SENIOR HIGH SCHOOL STUDENTS' VIEWS ON THE TEACHING OF INTEGRATED SCIENCE IN GHANA

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Abstract

This study examined Senior High School students' perceptions of the teaching of Integrated Science in Ghana. The design of the study was descriptive survey. Stratified random sampling method was used to select the schools and subjects for the study. A student questionnaire, titled, "Science Opinion Questionnaire (SOQ)" was used to collect information from 350 SHS 3 students. The views of SHS students were that most of the processes of science (i.e. observing, hypothesising, classifying, taking measurements, reporting, etc.) were not often carried out in Integrated Science lessons. The chi-square test revealed that school setting had significant effect on the students' opinions of the activities carried out by students and what the teachers do during integrated science lessons. It was suggested that UEW should critically examine its integrated science curriculum to tailor it towards producing teachers who can teach science as an integrated whole or unit.

Key words: *students' views, teaching strategies, student's activity, integrated science lesson.*

Background to the study

It is globally recognised that the development and application of science and technology are vital for a country's developmental efforts. Science education is needed in Ghana to produce the necessary human resource and skilled labour force to manage our local industries. A country's development rests on science and its application in the world of work and industry and competent workers and citizenry need a sound understanding of science and mathematics (Shadreck & Mambanda, 2012; Anamuah-Mensah, August 2004). A strong science and technology base therefore constitutes the currency for social and economic transformation of nations (Anamuah-Mensah, August 2004). Teachers are responsible that citizens acquire this

knowledge and are expected to teach inquiry science to the young ones. Hence, the study sought to examine:

(i) SHS students' view of what happens in integrated science classes lessons; and

(ii) the quality of integrated science teaching by science teachers.

Ghana's vision of the National Science, Technology and Innovation Policy (February, 2010) is:

"to support national socio-economic development goals with a view to lifting Ghana to a middle income status by the year 2020 through the perpetuation of a science and technology culture at all levels of society, which is driven by the promotion of innovation and mastery of known and proven technologies and their application in industry and other sectors of the economy (Ministry of Environment, Science, and Technology, 2010)". The policy has its basic objectives among others as:

(i)   "to seek to master scientific and technological capabilities by a critical mass of the products of all institutions;

(ii)   to accelerate the promotion of innovation through the development and utilisation of modern scientific and technological capabilities to provide   the basic needs of the citizenry and to compete ably in the global market;

(iii)   ensure that Science, Technology and Innovation (STI)   support Ghana's trade and export drive for greater competiveness; and

(iv)   to promote science and technology culture (Ministry of Environment, Science, and Technology.2010)"

The study is significant because of its contribution to the knowledge of how integrated science will be taught in SHS and its effects on students' scientific and technological development. The findings will help the Ministry of Education to improve teacher quality in Ghanaian schools by paying much attention to policies concerning recruitment, early preparation, and professional development as well as attention to working conditions. Teacher training institutions will come out with educational programmes to prepare effective and highly qualified science teachers with the current pedagogical skills to enable them teach well.

Knowledgeable, dedicated and resourceful science teachers are therefore needed to lay good foundation of science in these young ones. Unfortunately despite the government's drive to draw more students to science, especially at the second cycle levels, more students keep running away from it. O'Connor (2000) identified the use of inappropriate teaching methods as one of the factors that contribute to the

low participation and performance of students in science. The teaching methods used are not practical enough and that teachers make little effort to relate the concepts learnt and the examples/illustrations used to real life, especially within the context of the students' own lives and environment. This has a negative effect on students' interest and motivation to study science, mathematics and technology (SMT) subjects. Danso (2010) indicated that teachers favour teacher-centred, knowledge based teaching methods that leave little room for learners' participation. The most commonly used teaching methods at both basic and secondary levels have been found to be lecturing; question and answer; explanations of procedures and note giving, in that order (O'Connor, 2002). Little practical work is done due to shortage of equipment and consumables, and the development of a scientific way of thinking is abandoned in favour of the learning of nomenclature, definitions and stock standard procedures (O'Connor, 2002). If teachers belong to the Ghana Association of Science Teachers then they need not lack anything that would prevent them from imparting the required knowledge and skills to students at the pre-tertiary level. According to Ghana Web (2009), the mission of GAST is to promote the teaching and learning of science and technology at all levels of pre-tertiary education in Ghana, through the development of creative, enterprising, innovative and morally responsible science and technology teachers and laboratory technicians. However, most of our science teachers are subject specialists and do not go beyond their specialty in an attempt to teach integrated science. Some SHS schools that do offer pure science programmes may even suffer getting teachers to teach all the components of integrated science.

