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Socio-Scientific Issues in the Curricula: Discovering the Classroom Situation of Nigerian Secondary Schools' Science Teachers and Students

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Abstract:

An investigation was undertaken on "Socio-scientific issues in the curricula: discovering the classroom situation of Nigerian secondary schools science teachers and students". The main objectives of the study were to determine the perceptions of teachers on the inclusion of socio-scientific issues in the curricula of science. The study also investigated the extent to which the students were willing to study those issues. Moreover, the study found out the effect of type or geographical location of schools on students' academic performance. Three research questions were formulated along with three hypotheses to guide the study. The research design was partly descriptive and partly inferential; and the population was stratified on the bases of type of school, location and gender of the students and teachers. The sample comprised One hundred and eighty (180) science teachers and three hundred and sixty (360) science students drawn from senior secondary schools in the Federal Capital Territory, Abuja. They were sampled using proportionate sampling technique. The average students' age was 16 years. The instruments comprised teachers' perception questionnaire (TPQ), students' willingness questionnaire on socio-scientific issues and students achievement test on socio-scientific issues in the curricula. Data were collated and analyzed using means and standard deviations inferential statistics of chi-square and analysis of variance were used to test the hypotheses relevant to the study. Results revealed that teachers had positive perceptions about the inclusion of socio-scientific issues in the curricula. The results also showed that students showed strong willingness to study socio-scientific issues. It was similarly discovered that there was significant difference in the performance of the students due to type or location of school. It was recommended that schools should be adequately and equitably funded to addresse the observed gap.

Keywords:

Keyword Perception, Science Curricula, Academic Performance, Attitude

1. Introduction

Socio-scientific issues are introduced into the science curriculum, supposing, at least covertly, that those concepts improve the student learning, deepen their understanding of the concepts, and prepare them for useful living in the society. Students' successful living in the society after acquiring scientific knowledge is predicated on the physiognomies of such science based issues which have been designated as having comportments that can improvement of the quality of life of the members of the society. Recteffe and Grace (2003) have reported the wide-ranging features of socio-scientific topics. Accordingly, socio-scientific matters should have their origins in scientific literacy; they should be perceived by the society as having concerns for offering scientific solutions to human woes, and should receive a wide public knowledge. Such scientific matters should further possess social and ethical characteristics having to do with value systems of the society. For these issues to serve the society and probably lead it to attainment of economic prosperity, their practices must be regulated, bearing in mind the risks that can result from unwholesome use by people. In recent times the global society has reportedly and extensively expressed concerns about global warming, acute shortage of food for the ever-rising human population, biotechnology, energy, security and disease control. These situations are seen by experts as scientific issues begging for solutions by the human society. Hence, there is wisdom in the nations' educational policy makers seeking inclusion of these debatable topics in the curriculum.

However, the capacity for effective lesson delivery on socio-scientific based topics depends partly on the chemistry teachers' perceptions of the debatable subject matter. Researchers have reported that science teachers have observed contradictions between real classroom situations and the implementation of the proposals made by science education specialists on the strategies for improving the learning of socio-scientific issues. Teachers see socio-scientific issues coming into the science curriculum as a new challenge to their traditional way of reproducing scientific facts coupled with the damage caused by their lack of strength when the demand is placed for them to play the facilitators' roles during lesson delivery [1,2,7]. Borgerding et al (2015) reports that, teachers of science based subjects are often trapped and struck with awe during delivery on science-based issues which also have ethical or social perspectives.

To what extent can young learners' interests be sustained in science related professions if the society where they have identified with is continuously exhibiting extensive scientific ignorance, and economic fortune of science is being treated with contempt? Decades of escalating proof reveal that young learners' interests in science have deeply deteriorated, with their growing attitudes showing that science classes are boring to them. Do these young learners have their own views on why they get easily discouraged when they are faced with difficult concepts? [14]. Jarman & McLune [5] report that the challenge most teachers and learners face in the classroom can be mitigated if socio-scientific issue-based topics are given prominence; since it has the potency of improving basic skills, promote cooperate learning, enhance problem-solving and advance public knowledge.

Typically, in nuclear science, the scientific model offers the human society an opportunity to draw benefits from the use of atomic energy as a source of power and for the production of radiations that can be used for alleviations of human woes. Radioactive rays such as X-rays and gamma rays are essential energies used to kill cancer cells. They are equally used in the industries for quality control purposes and for research in most other fields of human endeavors. However, there is a social context restriction of the use of the same radiations, especially as it concerns effective

management of excesses or accidental discharges. In such cases, the society is made to suffer for the reckless handling of the otherwise beneficial radiations. Moris has cautioned against the inability of an individual to function in the society due to the incidence of self-creation of a barrier that can prevent him from functioning in a community.

