DIFFICULT CHEMISTRY CONCEPTS AS PERCEIVED BY STUDENTS AND TEACHERS OF SENIOR SECONDARY SCHOOLS IN AGBANI EDUCATION ZONE OF ENUGU STATE

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Abstract

The accepted general notion that chemistry is abstract in nature as it is presented via mathematical formulars, structures and arrows, goes to a long extent in being perceived difficult by the students, which in turn hinders their academic achievement and interest in the subject. Hence, the study investigated difficult concepts in chemistry as perceived by students and teachers in senior secondary schools in Agbani Education Zone of Enugu State. Two research questions guided the study. The study adopted descriptive survey design. The population for the study comprised 1462 senior secondary school three (SS3) chemistry students and 45 chemistry teachers in public secondary schools within Agbani Education Zone. A sample size of 359 (314 students and 45 teachers) was used for the study. The instrument for data collection was a structured questionnaire titled Difficult Chemistry Concepts Questionnaire (DCCQ), which was designed by the researcher. The instrument was divided into two sections namely: A and B. Sections A was based on the respondents' biodata while B consisted 46-item statements structured to elicit information from the respondents. The instrument was validated by three experts. In order to determine reliability of the instrument, the researcher administered 30 copies of the questionnaire on 28 SS3 chemistry students and 2 teachers in two schools in Enugu Education Zone to determine the overall reliability index of the instrument. Cronbach alpha reliability coefficient formula was used to estimate the reliability of the instrument, and an overall reliability coefficient of .75 was established. The data were collected by the researcher with the help of two research assistants. The collected data were analyzed using mean scores and standard deviation. The decision rule for interpreting the results was based on the values of the calculated means. Item responses on each of the research questions were considered high and difficult when the mean is 2.50 and above, and low and not difficult when less than 2.50. The results of the analysis revealed that the chemistry concepts in senior secondary school that teachers and students perceived as difficult are: chemical combination, mass volume relationship (stoichiometry), acid, base reaction, oxygen and its compounds, among others. The study also revealed that there was a significant difference between male and female chemistry students as well as teachers in their mean difficulty in some concepts. Based on the findings of the study, it was recommended that: teachers and students should devote greater attention to the teaching and learning of these difficult concepts, and workshops

and seminar should be organized for chemistry teachers to train them on how to effectively teach the identified areas where students struggle.

Key Words: Chemistry Concepts, Difficult Chemistry Concepts, Perception

Introduction

Education is an instrument "par excellence" for effective national development. The development of any nation depends largely on the level of education attained by her citizens especially in the area of science and technology. It is highly rated as the most important instrument of change since any definite change in the intellectual and social outlook of the people must be preceded by an educational revolution. In cognizance with the importance of science and technology in national development, science subjects-Biology, Physics and Chemistry are taught in secondary schools to prepare a base for any science and technological development (Ababio, 2013). This according to Idoko (2014), is important because the knowledge of science in general helps man to understand himself, his environment and how his environment influences him.

Therefore, science according to Idoko (2014) is the application of man's acquired knowledge to influence and manipulate his environment to achieve better living condition for himself. In another report, Mbajiorgu (2018) stated that science is the study of natural occurrence or way of making sense of the natural physical world. Mbajiorgu further revealed that there cannot be any meaningful development without science. This is in agreement with the notion of Nwachukwu (2015) which reported that the development of the nation depends on the level of scientific teaching and knowledge received by individuals.

From the above explanations, science in a nutshell can be seen as a field of study which involves a systematic process of carefully investigating and obtaining knowledge about nature and its phenomena. This knowledge when fully acquired is fit to develop scientifically literate individuals with high competence for rational thought and action, which by implication will bring about national development. Moreso, this scientific knowledge is unavoidably related to the classroom setting. Hence, most learning approaches are largely dependent on technological competence and skills which are products of scientific knowledge. This implies that scientific knowledge can be acquired through effective teaching and learning of science concepts. Thus, science education is vital in inculcating scientific knowledge to the desired learners.

