of students	240	240	240	240
Pretest mean	13.96	8.66	5.26	3.92
Pretest SD	3.20	5.65	3.00	5.19
Posttest SD	39.54	42.9	20.60	19.00
Posttest SD	3.62	6.22	3.42	7.00
Mean gain	24.50	38.07	11.01	13.20
Adjusted means	39.20	43.81	20.81	18.72

Table 1 showed that the experimental group which was taught using the STS curriculum that emphasized the relationships between science, technology and society produced higher means in both the test of decision making ability (39.54) and the test of problem solving ability(42.92) over the control group (20.60 and 19.00) in the two tests respectively even though their pretest means did not differ appreciably. The mean gains after posttest for the two groups in the two tests were thus 24.50 and 34.07 respectively for the experimental group and 11.01 and 13.20 respectively for the control group. This difference is attributable to the difference in treatment since the two groups did not differ significantly at pretest.

Table 2: ANOV A summary of scores of problem solving ability by groups with pretest data as covariate.

Source	SS	Df	Ms	F	Sig P
Covariates	560.98	1	560.88	13.822	0.00
Main effect	70751.83	1	70751.83	1709.90	0.00
Explained	71312.81	2	35656.41	861.86	0.00
Residual	19516	477	41.41		
Total	90828.81	479	189.62		

The F-value of 1709.90(Table 2) with df (1,479) significant at 0.00 level of significance was thus significant at 0.05 alpha level chosen for its study. Null hypothesis that there is no significant difference in the problem solving ability in peace and security issues of the experimental and control groups due to treatment was thus rejected. It was concluded that the science, technology and society curriculum significantly affected the students' problem solving exhibition in matters of peace and security.

Table 3: ANOVA summary of scores of decision making ability by groups using pretext data as covariates

Source	SS	Df	Ms	F	Sig P
Covariates	17792.61	1	17792.61	1061.62	0.00
Main effect	27511.14	1	27511.41	1525.72	0.00
Explained	45304.02	2	22652.01	1293.67	0.00
Residual	8352.27	477	17.51		
Total	53656.29	479	112.02		

To determine the effect of treatment on the students' decision making ability across the treatment groups, table 3 reveals an F-value of 1525.72 with df (1,479) significant at 0.00 level of significance. This is significant at the 0.05 level used in the study. This means that hypothesis 2 which states that there is no significant effect of STS curriculum on students' decision making for peace and security was rejected. This means that treatment significantly affected the students' ability to make decisions on issues of peace and security of the two groups (24.50 for experimental and 11.01 for the control group respectively).

Table 4: t- test summary of experimental group decision making and problem solving abilities by sex

Instrument	**Group**	**N**	**Mean**	**SD**	**t cal**	**t tab**	**Sig. P**
Test of decision	Male	141	9.28	2.42			
Making ability	Female	99	5.25	2.12	16.04	1.96	0.02*
Test of problem	Male	141	12.62	3.20			
Solving ability	Female	99	10.61	2.20	18.51	1.96	0.03*

*sig. at 0.05 alpha level

From Table 4,a t- value of 18.51 which is higher than the table value of 1.96 at 0.05 and as such significant at 0.00 level of significant was got. The null hypothesis that there is no significant difference in male and female students' problem solving exhibition after receiving treatment from the STS curriculum was rejected. The males with mean of 12.62 were found to be superior to the females (mean=1.061) in problem solving ability in the study.

Table 4 also showed as t-value of 16.04 which is higher than the table value of 1.960 at 0.05 level of significance. The null hypothesis that there is no significant difference between males and females in decision making on peace and security issues after treatment was rejected. This means that males and females in the sample differ significantly in decision making ability even after the STS curriculum in favour of males (mean = 9.28)

Discussion of Finding

A major finding of this study is the positive effect of science, technology and society curriculum on experimental subjects problem solving and decision making in the area of peace and security (experimental mean=42.9 and

39.54;control mean=19.00 and 20.60 respectively). An earlier study by Moemeke and Efedi (2010) using problem solving heuristic as treatment show a positive effect on students' problem solving and decision making ability in environmental sustainability. The findings are also in line with Bybee (1985), Moemeke and Omoifo (2003) who concluded that appropriate instruction can fortify the acquisition and exhibition of problem solving and decision making skills. However, the work of Anderson(1982) found no significant effects of instruction on students' problem solving and decision making.

