Secondary School Students' Level Of Understanding Of Selected Chemistry Concepts In Osun State, Nigeria.

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Abstract

This study was carried out to find out the level of understanding of selected chemistry concepts by senior secondary school students in Osun state, Nigeria. Two hundred and ninety one senior secondary school III (SSIII) students from six purposively selected secondary schools were used for the study. A test item termed test of concept understanding in chemistry (TCUC) was used. It was found out that the students' level of understanding of chemistry concepts was low and that students performed better in theoretically related concepts than in practically related concepts. Students also found it difficult to understand the following concepts: the mole concept, electrolysis, chemical formulae, equations and balancing of chemical equations, electronic configuration, preparation of salts, calculations in volumetric analysis, physical and chemical changes, and properties and identification of gases. Students however found it easy to understand acids & bases, and simple separation techniques.

Introduction.

Many research findings have shown that students' performance in ordinary level chemistry over the years does not indicate that the objectives of the senior secondary school chemistry are being achieved as desired. Notable among these findings are those of Aghenta (1982), Aboaba (1984), Rosier (1990), and STAN (1992). From 1995 to the year 2000, the percentage credits (A1 to C6) in senior secondary school chemistry examination conducted by West African Examination Council (WAEC) are respectively 32.72, 33.46,16.27, 21.40, 31.08, and 31.88. Heys (1972) emphasized the need for chemistry education by listing the following three reasons why chemistry should be studied:

1. to discover as much as we can about the behavior of different kinds of matter.
2. to find out reasons for this behavior and so obtain a deeper understanding of its nature.
3. to put this knowledge gained into practical use that would lead to the development of man.
4.

If students continue to perform poorly in chemistry as evidenced above, these reasons will be defeated. It is well known that chemistry is central to the training in science-oriented professions like Medicine, Engineering, Pharmacy, Teaching, Agriculture, etc. Research into the extent to which students understand chemistry concepts is therefore necessary as a way of formulating appropriate methods and actions that can improve their performances in the subject.

Purpose of the study

The main purpose of this study was to find out the general level of understanding of chemistry concepts by Osun state secondary school students. It also sought to find out:

1. Chemistry concepts which students find very easy to understand.
2. Chemistry concepts which students find easy to understand.
3. Chemistry concepts which students find difficult to understand.
4. Whether students understand practically related concepts better than theoretically related concepts.

Research questions

In this research, answers were sought for the following questions:

1. To what extent do students understand senior school certificate chemistry concepts?
2. Which chemistry concepts do students find very easy to understand?
3. Which chemistry concepts do students find easy to understand?
4. Which chemistry concepts do students find difficult to understand?
5. Do students understand practical chemistry concepts better than theoretical chemistry concepts?

Research hypothesis

1. Students do not understand practically related chemistry concepts better than theoretically related chemistry concepts.

Instrumentation

Six chemistry teachers and ten chemistry students were interviewed to find their perception about the status of various chemistry concepts, i.e. whether a particular concept is very easy to understand, easy to understand, or difficult to understand. The information gathered from the interviews were used to construct an achievement test called "Test of Concept Understanding in Chemistry" (TCUC) from both the concepts perceived as difficult and those perceived as easy. The instrument is made up of a total of sixty (60) questions. There are two sections, A and B. The questions in section A are derived from theoretically related concepts, while those in section B are derived from practically related concepts. The two sections carry equal marks. Each section has thirty questions. The first fifteen questions in each of the sections are developed from concepts perceived as difficult for students to understand while the remaining questions are developed from concepts perceived as being easy for students to understand. The students were examined on twelve (12) concepts. On every concept, five questions were asked. Some of the questions were structured short-answer questions while some were of the multiple-choice type. All the questions were developed from areas of the syllabus which pupils will have been previously taught in the classroom as at the time of the field work.

Instrument validation

To ensure content validity, the researcher ensured that the test items selected fairly covered the areas selected for the test. So also the test items were carefully drawn to ensure that the items fall within both the scope of the SSCE syllabus, and the specific areas that have been selected for the purpose of the research. The test items were referred to three (3) experts in educational research for criticism and modification. To ensure reliability, the instrument was field-tested with 5 pupils who were representative of the target population. A field study was therefore conducted with a larger group of 25. At the end of the study, necessary modifications were made based on the performance and reactions of the respondents. The split half method of determining reliability was used. The Pearson Product Moment of Correlation was used to analyse the scores and show whether the test items were reliable or not. When the instrument was field tested with 5 students and the scores were analysed, a reliability value of 0.71 was obtained. The result of the field study with 25 students gave a reliability value of 0.87.

