ANALYSIS OF THE PROGRESSION IN SECONDARY SCHOOL CHEMISTRY STUDENTS' UNDERSTANDING OF THE CONCEPT OF "MATTER" IN MINNA METROPOLIS

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Abstract

This study was undertaken to analyze the progression in the understanding of the concept of "Matter" among secondary school students in Minna metropolis. Three hundred (300) Students (150 male and 150 females) were randomly selected from three (3) Government owned secondary schools. The Students were from SS 1 (90), SS 2 (120) and SS 3 (90). The instrument used for data collection was a 19 – term Chemistry Concept Test (CCT) on "Matter". The instrument was validated and its reliability determined to be 0.81. Three (3) hypotheses were formulated and data collected were analyzed using ANOVA and Scheffes' test. The analyses of data revealed that students showed progression in the understanding of the concept of "Matter" SS 1 students irrespective of gender did better than SS 2 and SS 3 students. Based on these findings, recommendations were made to enhance the understanding of the concept of "Matter" among secondary school students as they move from one school level to another.

Keywords: Progression, analysis, students, Matter, understanding

Introduction

Science is derived from a Latin word "Scienctia" meaning knowledge. Science is a human activity involved in the accumulation of knowledge about the universe. Pursuit of knowledge is common to all scholarly endeavours in the humanities, social sciences and natural sciences. Historically, natural science has been closely associated with collection of facts; it involves comprehension, correlation, and an ability to explain established facts, usually in terms of a physical cause for an observed effect.

Chemistry is a special area in science that concerns itself with the study of the structure and behavior of matter. In includes finding out what things are made of and how they undergo changes. The varieties of matter that makes up the environment are called substances or chemicals. Chemicals are in the realms of chemistry; people use chemicals, eat chemicals and are made up of chemicals. Chemistry provides one with an existing view of nature and helps one understand chemical methods and terminology. Chemistry is studied to acquire knowledge about matter. Scientists perform experiments and learn to observe, record and make intelligent inferences. Despite the importance of chemistry to man and the society and the efforts of government and professional associations, students continue to perform poorly in chemistry in Nigeria (Chief Examiners Report, 2008 and 2009). Many reasons deduced for the present state of chemistry education in Nigeria include: Inability of candidates to comprehend specific areas or topics in chemistry, the conception that chemistry as a subject is abstract and difficult to comprehend and the non-exposure of students to chemistry practical, (WAEC Annual Reports, 2008, 2009) and Ifemuyiwa (2003).

There has been a considerable amount of research embarked upon by science educators on students conception about natural phenomenon from primary to tertiary levels of education (Driver & Erickson, 1983; Pines & West, 1984; Abimbola & Baba, 1996 & Ezenwa, 1999; Shawl, 2003; Aluko, 2004; Agbogboroma, 2005; Kozma and Russell, 2005; Ibrahim, 2009; and Yaki, 2011). Pine and West and Kozma and Russell (2005) revealed that teachers often found out to their surprise that the classroom experience does not always lead to the students forming the right conceptions of science expected of them. They reasoned that students' prior conceptions

were not known when learning experiences were devised and hence the experiences were interpreted differently by the children. They further suggested that teachers need to be skilled in diagnosing students' conception. 'Matter' is anything that occupies space and have mass. The "concept of matter" is taught in school right from primary level through secondary level to the university level. The scope of the topic involves the study of things around us, how they change and the causes for the change.

It appears that all forms of energy are generated by change in matter. Matter can also absorb energy to produce other physical and chemical changes. Indeed, energy by definition is that which can produce change in matter. It follows, that matter is a fundamental concept in science. The poor performance of students in the science may therefore be traced to their inability to grasp or understand the 'concept of matter'. Therefore, there is the need to look into what students know about matter as they progressively move from a lower class level to a higher one. Thus, the major concern of this work is to analyze and determine senior secondary school students' progressive understanding of the 'concept of matter' in chemistry in relation to students gender.

Objectives of the Study

The objectives of this study are:

(i) To determine whether there is progressive understanding of the concept of "Matter" in Chemistry among secondary school students in Minna Metropolis.

(ii) To find out if there are significant differences in students understanding of the concept of matter at different class levels and in relation to their gender.

Research Questions

The study specially sought answers to the following research questions:

(i) Is there any progressive understanding of the concept of matter in chemistry among secondary school students in Minna metropolis 3?

(ii) Is there any difference in progression in the understanding of the concept of 'matter' among senior secondary school male students from SS 1 to SS 3?

(iii) Is there any difference in progression in the understanding of the concept of 'matter' among senior secondary school female students from SS 1 to SS 3?

Research Hypotheses

The following hypotheses were formulated and tested at the 0.05 significant level:

Ho_1: There is no significant difference in students progressive understanding of the concept of 'matter' from SS 1 to SS 3.

