ASSESSING ALTERNATIVE CONCEPTIONS ABOUT CONCEPTS OF ATOM OF SECONDARY SCHOOL STUDENTS IN MINNA

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DEPARTMENT OF CHEMISTRY
NIGER STATE COLLEGE OF EDUCATION
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APPROVAL PAGE

This project was supervised, carefully read and approved as satisfactorily meeting the requirement for the award of Nigeria certificate in education (NCE) in the department of chemistry, Niger state college of education, Minna.

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DEDICATION

Ultimately, we dedicate this project work to almighty ALLAH Who created human and other living and non-living things to exist. We thank him for the wisdom and actualization of this project work.

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ABSTRACT

This work assessed alternative conceptions of secondary schools students on the concepts of atom in Minna. Survey research design which used students' Misconception Inventory on the Concepts of Atom as instrument for data collection was adopted for the study. The results of the study showed that secondary schools chemistry students hold alternative conception on the concepts in the area of atomic number, atomic mass number, isotopes, electronic configuration and basic particles of matter. It was concluded that the alternative conceptions were mostly school made probably due to teaching strategies. It is recommended among others that teachers should emphasise every aspect of a topic during instruction.

TABLE OF CONTENTS

CHAPTER THREE: RESEARCH METHOD

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATION

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Sharma and Sherma (2004) described chemistry as the branch of physical science which studies the structure and composition of materials as well as the changes in structure and composition which these materials undergo. Chemistry is chiefly concerned with atom and their interaction with other atom, for example, the properties of chemical bond formed between atoms to create chemical compounds such as oxides, carbonates e.t.c.

There had been several reports on why secondary school student have low performance in chemistry. One of such reports is misconception of students about chemistry concepts. A misconception usually results from incorrect thinking or flawed understanding; faulty teaching styles; and due to distancing nature of true scientific texts.

Johnstone (2006) stated that many chemistry concepts are abstracts, e.g. structures, bonding and related properties of substances and often not intuitive or able to be easily understood by students. Johnstone (2006) further stated that due to this abstract nature of chemistry, misconception of chemical concepts arose and become one of the major barriers to conceptual understanding of

chemistry. This study is on misconception of secondary schools students in chemistry.

1.2 Theoretical Framework

Theories are formulated to explain, predict and understand phenomenon and in many cases to challenge and extent existing knowledge within the limit of the critical assumptions. The theoretical frame work is the structure that can hold or support a theory of a research study. The theoretical frame works introduces and describe the theories which explain why the research problem under study exists. The theory of constructivism is used to explain misconception in chemistry. This research work tends to survey the misconception held by students in chemistry. Thus, constructivism is the theoretical framework of this study.

1.3 Statement of the Problem

Students' low performance in chemistry at senior secondary level is a major problem and the low performance is believed to be centred on misconception of some aspects of chemistry hold by students (Ayas and O'zmen, 2003). One of such aspect in particular is the properties of atoms. The major factors that have been identified to be responsible for those misconceptions are: improper exposure to laboratory activities; poor method of instruction; lack of

organisational skills; and inadequate exposure to problem solving procedures (Treagust, 2003). These studies therefore tend to survey misconceptions hold by secondary schools chemistry students on concepts of atoms in Minna.

1.4 Objectives of the Study

The objective of the study was to find out the type of misconception held by senior secondary schools chemistry students on the concepts of atom.

1.5 Research Question

The following research question guided this study:

What are the misconceptions held by senior school students about concept of atoms?

1.6 Significance of the Study

This study is significant in the following ways:

- It will help teachers in planning of their instructions of different concepts by providing them with information on the areas where more attention is needed for better understanding.
- Authors of textbooks will find the study useful in their presentation of the subject matter involving concepts of atoms in a way that will facilitate easier understanding of the concepts.

1.7 Basic Assumption

The study assumed that the students have equal exposure to the same curriculum since they are being thought by government trained teacher that are being employed by the same government.

1.8 Scope of the Study

The scope of the study includes all senior secondary school students in the study school but was delimitated to senior secondary year two (SS II) students. The study was to cover secondary schools in Minna but was delimited to only four (4) Governments owned schools in Minna. The SS II students were chosen because at this level, the students have been adequately exposed to these concepts in their SS I

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

Students' misconceptions before and after instruction have become major concern among researchers in science education because they influence how students learn new scientific knowledge, play essential role in subsequent learning of the students and if not addressed they become hindrance in acquiring the correct body of knowledge. This chapter is aimed at surveying the type of misconception held by chemistry students at senior secondary school level, in this chapter the literature review is organize under the following topics.