To actualize the strategic aim of the inclusion of socio-scientific issues in the science curricula, such a self-created barrier must be done away with by consciously encouraging the development and exhibition of specific skills by chemistry teachers in the classroom situation. This requires that teachers of chemistry should improve on their abilities to solve the dilemma introduced in the socio-scientific issues, and marry both the social and scientific models to serve as guides in the decision making process. Sometimes, kicking against a scientific theory by the society may not just be for nothing. In some aspects, it could be due to a misinformed decision due to the abstractness or non-materialistic perspective whereby the society cannot connect scientific theories with common practices or useful events. A common disastrous event that can result from inappropriate handling of socio-scientific issues in the classroom can reveal in the form of declining number of specialists in a chosen field as a result of the cumulative effect of reduced number of individuals having to do with its activities at the lower echelon of learning.

This study therefore serves to seek the views of science teachers and their students on the introduction of socio-scientific issues into the curriculum.

1.1. Statement of the problem

Science teachers' inability to positively perceive about the introduction of socio-scientific issues in the curriculum of science is a trending issue that is confronting our science educational system. There is need to urgently address this challenge by practitioners.

1.2. Purpose of the study

Considering the relative importance of this study in line with the national goal of science education, the following objectives have been identified towards actualizing the study:

a. To determine the perceptions of teachers on the inclusion of socio-scientific issues in the curriculum.

b. To find out the extent to which students prefer studying socio-scientific issues in the curriculum?

c. To determine effect of type or location of schools on students' knowledge level of and preference to the study of socio-scientific issues in the curriculum.

1.3. Research questions

a. How do science teachers perceive the inclusion of socio-scientific issues in the curriculum?

b. To what extent do students prefer studying socio-scientific issues in the curriculum?

c. What are the effects of the type or location of school on students′ knowledge level of and preference to the socio-scientific topics in the curriculum?

1.4. Research Hypotheses

H_{01}: The science teachers' perceptions on the inclusion of socio-scientific issues in the curriculum are not statistically significant at 0.05 confidence level.

H_{02}: There is no significant difference in the achievements of secondary school students on socio-scientific issues as a result of the type or geographical location of school.

H_{03}: There is no significant interaction between students' academic performance and the extent to which they want to study socio-scientific issues in the curriculum, as a result of the type or geographical location of the school.

1.5. Significance of the study

The significance of the study is in its stimulating nature. It is a research to reveal what goes on in our science classrooms with the emerging global calls to shift teaching activities from teacher-centered delivery method to students-centered activity-based strategy.

2. Methodology

The study was designed to conform to the descriptive survey as well as co-relational strategies. The population comprised all the science teachers and students in the public and private senior secondary schools in the Federal Capital Territory (FCT), Nigeria. The sample consisted of one hundred and eighty (180) senior secondary schools' science teachers and three hundred and sixty (360) science students in the FCT, chosen using probability sampling procedure. Questionnaire systems were four (4) in sets. Three of them were adaptations and expanded forms of the one earlier used by Kara (2012). Teachers and students were sampled to cover schools cited in rural and urban communities of the Federal Capital Territory. The area councils that make up the Federal Capital Territory are: Abuja Municipal Area Council, Abaji Area Council, Bwari Area Council, Kuje Area Council, Gwagwalada Area Council and Kwali Area Council. Science teachers in the affected zones were used to support the study. All the instruments were pilot-tested on Kwali Area Council's schools.

The first questionnaire sought to determine the perceptions of science teachers on the inclusion of socio-scientific issues of the curriculum; while the second questionnaire was designed to determine the choice of students to study the introduction of socio-scientific issues in the curriculum.

The third questionnaire was designed to measure academic performance of science students on socio-scientific issues in the curriculum. It was a series of objective-type questions on administered and intended to last for 30 minutes.

The instruments Cronbach's alpha coefficients respectively, were found to be 0.789, 0.874 and 0.897. The instruments went through science education experts' scrutiny for further validation before it was pilot-tested using science teachers and students of science from secondary schools in Kwali Area Council of the Federal Capital Territory (FCT), Nigeria. There were then administered by the researcher with the help of some science teachers chosen from each Area Council of the Federal Capital Territory, Nigeria. The completed sets of questionnaire were collected manually to ensure good return. Data was collated using frequency counts from where computations of means and standard deviations were achieved. The computed results were then used as the basis for answering research questions.