According to Cobern (2017), science education is the application of educational (learning) theories especially those based on the philosophical, sociological and psychological perspectives in the endless search for knowledge, resulting in the development of the cognitive, affective and psychomotor domains through some systematic processes involving careful observation, deduction and testing by empirical means. Cobern opined that for the purpose of teaching, science education is the process whereby persons (teachers inclusive) are prepared or equipped with knowledge and skills

to help ensure the effective dissemination and inculcation of scientific concepts, culture and thinking process and activities through general accepted pedagogical strategies and theories. Science education is thus more than the presentation or acquisition of scientific facts and skill. Science education includes the development of new ways of thinking, reacting and behaving--a development that reveals itself in increased skills, knowledge and thinking capacities to tackle problems of life. It is the field of science that is concerned with sharing of science contents, some social sciences, and the process of teaching science pedagogy in order to provide expectations for the development of understanding part of the scientific community.

However, science as a discipline is broadly studied in three major subjects; Biology, Physics and Chemistry (Aniodoh, 2019). Aniodoh further stated that the concept of chemistry and chemical activities in the environment has helped to expose one's mind to the importance of chemistry to the society. Hence, the relevance of chemistry as a requirement for technological advancement of a nation cannot be looked down upon. The classification of any nation into developed, developing and under developed could be measured accurately by the number of chemists, physicists, engineers, pharmacists, doctors, agriculturalists and science educators the nation could produce. Chemistry is most commonly regarded as the central science or the mother of all Science owing to its confluence and influence (Ahiakwo, 2017). Chemistry as a physical science is that branch of science which deals with how substances are made, how they combine with each other under controlled environmental conditions, such as temperature and pressure, and how the subject can lay the necessary foundation for technological advancement Magbo, (2018). Chemistry is a science subject that deals with the properties, composition and structure of substances, the transformation they undergo and the energy that is released or absorbed during these processes (Alan, 2019).

Through the learning of chemistry, it is possible to acquire knowledge, skills and understanding in engineering, medicine and other related scientific and technological fields. According to Patrick (2020), using chemistry, pharmaceutical products were discovered which have contributed to improvement in life expectancy and quality of life of many patients. It has increased food production through the use of fertilizers and pesticides, and also increased developed plastics and other materials that are used in almost every facet of our lives.

Chemistry education plays a crucial role in developing students' scientific literacy and in preparing them for future careers in science-related fields.

The objectives of chemistry education according to the revised edition of the Senior Secondary School Chemistry Curriculum (NERDC, 2017), is expected among other things to enable students to:

i. Develop interest in the subject of chemistry.
ii. Acquire basic theoretical and practical knowledge and skills.
iii. Develop interest in science, technology and mathematics
iv. Acquire basic STM knowledge and skills

v. Develop reasonable level of competence in ICT applications that will engender entrepreneurial skills.
vi. Apply skills to meet societal needs of creating employment and wealth.
vii. Be positioned to take advantage of the numerous career opportunities offered by chemistry.
viii. Be adequately prepared for further studies in chemistry.

The above objectives are quite good and it is expected that when chemistry teaching is geared towards the attainment of the objectives, the students' achievement will be high. If the objectives are achieved, the chemistry students will not only be highly knowledgeable in chemistry, but will also acquire the necessary skills and competencies that will translate to high achievement in the subject in external examinations. The knowledge of chemistry provides important understanding of our world and how it works. It is an extremely practical science and its' knowledge and principles help in our daily lives, especially in the improvement of health care, conservation of natural resources, protection of the environment and provision of our everyday needs for food, clothing and shelter.

Despite the numerous important applications of chemistry to life, students encounter difficulties learning the subject because of the abstract nature of the subject, (Kousathana, 2019). The students offering chemistry are faced with various difficult concepts in the subject matter. The failure of senior secondary school students in chemistry over the years has been of great concern to scientific researchers, West African Examination Council chemistry results has consistently for two years recorded low grades for chemistry, for instance, far below average level was recorded in 2017 and 2018 respectively. Out of 454,28 that sat for chemistry WAEC exam in 2017 only 45.78% credited chemistry and in 2018 out 439,622 that wrote the exam only 45.46% credited chemistry (WAEC Chief Examiner, 2017 and 2018). It shows that students' performance on the average were below fifty percent from 2017- 2018 which was not too good. There has been an outcry by the students each year when WAEC releases their annual results, as a result of students' poor achievement especially in the Science subjects (Salami, Mohammed, and Ogunlade; 2019).