- Definition of chemistry.
- Definition of misconception in chemistry.
- Overview of similar studies on misconceptions.

2.2 Definition of Chemistry

Chemistry has been described as a branch of physical science which studies the structures, properties and changes in matter. Chemistry tends to focus on properties of substances and interaction between different types of matter (Sharma & Sharma, 2004; Smith, 2002).

Tai and Salder (2007) described chemistry as central science subject because it connects other sciences taught in schools. They further stated that the teaching

of chemistry in secondary schools helps students to understand the world around them and how things work.

Tai and Ward (2006) stated that chemistry as a field of physical science influences the interest of people to learn more about the physical world and the changes matters undergo. Students learn about how the knowledge of chemistry has developed and how the works of chemists interact with the society. Students also learn to communicate using the language and symbols of chemistry, for example, writing chemical equations to represent chemical reactions.

2.3 Definition of Misconception

Campbell (2010) defined misconception as a conclusion that is wrong because it is based on faulty reasoning or facts that are wrong about a concept.

Talaquer (2006) in terms of common sense explanatory framework explained that students having misconception assume that:

- All component parts of the world exist and develop independently of the observer.
- Things are as they perceived.
- Something exists only if it can be sense.
- Objects and materials tend to waste in natural states (normally stationary and inert) and that only their abnormal properties and behaviour require

explanations. These explanations should be based on analysis of perceptible features.

Barke and Roelleke (2007) divided misconception into two categories namely alternative conception/original conception/preconception and school made misconceptions. They described alternative/original/preconception misconception as ideas that are developed without having any prior knowledge of the subject while school made misconception are due to faulty teaching styles or due to distancing nature of true scientific texts.

Campbell (2010) on the other hand, divided misconceptions into five basic categories:

- Preconceived notion.
- Non-scientific beliefs
- Conceptual misunderstanding
- Vernacular misconception.
- Factual misconception

2.4 Overview of Studies on Misconception

Previous studies have revealed that students hold misconception in chemistry. According to Voska (2000), the term misconception has been conceived as conceptual and propositional knowledge that is inconsistent

with or different from the commonly accepted scientific consensus. Students' misconceptions are therefore erroneous, fallacious or naive conception which students hold.

Baker (2004) investigated student's understudying of chemical bonding and thermodynamics. The researcher found that although basic ideas about covalent and hydrogen boding appear to be learned by a majority of students, ions and ionic bonding continue to cause to cause difficulties. A study reported by Nicolle (2001) described the misconception related to electron negativity, bonding, geometry, and microscopic representation that undergraduate chemistry student's hold. According to results, whole students may have appeared to know about the concept polarity but they did not associate it at all with electro negativity.

Another study conducted by Coll and Tylor (2001), aimed at misconceptions o chemical bonding held by upper determining secondary ad tertiary students at the end of study, some 20 misconception were revealed, the most common being the belief that continuous ionic and metallic lattices were molecular in nature and there was confusion over ionic size and charge.

Coll and Treagust (2001) investigated year 2 undergraduate and postgraduate Australians student's mental models for chemical boding using semi

structured interviews comprising a three phase interview protocol. In the study students

were presented with samples of metallic, ionic and covalent substances, and asked to describe the bonding in the substance. In contrast, other studies reveal that the mental model of bonding becomes sophisticated and complex models they were exposed to during instruction (Coll and Tylor, 2002, & Coll and Treagust, 2003). The students also struggle to use their metal model to explain physical properties of covalently bounded substances.

Finally, Adesoji and babatunde (2008) investigated gender difficulties and misconception in inorganic chemistry at senior secondary level. The result shows that:

- Both male and female chemistry students held misconception in inorganic chemistry.
- Female students had more problem solving difficulties than their male counterpart in inorganic chemistry.
- Female student held more misconception than their male counterpart in inorganic chemistry.

Adesoji and babatunde (2008) summarised the results of their investigation on concepts of atoms by Nigerian secondary schools chemistry students as follows:

- Atoms can be seen with a microscope
- Atoms are alive (because they move)
- Atoms are like cells with membrane and nucleus.
- Atoms can be reproduced after nuclei divide.
- Atoms have electrons circling them like planets around a star.
- A electron shell is like an eggshells or clamshells, thin and hard.
- The electron shell is there to protect the nucleus, like an eggshell and a yolk.
- The electros cloud is like droplets of water the cloud contain the electrons but is made of something else.
- The electron shell is a matrix of some kind of stuff with electrons embedded in it.
- Atoms "own" their electrons.