Chi-square (χ^2) analytical tool was used to test hypothesis 1. For hypotheses 2 was tested using a one-way analysis of variance analytical tool and 3 a two-way analysis of variance (ANOVA).

Table 1. *Demographic information.*

Teacher Gender	N
Male	101
Female	76
No submission of report	3
Students Gender	N
Male	215
Female	144
No not submitted	1
Type of school	N
Public	177
Private	182
No not submitted	1
Location of school	N
Urban	180
Rural	179
No not submitted	1

3. Presentation of Results

The study's results were in Tables 2 - 7.

Research question 1 What are the perceptions of science teachers on the introduction of socio-scientific issues in the curriculum?

Table 2 shows how science teachers perceived about the inclusion of socio-scientific issues in the school curriculum. In their views on item one the mean of 0.9 and standard deviation of 0.91 are observed. This shows that the teachers have expressed their willingness to make use of available resource materials for promoting the teaching and learning of socio-scientific issues in the classroom. Item 6 also attracted the teachers' attention as the mean rating of 0.93 and standard deviation of 0.66 is the highest. Table 2 however reveals that item 7 received the least mean rating of 0.35 by the respondents with standard deviation of 0.21. What the teachers are saying here is that socio-scientific issues should not be dropped from the school science curricula. The teachers are almost introducing controversy on the manner they respond to item 4, by rating it low (mean = 0.55 and standard deviation = 0.42). On item 8 the teachers confess that socio-scientific issues are difficult concepts and can pose challenge during lesson deliveries (mean = 0.57 and standard deviation = 0.46).

Table 2. *Mean distribution of the respondents on the perceptions of science teachers on the necessity of introducing socio-scientific issues in the curriculum (N=359).*

S/n	Item	X	Std
1	I am ready to use resource material for teaching socio-scientific issues, if available	0.90	0.91
2	I am ready to get involved the activities that can help	0.85	0.93
	teachers deal with socio-scientific issues in the curriculum		
3	I think that it is more appropriate to deal with socio-	0.78	1.03
	scientific issues in ethics, socio-logy or technology in the chemistry classroom		

4	Introducing Socio-scientific issues into science lesson will increase students' interest in these issues	0.55	0.42
5	Students need to be concerned with socio-scientific issues related to science	0.73	0.46
6	Students need to learn and enhance ability to decide their own positions about socio-scientific issues in science lessons	0.93	0.66
7	Socio-scientific issues should be completely removed from the school curriculum	0.35	0.21
8	Teaching socio-scientific issues are the most difficult if the learners are not matured enough	0.57	0.46
9	The complex nature of socio-scientific issues is the reasonwhy many science teachers doge lessons having to do with such topics	0.88	0.91
10	Socio-scientific issues make many science teachers more confused about ethics and sociology	0.63	0.40

Table 3 gives the results of the investigation of the science students' willingness to study socio-scientific issues. The trend shows that students are mostly willing to debatable issues on health and medicine (mean = 3.643 and standard deviation = 0.045) followed by food/nutrition/agriculture (mean = 3.335 and standard deviation = 0.56). The students also preferred to study science culture (mean = 2.947 standard deviation 0.52); genetic technology (mean = 2.416 and standard deviation = 0.81); and information and communication technology (mean = 2.348 and standard deviation = 0.62). The least preferred socio-scientific issues for the students is security science (mean = 0.879 and standard deviation = 0.65).

Table 3. *Distribution of the mean response on students' willingness to study some socio-scientific issues as the programs of study (N = 359).*

S/N	Socio-scientific issues	Mean (x)	Standard deviation (stdev)
1	Atomic energy	1.625	0.701
2	Virology	1.349	0.42
3	Security science	0.879	0.65
4	Health and medical science	3.643	0.045
5	Food / Nutrition /Agriculture	3.335	0.56
6	Genetic technology	2.416	0.81
7	Environment	1.512	0.88
8	Science Culture	2.947	0.52
9	Information and Communication Technology	2.348	0.62

Table 4 gives the overall mean of the respondents on the willingness to study socio-scientific issues and their performance on the achievement test. Private schools have the mean score of 1.876 with standard deviation 1.326. This is followed by urban schools whose overall mean is 1.661 with standard deviation of 0.969. The third overall mean score of 1.079 (standard deviation, 0.764) is for the public schools; while the last is the position of the public schools having the overall mean of 0.661 and standard deviation 0.426.