Ho_2: There is no significant difference in male students progressive understanding of the concept of 'matter' from SS 1 to SS 3.

Ho_3: There is no significant difference in female students progressive understanding of the concept of 'matter' from SS 1 to SS 3.

Methodology

A survey research design was employed for the study. The target population was Senior Secondary School (SSS) 1, 2 and 3 Chemistry Students from secondary schools within Minna metropolis. Three schools were randomly selected as sample schools for the study. The subject (sample) for the study consists of 300 (150 male and 150 female) senior secondary chemistry students. This sis made up of SSS 1, 2 and SSS 3 Chemistry students randomly selected from each of the three schools during the 2007/2008 school year. These schools are:

(i) Maryam Babangida Girls Science College (MBGSC) Minna

(ii) Ahmadu Bahago Secondary School (ABSS) Minna and

(iii) Zarumai Model School (ZMS) Minna

The breakdown of the 300 students randomly selected from the three schools is shown in table 1 below.

Table 1: Schematic presentation of selected schools and students

Schools	Class level	Number of students selected	
	SS 1	30	
MBGSC, Minna (female)	SS 2	40	
	SS 3	30	
ABSS, Minna (male)	SS 1	30	
	SS 2	40	
	SS 3	30	
		Male	Female
ZMS, Minna (male and		15	15
female)	SS 1	20	20
	SS 2	15	15
	SS 3		
Total		300	

The research instrument used for this study was a Chemistry Concept Test (CCT). It was made up of a set of 19 questions on the concept of matter. The researchers developed the instrument. The instrument had two sections; section A: elicited students bio-data while section B consist of 19 test items of the concept of 'matter'. The items were structured and designed to obtain students understanding of the concept of 'matter' as they progressed through the senior secondary classes 1 to 3. The instrument, CCT was validated by two science educators in Science Education Department, Federal University of Technology, Minna. Useful and constructive suggestions, observations and corrections were made, which led to the re-structuring of some items before they were administered to the students. From initial 25 items, 19 items were finally selected and were certified to have content validity. To determine the reliability of the CCT, a pilot test was carried out using 20 students (10 boys and 10 girls) from Government Secondary school, Minna. Test-retest method was adopted at an interval of two weeks. From the two sets of scores obtained, reliability coefficient of the test instruments was calculated. A reliability coefficient r_{xx} = 0.81 was obtained. The test items were administered o the students in the three selected schools by the researchers. The test was scored and the students scores formed the data for testing the study hypotheses. ANOVA and Scheffes test was used to analyze the data using SPSS computer statistical package.

Results

The results of the study are presented in tabular form below.

Ho_1: There is no significant difference in students progressive understanding of the concept of 'matter' from SS 1 to SS 3.

Table 2: ANOVA of SS1, SS2 and SS3 progressive understanding on the concept of 'matter'

Source of Variation	Sum of Square	df	Mean Square	Fcal	Fcritical	Sign
Between Groups	5556.826	2	2778.413	6.295*	3.07	0.002
Within Groups	131080.90	297	441.350			
Total	136637.37	299				

* Significant at 0.05 level,

Table 3: Scheffe result of SS1, SS2 and SS 3 students progressive understanding of the concept of Matter

(I) VAR(12)	(J) VAR(12)	Mean difference (I – J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
1.0	2.00	10.3889*	2.9295	.002	3.1820	17.5958
	3.00	6.2500	3.1317	.138	1.4545	13.9545
2.00	1.00	10.3889*	2.9295	.003	17.5958	13.1820
	3.00	4.41389	2.9395	.370	11.3458	3.0680
3.00	1.00	6.2500	3.1317	.138	13.9595	1.4545
	2.00	4.1389	2.9295	.370	3.0680	11.3458

Table 2 present ANOVA results of SS 1, SS 2 and SS 3. The result revealed that there was significant difference in SS 1, SS 2 and SS 3 students progressive understanding of the concept of 'matter' (Fcal= 6.295).

Table 3 indicates that the significant difference was between SS 1 and SS 2 only with the highest mean difference of (10.3889) and highest upper boundary of (17.5958) at 95% confidence interval. On this basis, the hypothesis 1 is rejected. There is therefore significant difference in the progressive understanding of the concept of 'matter' by senior secondary school students.

Ho_2: There is no significant difference in male students progressive understanding of the concept of 'matter' from SS 1 to SS 3.