CHAPTER THREE

RESEARCH METHOD

3.1 Introduction

This chapter presents the methodology used in this study. This chapter is discussed under the following sub-heading.

- Research design
- Population of the study
- Sample and sampling procedure
- Instrumentation
- Data collection procedure
- Data analysis technique

3.2 Research Design

The design used for the study was survey design with questionnaire asthe instrument.

3.3 Population of The study

The population of this study comprised of all the SS II secondary schools chemistry students in Minna.

3.4 Sampling and Sampling Procedure

Random sampling technique was used to select sample four schools and 60 students (30 male and 30 female) from the schools used for the study. Table 3.1 below shows the four sampled schools used for the purpose of this study.

Table 3.1: Name of schools, number and distribution of students used for the study

School	Male	Female	Total
Government Secondary School, Minna	15	-	15
Maryam Babangida Girls Science College, Minna	-	15	15
Day Secondary School, Maitumbi	10	5	15
Day Secondary School, Minna	10	5	15

3.5 Instrumentation

The research instrument used for the student was Student Misconception Inventory Test on the concepts of atom (SMICA) which comprised of 7 items multiple- choice test. The questions covered areas of basic particles of atoms, isotopes and mass number.

3.6 Procedure for Data Collection

The project students visited the schools and sought permission from the principals of the schools to administer the test. Data was collected by administering the SMICA test item to SS II chemistry students in the study

schools and the test items were collected back from the students immediately after the students responded. The students' responses were analysed to obtain the level of students' misconceptions on the concepts of atom.

3.7 Techniques of Data Analysis

The data collected was used to answer the research question. The responses of students to SMICA were scored based on the marking scheme. Simple percentage technique was used to analyse the data collected.

CHAPTER FOUR

DATA ANALYSIS, RESULTS AND DISCUSSION

4.1 Analysis of Data

This study used survey research design and the study used Students' Misconception Inventory on the Concept of Atom (SMICA) as instrument to collect data. The students were given multiple choice test with three option a, b, and c to choose correct option for a question. The number of responses on each option was counted and percentage responses were determined.

The result of the analysis which involved percentage of the correct and distracters of the questions is shown in the table below

Table 4.1: Analysis of students' responses to SMICA by percentage

S/N	QUESTION	OPTIONS	% RESPONSES
1.	Which of these options represent particles of matter?	a. Atom, ions and molecules	21.7%
		b. Electron, proton and neutron	10.0%
		c. Liquid, solid and gas	68.3%
2.	Which of these options defines atomic number?	a. Number of protons in the atom	45.0%
		b. Number of electrons in atom	46.6%
		c. Number of neutron n the atom	8.3%
3.	Sodium contains 11 protons, 12 neutrons and 10 electrons. Which of these values would be used to write electronic configuration?	a. 11	53.4%
		b. 10	20.7%
		c. 12	25.9%
4.	Which of the following does not define atomic mass number?	a. A=Z+ Neutron number	25.9%
		b. $A = \sum P + \sum N$	68.9%
		c. A = Z + electron number	5.2%

5.	Which of the following pairs of particles represents isotopes?	a. Atoms X and Y with atomic no. of 17 and 18, mass no. of 37 and 38 respectively.	45.6%
		b. Atoms P and Q with atomic number 17 and mass number of 36 and 38.	40.4%
		c. Atoms M and N with atomic number 8 and 9, neutron number 8 and 10 respectively.	14.0%
6.	Calculate the mass number of an atom with atomic number of 16, 16 electrons and 16 neutrons	a. 16	8.5%
		b. 32	59.3%
		c. 48	32.2%
7.	Which of the following particles are atomic particles?	a. Proton, anion and electron	1.7%
		b. Proton, cation and electron	6.8%
		c. Proton, electron and neutron	91.5%

Table 4.1 above indicates the responses of the students to correct and distracters options of each question. Question 1 for example only 21.7% got the answer correctly. The other option (b) & (c) formed the misconceptions of the students with 10% and 68% respectively. The research question was answered using the analyzed data in table II.

4.2 Research Result

The research result was obtained by answering the following research question.

Research Question: what are the misconceptions held by senior secondary school students about concept of atoms?

Table 4.2 presents the misconceptions held by the students on different concepts related to atoms (atomic number, electronic configuration, isotopes and atomic mass number.