Table 4. *Ratings of the respondents' scores in terms of students' willingness to study and their performance in achievement test.*

	Mean rating of the responses on the extent to which students are willing to study socio-scientific issues					Mean performance of students on the test on socio-scientific issue					Overall Mean	Stdev
Grade	A	B	C	D	E	A	B	C	D	E		
Publi	1.2	1.8	0.8	1.5	0.1	0.0	0.7	1.8	2.2	0.3	1.079	0.7

c schools	71	08	30	14	81	57	23	31	37	4		64
Private schools	2.198	2.374	1.681	1.055	0.264	3.673	3.978	2.542	0.859	0.133	1.876	1.326
Urban schools	1.111	2.467	2.65	1.333	0.111	1.945	2.844	2.1	1.6	0.131	1.601	0.969
Rural schools	0.371	1.225	1.098	0.146	0.034	0.862	0.552	0.931	1.031	0.368	0.661	0.426

The above results reveal that private schools' students are the most willing to study socio-scientific issues in the curriculum; and they have the best achievement in the proficiency test. These performances are closely followed by students from urban schools but trailed by the public and rural schools' students.

4. Test of Hypotheses

H_{01}: The science teachers' perceptions on the inclusion of socio-scientific issues in the curriculum are not statistically significant at 0.05 confidence level.

Table 5 indicates the total chi-square ($\chi 2$) of the distribution is 16.186 at the degree of freedom of 27. As the calculated $\chi 2 = 16.186 \lessdot 40.1$ at 0.05 level of confidence, H0 is accepted, and hence the perception of science teachers on the inclusion of socio-scientific issues in the curriculum is statistically significant.

Table 5. *$\chi 2$ distribution of the respondents on the perceptions of science teachers on the necessity of introducing socio-scientific issues in the curriculum.*

S/n	Item	χ^2	P
1	I am ready to use resource material for teaching socio-scientific issues, if available	0.955	0.812
2	I am ready to get involved the activities that can help teachers deal with socio-scientific issues in the curriculum	1.104	0.776
3	I think that it is more appropriate to deal with socio-scientific issues in ethics, socio-logy or technology in the chemistry classroom	1.025	0.795
4	Introducing Socio-scientific issues into chemistry lesson will increase students' interest in these issues	0.566	0.904
5	Students need to be concerned with socio-scientific issues related to chemistry	0.572	0.903
6	Students need to learn and enhance ability to decide their own positions about socio-scientific issues in chemistry lessons	1.892	0.595
7	Socio-scientific issues should be completely removed from the school curriculum	4.947	0.176
8	Teaching socio-scientific issues are the most difficult if the learners are not matured enough	2.644	0.45
9	The complex nature of socio-scientific issues is the reason why many chemistry teachers doge lessons having to do with such topics	1.786	0.618
10	Socio-scientific issues make many chemistry teachers more confused about ethics and sociology	0.695	0.874

$\chi^2 = 16.186$, DF = 27

H_{02}: There is no significant difference in the achievements of secondary school students on socio-scientific issues as a result of the type ors geographical location of school.

a. F between rows: F (4,12) at 0.05 level of significance = 3.2593

As FR = 4.97947 › 3.2592, H_0 = is rejected. Hence, there is significant difference between rows. The results in Table 6 there indicate that there is significant difference in the grades obtained from the students on test on socio-scientific issues in the curriculum.

b. F for between the columns: F (3,13) at 0.05 level of significance = 3.4903.

As FC = 0.0023, so, H_0 is accepted. Hence, there is no significant difference between columns. The results in Table 6 also show clearly that there is no significant difference in the mean achievements of the students due to school type or geographical location.