The statement of the problem

The current state of teaching and learning of science in Ghana is poor. Studies show that many of our students tend to learn science by rote and hence lack understanding of science concepts since no meaningful learning occurs Anamuah-Mensah & Benneh, 2010; Jones, 2008; O'Connor, 2002). The quality of science teaching and learning in basic, senior high schools and tertiary institutions in Ghana has therefore been criticized by parents, science educators, technocrats and the government (Anamuah-Mensah, Mereku, &Ampiah, 2010; Ndago, 2012). The poor teaching and learning of integrated science in Ghanaian schools has been reflected in the poor performance of Ghanaian SHS students in West African Senior School Certificate Examination (WASSCE) that disqualify them from gaining admission into tertiary institutions for further studies (Entsuah-Mensah, 2004; Anamuah-

Mensah & Asabere-Ameyaw, 2011; Bello & Oke, 2011). This has also accounted for the enrolment of people with weak grades in science and mathematics into Colleges of Education (Anamuah-Mensah & Asabere-Ameyaw, 2011).

It is also on record that Ghanaian students who completed training in science and technology related programmes are also found wanting when it comes to the application of scientific knowledge to solve societal problems (Anamuah-Mensah & Asabere_Ameyaw, 2011).

The dearth of integrated science teachers in Ghana and the lack of teaching skills and competencies among teachers are the result of their poor instructional approaches (Anamuah-Mensah & Benneh, 2010; Jones, 2008) to integrated science and the resultant mass failure of students in this subject every year. Senior High School (SHS) students have blamed teachers and government for the poor run of results in the 2009 and 2010 WASSCE integrated science (The Ghana Journal, 2010). The present crops of teachers who teach integrated science have been trained in specific subject areas of biology, chemistry, physics, and agriculture (Nyavor & Seddoh, 2000; Haggis, 1969). Hence, they generally lack the skills of teaching science as a unified whole. Anamuah-Mensah and Asabere-Ameyaw (2011) observed that there are weaknesses in the teacher preparation, for whilst low emphasis is given to subject matter content during pre-service training there is also a disconnection between theory and practical application.

The purpose of the study was to investigate the views of SHS students on the teaching of integrated science at the senior high school level in Ghana. Specifically, the study was to find out:

(i) what happens in the integrated science lessons;
(ii) (ii) the types of activities that are carried out in integrated science lessons; and
(iii) (iii) whether school location affects what happens in integrated science lessons.

Research questions
Three main research questions were set to address the issue:
1. What do science teachers do during integrated science lessons?
2. What are the learning activities engaged in (inquiry science processes) by SHS students during integrated science lessons?

3.   Do urban and rural SHS students differ in their opinions of what happens during integrated science.

Hypotheses

Ho 1: There is no significant difference in opinions between SHS students of urban and rural schools of what teachers do in integrated science lessons.

Ho 2: There is no significant difference in opinions between SHS students of urban and rural schools of the activities being carried out in integrated science lessons.

Research Methods

The design of the study was survey.

The target population was all SHS students in Ghana. The accessible population comprised SHS students of forms II and III of the Central, Volta, Upper East, Upper West, and Northern regions of Ghana.

The study involved 350 students from nine randomly selected schools.

Two senior high schools were randomly chosen from each of the above regions. Two of the schools chosen were girls' schools. The other seven schools in the regions were co-educational (mixed). In each school one arm of SHS 3 was randomly selected. A total of 350 students comprising 185 females and 165 males were involved. The sample was also made up of 205 students from urban and 145 students from rural schools. The 205 urban participants further comprised 95 boys, 110 girls; while the rural participants were made up of 70 boys and 75 girls respectively (Table 1).

Table 1: The sample frame for the study

Participants	School setting				Total
	Rural		Urban		
	Male	Female	Male	Female	
Number	70	75	95	110	350

n = 350

Instrument and data collection

A student questionnaire, "Science Opinion Questionnaire (SOQ)", designed by Aworanti (1992) was adapted by the researcher. This was face and content validated by three senior Integrated Science lecturers and experts in the field of test,

measurement and evaluation and used for the collection of data. The questionnaire consisted of three sections: Section A explained the purpose of the questionnaire and elicited some demographic information from the respondents. Section B contained five items and sought information about what happens in Integrated Science lessons, Section C contained 12 items that elicited information about activities carried out by students during integrated science lessons. The questionnaire items were of the three item Likert-type- often (3), sometimes (2) and not at all (1).

The questionnaire was pilot-tested at Swedru Senior High School, Agona-Swedru.