Table 4.2: Summary of identified Misconceptions of Senior Secondary Chemistry Students on Concepts of atoms

S/N	MISCONCEPTION HELD BY STUDENTS ABOUT CONCEPTS OF ATOMS
1.	Electrons, proton and neutron or liquid, solid and gas are particles of matter instead of ions and molecules as particles of matter atoms.
2.	Number of electron or number of neutron in an atom is used to define atomic number, instead of number of proton only.
3.	Proton number or neutron number not electron is used to write electronic configuration of ions
4.	Sum of atomic number and neutron number or sum of proton and neutron number cannot be used to find atomic mass number
5.	Difference in mass number or difference in neutron number makes two atoms to be isotopes.
6.	Atomic number, neutron number, electron number or their sum is the mass even when the atomic number differs.
7.	Cations and anions are atomic particles.

The above table 4.2 summarized the misconception of senior secondary chemistry students on the concepts of atoms. The results it was obtained from the percentage response of the distracters by the students. Thus, the following identified misconceptions in table 4.2 answer the research question of the study:

- Electrons, proton and neutron or liquid, solid and gas are particles of matter instead of ions and molecules as particles of matter atoms.
- Number of electron or number of neutron in an atom is used to define atomic number, instead of number of proton only.
- Proton number or neutron number not electron is used to write electronic configuration of ions
- Sum of atomic number and neutron number or sum of proton and neutron number cannot be used to find atomic mass number
- Difference in mass number or difference in neutron number makes two atoms to be isotopes.
- Atomic number, neutron number, electron number or their sum is the mass even when the atomic number differs.
- Cations and anions are atomic particles.

4.3 Discussion of the Result

The identified misconceptions must have been developed due to:

i. Common sense explanatory frameworks where all components of the world exist and develop independently. For example, in most introductory chemistry class, states matter is mentioned and that ions,

atoms and molecules are mention in relation to elements and compounds independent of matter

ii. School made, this is because, most of these concepts must have been taught in SS1 therefore, it is assumed that during teaching certain things were not emphasised, thus, the misconception of the students were not checked (Treagust, 2003) for example concepts of atomic number, mass number and isotopes.

The study proved assertions of many researchers on misconceptions of chemistry students (Barke & Roellelke, 2007) TAlanguer, 2006 Necoll, 2001)

The implication of this study is that it explains why the continuous observed failure of secondary school students in chemistry (Ayas & Ozman, 2003). The presence of misconceptions on conceptions of atoms would definitely have effect on the performance of students because not only that the concepts are tested but the understandings of other topics depend on the understanding of these concepts.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The study surveyed the type of misconceptions held by senior secondary year II chemistry students in inorganic chemistry. This chapter is discussed under the following sub headings.

- Summary
- Major finding
- Conclusion
- Recommendation
- Suggestion for further studies

5.2 Summary of the study

The purpose of this study was to find out misconceptions of senior secondary school chemistry students on the concepts of atom. One research question was asked. Four schools were randomly selected for the study. Sixty (60) students were also randomly selected from the four schools. The topic selected for the study was concepts of atom which form the basics of chemistry. The students' misconceptions Inventory on the concepts of atom (SMICA) was the instrument of the study. This consisted of 7 - test items test to collect the data that was

analysed to answer the research question. The SMICA was administered by the Project students in the four secondary schools. Only the science students taking chemistry and were present in the school at the time of the project students' visit to the schools were used.

The collected data as SMICA responses of the students were analysed by finding percentage response of each options of the test items.

5.3 Major Findings

- Electrons, proton and neutron or liquid, solid and gas are particles of matter instead of ions and molecules as particles of matter atoms.
- Number of electron or number of neutron in an atom is used to define atomic number, instead of number of proton only.
- Proton number or neutron number not electron is used to write electronic configuration of ions
- Sum of atomic number and neutron number or sum of proton and neutron number cannot be used to find atomic mass number
- Difference in mass number or difference in neutron number makes two atoms to be isotopes.
- Atomic number, neutron number, electron number or their sum is the mass even when the atomic number differs.
- Cations and anions are atomic particles.

5.4 Conclusion

Based on the findings of this study, it can be concluded that SSII chemistry students hold misconceptions on the concepts of atoms as summarised in the major findings of the study (see section 5.3)

5.5 Recommendations

Considering the findings of this study, it was recommended that;

1. The level of misconception on the concepts of atoms is high. This is an indication that the students lack basics of chemistry concepts. Thus, there is the need to teach these concepts well in senior secondary schools.
2. Chemistry students hold misconceptions in all the concepts of atom. There is need to use varieties of teaching methods and instructional materials to facilitate the teaching and learning process of concepts of atom, noting the causes of misconceptions in chemistry.

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