Table 6. *One-way analysis of variance for testing equality of variance regarding hypothesis H_{02}.*

Source of variation	Sum of squares (SS)	Degree of freedom (DF)	Mean square (MS)	F statistics	p-value
Between rows	SR = 8497.8	r-1 = 4	MSR = 8497.8/4 = 2123.45	2124.45/426.65 = 4.9794	0.0134
Between columns	SSC = 2.95	c – 1 = 3	MSC = 2.95/3 =0.9833	0.9833/426.65 = 0.0023	1
Error (residue)	SSE = 5119.8	(r – 1)(c – 1) = 12	MSE = 5119.8/12 = 425.65		

H_{03}: There is no significant interaction between students' academic performance and the extent to which they want to study socio-scientific issues in the curriculum, as a result of the type or geographical location of the school.

a. F calculated for between rows: F (3,27) at 0.05 level of confidence = 2.9604

As calculated FR = 0.7967 ‹ 29604; so H0 is accepted, hence there is no significant interaction between rows. Therefore, there are no significant relationships between school-types or geographical locations of schools.

b. F for columns: F (9,27) at 0.05 level of significance = 2.2501. As calculated FC = 2.9584 › 2.2501, so H0 is, rejected, hence there r is significant difference between columns. Therefore, there is significant relationship between the students' willingness to study socio-scientific issues and their performance in the achievement test.

Table 7. *Two-way analysis of variance for testing equality of variance regarding hypothesis H_{03}.*

Source of variation	Sum of squares (SS)	Degree of freedom (DF)	Mean square (MS)	F statistics	p-value
Between rows	SR = 0.1431	r-1 = 3	MSR = 0.1431/43 = = 0.0477	0.0477/0.059 = 0.7967	0.5065
Between columns	SSC = 1.5942	c – 1 = 9	MSC = 1.5942/9 =0.1771	0.1771/0.0599 = = 2.958.	0.0501

Error (residue)	SSE = 1.6166	(r – 1)(c – 1) = 27	MSE = 1.6166/27 = 0.0599		
Total	3.354	Rc – 1 = 39			

5. Summary of Findings

a. FCT science teachers have positive perceptions about the inclusion of socio-scientific issues in the curriculum

b. FCT secondary schools science students have positive interests for the study of socio-scientific issues of global concerns.

c. There are significant differences in the performances of FCT secondary schools' students as a result of the type or geographical location of their schools.

d. There are significant interactions in the students' decisions to study socio-scientific issues introduced into the curriculum and their academic performance in these issues.

6. Discussion

An overview of the observations from the affective and cognitive outcomes of the study on socio-scientific issues reveals that teachers' perceptions as well as students' performance seem to be affected by the type or location of schools. This goes on to suggest that there are disparities in the distributions of amenities and learning resources in senior secondary schools in the Federal Capital City of Nigeria. The distributions of both material and personnel resources seem to favor private and urban schools more than they affect their rural schools counterparts as can be verified with their higher means scores on achievement test grades and interest for SSIs. Moreover, inferential statistics results have affirmed these positions all together. Since the essence of the tenet of education for all presumes that all students should be given equal educational opportunity to help them acquire functional scientific knowledge, it is the duty of a wise society to consciously do everything possible to preserve our cherished values by supplying the educational needs of every child irrespective of where the child finds himself in the classroom.

The findings of the study also reveal that teachers tend to play their roles effectively as they perceive positively about the inclusion and teaching of socio-scientific issues in the schools' science curricula. This revelation also implies that the teachers have good knowledge of ethics and sociology, which they probably acquired during their teacher training programs. The teachers' expertise and positive roles which they play in the science classroom must have impacted positively also, on the students interest for and achievement in socio-scientific related tasks. This is the reason why it may be deduced that students have on the average, an improved knowledge level of socio-scientific issues; therefore, majority of them must have decided to hold onto the study of these issues, irrespective of the type or location of their schools.

7. Conclusion

An investigation of what goes on in the science classroom between the teachers and students in the FCT secondary schools, typically, during the teaching and learning of socio-scientific issues, made it possible to understand that the learners usually have excited moments, increased interest and improved academic achievements. The

science teachers are well equipped with the knowledge of ethics and sociology coupled with expertise in the socio-scientific issues of the curricula. However, the type or geographical location of schools determined greatly the interest and academic characteristics of the students; therefore, the researcher recommended strategies that could help in tackling this challenge, which also included adequate and unbiased distribution of services to all schools

8. Recommendations

Seeing that the decision made by the students to study socio-scientific issues that are introduced into the school science curricula is a function of interest, and having established in this study that there is a relationship between interest and academic achievement, it is pertinent to recommend that any initiative geared towards the sustenance of such affective outcome of learning is a very welcome development. Particularly, the observed differences in interest and achievement of students due to the school type or geographical location, revealed from this study can be reduced if our various science classrooms are adequately and equitably furnished with relevant resource materials and qualified personnel. Attention of the school proprietors should be directed towards adequate budgetary provision for improved service delivery by the managers of the classrooms.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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