The differential effect of the STS curriculum treatment on gender problem solving and decision making within the experimental group is noteworthy. It corroborates Umoren (1991) and Moemeke and Efedi (2010) who found significant male dominance in these two variables and implicated cultural issues as responsible for the disparity. Other studies in other cultures have shown no male dominance in problem solving and decision making (Ridley and Novak, 1983; Klahr and Dumbar,1988). This draws attention to gender issues in the science classroom and the need to de-emphasize all practices that accentuate gender disparity in the science classrooms.

Conclusion

The STS curriculum provides avenue for integration of understanding of societal/social issues into everyday science classroom discourses. Since this study has shown that problem solving and decision making can be outcomes of science and technology instructional process, the need to diversify the science and technology curriculum to relate more issues of our current time such as unity, implication of use of weapons of mass destruction, effect of bombing and conflict on human life, genetic mutation, ecology of the environment and weakening of national might and manpower which opens the country to external evasion by her neighbours should not be overlooked. The study also concludes that difference still exists between male and female students in application of science learning outcomes in Nigeria. This needs some urgent attention by all and sundry since girls in the study showed very low knowledge of peace and security issues of our time and how they could be solved.

Recommendation

Science, technology and society (STS)address the social aspects of life and living as they relate to science and technology since the aim of science and technology is to help man improve his living conditions. Everyday activities such as problem solving and decisions making should become regular aspects of classroom science that should be deliberately taught and targeted. Analysis of some security actions and their implication should be a regular part of science classroom discourses. Leadership and security clubs should also be set up to give learners' opportunity to practice decision making, problem solving and security consciousness as co-curricular aspects of school learning. This could contribute

very early in life to building an understanding of peaceful co-existence among youths.

References

Aikenhead, G. S (1986).“The Content of STS Education. A Missive to the Science-Technology-Society's Most Urgent Imperatives". A Paper Presented at the International PATTZ (Pupils Attitude Towards Technology Conference) Nottingham U.K.

Bryant, N. A (2003). “Sustainable Development: Its Application in Nigeria". Proceedings of the 44th Annual Conference of Science Teacherrs' Association of Nigeria (STAN), 6-8

Edikpa, E. C. (2006) Peace Education: A Sine Quo Non for All Colleges of Education. Ebonyi state University Journal of Education, 4(1),145-152.

Ezeugwu, K. U (2009) "Peace and Co-existence in Nigeria: The Curriculum Planning and Implementation Task". Nigerian Journal of Curriculum Studies. 16(3)

Galtung, J.(1996).Peace by Peaceful Means: Peace and Conflict, Development and Civilization. London: Sage.

Gerson, J and Opotow, S (2004).“Deadly Conflict and the Challenges of Co-existence”, Analysis of Social Issues and Public Policy. 4,265-268

Harris, J. M and Morrison, M.I(2003). Peace education. Jefferson macfoartand and Co.

Key, C. W (1994). “The Development of Scientific Reasoning Skills in Conjunction with Collaborative Writing Assignment: An interpretive Study of Six Ninth-Grade Students. Journal of Research in Science Teaching. 3(9),1003-1022.

Klahr, D. and Dumbar, K. (1988). “Dual Search During Scientific Reasoning". Cognitive Science 12, 1-48

Kumar, D & Chubin, D. (2000). Science, Technology and Society: A Source Book of Research and Practice. London Kluwer Academic

Kuhn, T. S. (1970). The Structure of Scientific Revolution. (2nd ed.) Chicago, University of Chicago press.

Moemeke, C.D & Omoifo, C. N(2003).“The Effectiveness of Individualized, Collaborative Fieldwork and Expository Learning on Biology Students' Ability to Solve Problems". The Jos Journal of Education 6(2),84-94

Moemeke, C.D (2010). “Science Education and the Development of Decision Making Ability: A Curriculum Implementation Dimension”, *Journal of curriculum organization of Nigeria* 17

Omoifo, C.N & Moemeke, C. D (2002/2003)“Effects of Visual Information Process Aids On Students Attitude and Learning of Biology. Journal of Nigerian Educational Research Association 16 &17 15-25

Ogunniyi, M. B (1986). Teaching Science in Africa. Salen Media (Nig.) Ltd; Ibadan.

Pedietti, E(2005) STSE Education: Principles and Practice In ASLOP S. Bencze, L; Peditti, E (eds). “Analysing Examplary Science Teaching: Theoretical lenses and a spectrum of possibilities for practice". Open University press, Mc Graw-Hill Education.

Umoren, G. U. (1991). “A Science-Technology-Society Paradigm and Cross River States Secondary School Students Scientific Literacy, Problem Solving and Decision Making”. A Ph.D Thesis submitted to Faculty of Education, University of Ibadan, Nigeria.