Table 4: ANOVA result of SS1, SS2 and SS3 Male students

Source of Variation	Sum of Square	df.	Mean Square	Fcal	Sign
Between Groups	4456.759	2	2228.390	5.638*	.004
Within Groups	52168.7648	132	395.219		
Total	56625.48	134			

* Significant at 0.05 level

Table 5: Scheffe result of SS 1, SS 2 and SS 3 Male

(I) VAR(12)	(J) VAR(12)	Mean difference (I – J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
1.0	2.00	13.5556*	4.1911	.007	3.1793	23.9318
	3.00	10.0556	4.1911	.160	.3207	20.4318
2.00	1.00	-13.5556*	4.1911	.007	23.9318	3.1793
	3.00	-3.500	4.1911	.706	13.8763	6.8763
3.00	1.00	-10.0556	4.1911	.060	20.4318	.3207
	2.00	3.5000	4.1911	.706	6.8763	13.8763

Table 4 presents the ANOVA results of SS1 – SS3 male students. The result revealed that there is significant difference in male students understanding of the concept of 'Matter' as they moved from one school level to another (Fcal = 5.638, df = 134; p= < 0.05)

Scheffes' analysis on Table 5 indicated that the observed significant difference was between SS 1 and SS 2 with the highest mean difference of 13.5556 at 95% confidence interval. On this basis, hypothesis 2 is therefore rejected. There is significant difference in the progressive understanding of the concept of 'matter' by senior secondary school male students.

Table 6: ANOVA result of SS1, SS2 and SS3 Female students

Source of Variation	Sum of Square	df.	Mean Square	Fcal	Sign	Fcritical
Between Groups	2054.444	2	1027.222	4.6278*	.011	3.07
Within Groups	29303.889	132	221.999			
Total	31358.333	134				

* Significant at 0.05 level, Fcal= 4.6278 P< 0.05)

Table 7: Scheffe result of SS1, SS2 and SS3 Female

(I) VAR(12)	(J) VAR(12)	Mean difference (I – J)	Std. error	Sig.	95% confidence interval	
					Lower bound	Upper bound
1.0	2.00	9.2222*	3.1411	.015	1.4455	16.9990
	3.00	2.4444	3.1411	.739	5.3323	10.2212
2.00	1.00	9.2222*	3.1411	.015	16.9990	1.4455
	3.00	6.778	3.1411	.101	14.5545	.9990
3.00	1.00	2.4444	3.1411	.739	10.2212	5.3323
	2.00	6.7778	3.1411	.101	.9990	14.5545

* The mean difference is significant at the 0.05 level

Table 6 revealed that there is significant difference in the understanding of the concept of 'matter' by female students as the progressed from SS1 to SS3 (Fcal = 4.6278 = 3.07, df = 134; p < 0.05). Scheffes' result on Table 7 showed that the significant difference portrayed in Table 6 was between SS 1 and SS 2 (mean difference of 9.2222). on this basis the hypothesis 3 is rejected. There is significant difference in the progressive understanding of the concept of 'matter' by senior secondary school female students.

Findings of the Study

The major findings of the study were that:

(i) There is progressive understanding of the concept of matter in chemistry among students particularly as they progressive from SSS1 to SSS2 as indicated in the scheffes test

(ii) There is significant difference in male students progressive understanding of the concept of 'matter' from SSS 1 to SSS2.

(iii) There is significant difference in female students progressive understanding of the concept of 'matter' from SSS 1 to SSS 3.

Discussion of results

Result of the study revealed that senior secondary school students of chemistry do experience progressive understanding of the concepts of 'matter' as they proceed from senior secondary school (SSS) class one to class two, but this progress has not manifested itself in SSS3. At the SSS one level, concept of matter and major components that relates to it such as atom, atomic

theory, gas laws etc feature vividly in the curriculum. At this level students demonstrated very clear understanding of the concepts. This was carried over to the next senior class (SS two) where these concepts are further discussed and expanded in the curriculum. So, at this level evidence of relationship between matter and the concept discussed in the curriculum are still encountered but in a broader manner. This makes it easier for students to connect previous learning of the concept of matter to the present concepts that are deeper in meaning and scope with the previous ones. This growth or increase in understanding is between SSS1 and SSS2 (table 3).

However, lack of differences between SSS2 and SSS3 could be as a result of the spiral nature of Nigeria's Chemistry Curriculum which provides for deeper perspectives of concepts as students graduate from one level to another. So, the SSS 3 componebts of matter discussed were so deep to the extent that it neutralizes their connection of the concept at this level with the generic concept of matter.

Conclusion

Based on the findings of this research, the following conclusions were drawn.

(i) There is progressive understanding of the concept of matter among Secondary School Students.

(ii) There are significant differences in the progressive understanding of the concept of matter among students from SSS 1 to 3 and among male and female students respectively

Recommendations

To improve senior secondary school students understanding of the concept of 'matter' in chemistry, the following recommendations are made:

(i) Chemistry teachers should determine the level of their students understanding of a particular concept before teaching higher concepts. In other words, teachers should be conversant with previous knowledge of students and make efforts to build on it.

(ii) Chemistry teachers should evolve effective procedures of assessing students understanding and

(iii) Authors of Chemistry textbooks should use the outcome of research studies to organize their text in order to make learning more meaningful.

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