A sample of 50 respondents was selected for the pilot testing of the instrument. Fifty student respondents were selected randomly from the second year students who numbered 178. A self-addressed introductory letter was presented to the Assistant Headmaster who then appointed one tutor to assist the researcher to administer the questionnaire he deemed appropriate. Consequently, the class register of the third year students was taken and all the names of the students were written vertically on a sheet of paper. Then, using the systematic random sampling method, the number of third year students who numbered 178 were divided by 50 and the results was 3.56. This rational number was approximated to 4. Using the interval of four in a systematic linear manner the 50 respondents were selected. Students who were selected were spoken to and the rationale for the data collection explained to them. They were given one hour to complete the questionnaire to which they obliged. In the end, all the 50 questionnaires were retrieved from respondents. After the questionnaires had been retrieved, they were edited to make sure that each questionnaire contained relevant data sought for by the researcher. The items were coded with numerical values which facilitated the keying process into the computer software, SPSS version 16.0. This software helped to run frequency tables and which also helped to work out the alpha reliability coefficient. The outcome of the reliability test was r = 0.784; which according Trochim (2009) was good for the instrument to be used for the final data collection.

Permission was obtained from heads of the selected schools to conduct the study. The researcher and some teachers of the schools distributed the questionnaire to the selected participants. The questionnaires were completed and collected back the same day.

Analysis of data

Mean score for each item on the questionnaire was calculated. Chi-square was used to compare the responses of students in urban and rural schools at an alpha of $\alpha = 0.05$.

Results

A summary of what happened in the Integrated Science lessons is presented in Table 2. The mean scores for all the five items are below the value 1.5. The results indicate that teachers only teach Integrated Science lessons without performing experiments. They also do not engage students in discussions that demand critical thinking and problem solving.

The mean scores (Table 3) show that students sometimes observe things, record observations made, analyse data and make deductions, perform experiments, put things into different classes/groups, interpret data by using charts and graphs, carry out activities again when results are doubtful, and discuss results obtained with other members of the class; but students did not take measurements of things, identify problems, neither did they formulate hypotheses nor question the results of activities. Results in Table 4 indicated that there was a significant difference in opinion between the urban and rural SHS students of what happened in Integrated Science lessons [x^2 (2, n =350) =40.20, p<0.05]. The calculated x^2 value of 40.20 is greater than the critical c^2 (2, p=0.05) which is 6.00. Thus, the views of students on what happened in integrated science lessons did differed by school setting at p≤ 0.05. It means there was significant evidence to conclude that urban students differed in their views from their rural counterparts on what teachers did during integrated science lessons.

Information about activities carried out in Integrated Science lesson is given in Table 5. The calculated chi-square value is: x^2 (2, n =350) = 26.45, p<0.05. The critical c^2 is 6.00 (df =2, p=0.05). Since the calculated chi-square of 26.45 is greater than the critical chi-square value of 6.00, p< 0.05, the null hypothesis is rejected. Therefore, urban students' opinion was significantly different from that of their rural counterparts on the type of activities they carried out in Integrated Science classes. The implication is that urban and rural school teachers teach integrated science using different strategies that may include or exclude tasks on science processes.

Table 2: Teacher's teaching strategies during integrated science

S/N	What happens during integrated science lessons	Mean
1	We carry out science activities	1.05
2	The teacher teaches without performing science activities	1.08

3	We only read the integrated science text book during science lessons	1.12
4	We do project work in integrated science	1.21
5	The teacher engages us in discussions and critical thinking.	1.08

n=350   Mean score below 1.50 indicate that these activities were not performed.

Table 3: Activities Carried Out by students in Integrated Science Lessons

S/N	Activities	Mean
1	Observing things	1.47
2	Take measurements of some things	1.28
3	Recording some data from observing things	1.55
4	Analysing and making deductions from data	1.80
5	Identifying problems	1.33
6	Performing the experiment again when results are not satisfactory	1.88
7	Putting things into different classes/groups	1.51
8	Formulating hypotheses/making guesses	1.08
9	Asking insightful questions during activities	1.34
10	Interpreting data by using charts and graphs	1.69
11	Communicating/discussing results in class	1.92

*Mean score below 1.50 indicate that these activities were not carried out.

Table 4: Contingency table of students' responses on what happens in integrated science lessons according to type of school

Setting	Often		Sometimes		Not at all		Total
	Observed	Expected	Observed	Expected	Observed	Expected	
Urban	82	(62.67)	27	(18.16)	96	(124.17)	205
Rural	25	(44.33)	4	(12.84)	116	(87.83)	145
Total	107		31		212		350

n=350, df = 2, x^2=40.20; $p<0.05$

Table 5: A table of contingency indicating numbers of students' responses on activities carried out in integrated science lessons according to type of school.