Data Analysis technique

Data analysis was done by finding out the mean score of students in each concept, the mean score of students in all the theoretically related concepts, the practically related concepts, and in all the concepts put together. The mean score was analyzed as follows for the total score:

70% and above------Excellent
60% to 69%----------Good.
50% to 59%----------Fairly good.
Below 50%----------Poor.

The status of each concept was determined as follows:
Less than 2.5 = Difficult to understand.
2.5 to 3.9 = Easy to understand

Above 4.0 = Very easy to understand.

By comparing the mean scores of section A of the test items (which was based on theoretically related concepts), and section B (which was based on practically related concepts), it was possible to deduce which of the two areas the students found easier to understand. The area that had the highest mean score (better performance) was considered better understood by the students.

Results

The table below summarizes the result of the study.

Table Showing Level Of Understanding Of Students In The Respective Concepts, In Each Of The Schools Used For The Study.

Total mark per concept = 5.
* Difficult concepts.
** Easy concepts.
*** Very easy concepts.

In this table, the average scores of the students from each of the schools in each of the schools examined were presented. For an example, in school I, the average score of the students in the mole concept is 0. 72. Figures for each school added together for each of the concepts and the average of the scores were determined by dividing the total sum by 6 since there are six schools. For example, the scores in the mole concept were added together and divided by 6.

	Concept	Average Scores In Respective Concepts)						
		Schl1	Schl2	Schl3	Schl4	Schl5	Schl6	Av/5
1	The Mole Concept	0.76	0.72	2.08	1.46	1.15	2.63	1.47*
2.	Electrolysis	1.33	1.42	2.10	1.08	1.40	2.17	1.58*
3	Oxidation And Reduction	1.10	0.76	2.64	0.52	1.37	2.57	1.49*
4.	Chemical Formulae, Equation And Balancing Of Chemical Equations	0.84	1.00	1.62	0.34	1.4	2.24	1.24*
5.	Electronic Configuration	2.10	1.66	3.42	0.34	2.85	3.52	2.32*
6.	Acids And Bases	3.00	2.86	3.50	0.62	2.8	3.52	2.72**
7.	Preparation Of Salts	1.30	1.54	2.74	0.18	1.63	2.12	1.60*
8	Calculations In Volumetric Analysis.	0.08	0.1	0.36	0.08	0.37	0.92	0.32*
9.	Qualitative Analysis	0.35	0.22	0.22	0.00	0.5	2.74	0.67*
10.	Physical And Chemical Changes	1.63	2.04	1.26	0.14	2.02	3.24	1.72*
11.	Simple Separation Techniques	3.14	3.14	2.0	0.98	2.1	3.6	2.50**
12.	Properties And Identification Of Gases	1.35	1.2	1.6	0.1	1.0	2.4	1.20*
	Total Score For Each School/60	16.98	16.66	23.1	5.84	18.59	31.67	18.83

i.e. 0.76+0.72+2.08+1.46+1.15+2.63÷6

= 1.47.

This means that the average score/ 5 of the two hundred and ninety one student samples in the mole concept is 1.47 out of a total maximum score of 5. The same was done for all the other concepts.

To find out the average score/5 of the students in all the theoretically related concepts, the average score/5 in the six theoretically related concepts were added together and divided by 6 (since there are a total of six theoretically related concepts). Thus for the theoretically related concepts, the average score for all the respondents

=1.47+1.58+1.49+1.24+2.32+2.72÷6

=1.80 i.e. 1.80 out of a maximum score of 5.

For practically related concepts, the average score for all respondents = 1.6+0.32+0.67+1.72+2.50+1.20÷6

=1.34 i.e. 1.34 out of a maximum of 5.

Average scores for the theoretical concepts (1-6)

= 1.47 + 1.58 +1.49 +1.24 + 2.32 +2.7 6÷6

= 1. 34 i.e. 1. 34 / 5

Summary of major findings

This study showed that none of the concepts examined was found very easily understood by students. However, students found it easy to understand two out of the twelve concepts examined. The two concepts that were easy for them to comprehend are acids & bases, and simple separation techniques. Students found ten (10) of the twelve (12) concepts examined (83%) difficult to understand. The difficult concepts for the students are:

1. The mole concept
2. Electrolysis
3. Oxidation and reduction
4. Chemical formulae, equation of reaction and balancing of chemical equations
5. Electronic configuration
6. Preparation of salts
7. Calculations involved in volumetric analysis
8. Qualitative analysis
9. Physical and chemical changes
10. Properties and identification of gases

It is also significant that students performed better in theoretically related concept than in practically related concepts. It was also found that, generally, students had a poor understanding of concepts in ordinary level chemistry.

Discussion

The outcome of this study gives an insight into one of the reasons behind persistently poor performance of students in chemistry in the senior secondary school final examinations. For instance, it was found in this study that ten (10) out of the twelve (12) i.e. 83 percent of the chemical concepts examined were difficult for students to understand, leading to poor performance in the test items. This could be attributable to poor performance of students in the final school certificate examinations over the years (STAN, 1992). What are the underlying factors that are responsible for this? Ahiakwo (1984) identified some factors contributing to low performance of students in ordinary level chemistry. According to him, the factors include: inadequate competent teachers, poor preparation of lessons by teachers, inadequate monitoring of teachers, overcrowding in classrooms, and poorly stocked laboratories. In another study, the

Science Teachers Association of Nigeria (STAN, 1992) listed some factors responsible for students' poor performance in science generally. These factors are: overcrowding, poor laboratories, lack of adequate textbooks, inadequate libraries and personnel.

Looking specifically at some of the concepts that were found to be difficult to understand by the students, Ahiakwo (1984) also identified similar concepts as being difficult for students to understand. Such similar concepts are: the mole concept, electrolysis, preparation of salts, and calculations in volumetric analysis. To a very large extent, these similar concepts require mathematical competence. This confirms the findings of Teibo (1975) who had much earlier identified two of the problem areas of chemistry as being topics that dealt with abstract concepts and those requiring mathematical competence. Onwu and Moneme (1986) sought to find the extent to which chemistry students failed to solve electrolysis problems. The analysis of the researchers' result confirmed that learners generally find solving problems in electrolysis difficult. This was also confirmed by findings from the present study.

The fact that students perform better in theoretically related concepts than practically oriented concepts in this study appears to be supported by available literature. For an example, Aboaba (1984) listed inadequacy of practical work as one of the reasons behind students' poor performance in chemistry. Experimentation is a major process in the learning of chemistry. It is not an understatement, therefore, to say that "no experimentation, no chemistry." Besides, chemistry is an experimental subject and as such its implied learning approach should stimulate students, bridge the gap between theory and reality, promote scientific attitude and scientific knowledge, and lead to better understanding of abstract concepts (Onwu, 1983). If the learning of chemistry is deficient in practical work, no meaningful leaning can take place. As pointed out by Onwu (1983), abstract concepts can be made simple and easily understood if practical experiences are included in the learning process (see Onwu 2000b).

Conclusion

A critical analysis of the table of result brings certain conclusions to the limelight.
From the general performance of the students in the test items, it can be concluded that there is a general low standard of teaching and learning of chemistry in our public schools. A situation where students are merely able to score average marks in two out of the twelve concepts examined is not desirable.

1. Students did not perform well in concepts requiring mathematical competence.
2. Students performed better in theoretically related concepts than practically related concepts. This in itself is a pointer to the fact that students do not have enough laboratory experience to cope with the demand of the subject.
3. Based on the low scores of students, students found the following concepts difficult to understand: the mole concept, electrolysis, chemical formulae, equations and balancing of chemical equations, electronic configuration, preparation of salts, calculations in volumetric analysis, physical and chemical changes, and properties and identification of gases. Students however found it easy to understand acids/bases, and simple separation techniques.

Recommendations

The following recommendations are therefore considered appropriate if the prevailing situations are to be properly tackled.

1. Since chemistry is an experimental subject, government and parents should work hand in hand to build appropriate laboratories for effective learning and these laboratories should be adequately equipped with necessary equipment and reagents for instruction, so that practically related concepts are better understood.
2. Chemistry teachers should give more priority to practical experiments as part of instruction in order to improve students' understanding of practically related concepts.
3. Since the result of this work has shown that students do poorly in concepts requiring mathematical competence, adequate effort should be made by appropriate authorities: government, school authorities, etc. at ensuring that students are well tutored in Mathematics.
4. Chemistry teachers should work hand in hand with mathematics teachers in their schools to ensure that aspects of mathematics required in chemistry are properly taught to improve performance in concepts requiring mathematical competence.
5. Chemistry teachers should be encouraged to be members of professional bodies and associations like the Science Teachers Association of Nigeria (STAN). They should also be given the opportunity to attend seminars and conferences organized by these professional bodies where they can rub minds with colleagues in the teaching profession on how to improve the teaching and learning of chemistry in our schools.
6. Curriculum developers should have a critical look at the present senior secondary school chemistry curriculum. Teachers often complain that the senior secondary school chemistry syllabus is too wide. The outcome of this is that teachers often rush over the syllabus not minding whether the students understand or not. Streamlining the chemistry curriculum will enable teachers to spend more time on difficult concepts and students will hopefully learn better.
7. Majority of our schools have no functional libraries. In a period when prices of books are not within the reach of the average family, school libraries should be well stocked with appropriate textbooks to enable students study privately after their lessons in the class and the laboratories. This will foster better understanding of chemistry concepts generally.

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