Setting	Often		Sometimes		Not at all		Total
	Observed	Expected	Observed	Expected	Observed	Expected	
Urban	76	(63.84)	41	(29.87)	88	(111.29)	205
Rural	33	(45.16)	10	(21.13)	102	(78.71)	145
Total	109		51		190		350

 n=350, df = 2, x^2= 26.45; $p<0.05$

Discussion

Data in Table 2 indicate that students are not led to carry out activities as suggested by the integrated science curriculum; teachers teach without performing activities suggested in the curriculum. It is also revealed in Table 2 that students are made to read the textbooks while teachers explain some of the concepts. Whilst the curriculum suggests that students carry out project work for assessment, this is often not done. This approach to teaching integrated science seems to have been the trend since 1963 when general science was being taught (Haggis, 1969). This approach to teaching and learning of integrated science does not lay good foundation that will lead to a culture of innovation and a change required for nation building (Anamuah-Mensah, August 2004).

Again response data in Table 3 indicate that SHS students recorded what was observed, made deductions from data recorded, classified objects/things into groups, performed some experiments and drew charts to illustrate their data. They also sometimes did discuss some results with colleagues in class. A few of such activities is expected as some teachers who like their job will try to engage their students in some aspect of inquiry science. However, some areas such as taking measurements, identifying problems, formulating hypotheses, and questioning the results of some findings were not carried out. These are the areas that promote critical thinking but are neglected. This accounts for one of the reasons why students perform poorly at national and international examinations that demand students' knowledge of comprehension, deduction and analysis of issues. Haggis (1969) argued that science teaching in initial teacher training colleges in Ghana has been theoretical; and thus pre-service science teachers in training were ill-equipped to teach secondary science (Haggis, 1969). The practice seems to be the same as of old.

Results of hypotheses tested concluded that urban SHS students differ significantly from their rural counterparts on the opinions they hold of integrated science teaching (see Tables 4b & 5b). In Table 4, 116 constituting 80% of the rural students were of the opinion that integrated science teachers taught them without using inquiry strategies; whilst 96, that is 46.83% of their urban counterparts held similar views. Also in Table 5, 102 making up 70.34% of rural students held the view that they never carried out practical activities during integrated science lessons, while 88 constituting 42.93% of urban students felt they never had the opportunity to do practical activities during integrated science lessons. These large differences in percentages help explain the significant differences in the opinions between urban and rural SHS students of how integrated science is taught in senior high schools in

Ghana. The percentages of urban students who felt they never carried out science activities though lower than that of rural students are still significant and cannot be overlooked.

This calls for worry since integrated Science is a compulsory subject in SHS for the three years of secondary education. This is based on the belief that much benefit is to be derived from the study, at this level, of science as an integrated whole composed of interdependent parts; than from the study of one or more of the parts in isolation (Haggis, 1969).

In spite of the fact that the majority of urban respondents and a few rural students were positive about the way integrated science teaching and learning was organised, the concern of other student respondents cannot be overlooked. They sincerely believed that, the practice did not meet the standards of teaching integrated science and something has to be done to rectify the situation. This view is amply supported by several research findings that the teaching of science had not been as expected and students get dissuaded from studying science (Darling-Hammond, 2003; Stacy, 2009).

Conclusion

Findings of this study indicate a gap between actual science teaching and learning and an ideal school science with regards to curriculum, pedagogy and learning, teacher knowledge and skills.

The results of the study indicated that students were not led to carry out activities as suggested by the integrated science curriculum; teachers taught without performing activities suggested in the curriculum. It is also revealed that students are made to read the textbooks while teachers explained some of the concepts. Whilst the curriculum suggests that students carry out project work for assessment, this was often not done. This approach to teaching integrated science seems to have been the trend since 1963 when general science was being taught (Haggis, 1969). This approach to teaching and learning of integrated science does not lay good foundation that will lead to a culture of innovation and a change required for nation building (Anamuah-Mensah, August 2004).

The study observed that in a few cases SHS students recorded what was observed during experiments, made deductions from data recorded, classified objects/things into groups, performed some experiments and drew charts to illustrate their data. They also sometimes did discuss some results with colleagues in class. A

few of such activities was expected as some teachers who are enthused in their job will try to engage their students in some aspect of inquiry science.

Based on the results of the study, it is suggested that:

1. In-service training should be organised for service teachers who currently are subject specialist to enable them integrate the topics in science as they teach the course.

2. The Department of Integrated Science Education, of the University of Education, Winneba will have to have a critical look at how its programme is run, how the lecturers handle the courses in the department so that its products do not disappoint the nation at the end of their training.

3. A course in integrated science should emphasise the importance of observation, testing and experimentation which are processes of science for increased understanding of the environment; it should introduce students to logical thinking and scientific aptitude.

4. As it may be necessary in integrated science course to omit some details, it is essential that the content of the course for SHSs should be judiciously chosen. Its current content or subject matter is too overloaded for SHS students.

5. The Colleges of Education in Ghana should collaborate with University of Education, Winneba in designing integrated science content to suit the two levels since both produce integrated science teachers for the nation.

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