Candidates' achievement at the Senior School Certificate Examination (SSCE) conducted by WAEC has consistently remained poor with Chemistry having one of the worst and poorest results over the years (Ibe & Maduabam, 2019). For example, a look at the West African Examinations Council (WAEC) results in Chemistry from 2010 to 2014 shows that in 2010, out of 105,453 that sat for Chemistry in all the secondary schools in Enugu State only 26,680 credited Chemistry, in 2011, out of 107,781 candidates that sat for chemistry WAEC Examination, only 40, 506 credited the subject, in 2012, out 115, 549 that sat for the examination, only 35,095 candidates credited chemistry subject, and in 2013, out of 91,781 that wrote the exam, only 28,852 credited

chemistry, also in 2014, out of 126,401 candidates that sat for the examination, 26,031 credited chemistry subject.

This means that only about one in four students can use Chemistry as one of the subjects that would qualify them for university admission. (Ibe & Maduabam, 2019).Yet, chemistry is a prerequisite to all courses in medicine and related field, all engineering courses, pharmacy, and many others that are considered prestigious by the society; this means that there will be a low number of admissions. WAEC annual report by Chief Examiners 2015 and 2016 also noted poor academic achievement in Chemistry which manifested in constant poor grades and repetition of classes. Thus, one tends to question why the general unsatisfactory academic achievement in Chemistry among the secondary school students. These poor achievements in Chemistry have made some researchers to study the problem with the hope of finding the causes and possible solutions.

Student's poor achievement in senior secondary school chemistry is as a result of the broadness and difficult concepts in chemistry. Other causes could also include; difficult chemistry concepts (Agogo, 2020), and the abstract nature of chemistry concepts (Samba & Eriba 2021). Concept is defined as a perceived regularity in objects or events or a record of events designed to be labeled. Examples are kinetic energy, thermodynamics, and so on.

Difficult concept is the extent to which a concept or topic can be comprehended by a learner. The spectrum stretches from least difficult where the student very readily progresses in the concept from rote to meaningful learning (Novak, & Grove, 2017) to the polar end of most difficult where the learner encounters challenges from meaningfully learning from the concept. Grove and Novak have implied it to mean the easiness or difficulty in attaining a concept. According to Erin (2020), Dealing with unobservable chemistry concepts can be challenging, as these concepts are not directly observable through our senses. Dealing with unobservable chemistry concepts requires creativity, rigorous reasoning, and a combination of experimental and theoretical approaches. Understanding chemistry indeed requires critical thinking skills. Chemistry is a complex scientific discipline that deals with the composition, properties, and reactions of matter. To grasp the concepts in chemistry, one must engage in critical thinking at various levels like, problem solving, conceptual understanding, analyzing data, and creativity, predicting outcomes, experimental design, problem identification, evaluation and reflection.

Chemistry is best understood and practiced by writing notes and formulas using a pen and paper.

Moreover, breaking down complex concepts, consistent practice, seeking help from teachers or peers, and using study aids can all aid students' understanding of difficult chemistry concepts (Erin, 2020). Omiko, (2017) in reaction to this opined that a concept is considered difficult if an academically average chemistry student performs poorly in it after evaluation, even when the teacher has put in his best during instructional delivery.

Individual's perception of a given concept depends on the cognitive ability and determines the level of understanding of the concept. Consequently, the concept of easiness or difficulty as perceived by any individual is dynamic, relative and subjective. This explains why a difficult concept to a particular student may be easy to another in the same class even under the same condition and can vary from person to person due to individual differences in cognitive abilities, learning styles and motivation. And the difficulty of a concept is subjective and depends on how a person perceived and interpret it.

Perception is the organization, identification and interpretation of sensory information in order to represent and understand the presented information (Pormerantz & James, 2019). It is important to understand student perceptions of how they perceive teachers' questions and answer questions in class. Those perceptions affect students' willingness to participate actively in question and answers sessions (Cole, 2017).

Perception refers to the process of interpreting and making sense of sensory information from our environment. It involves the way we perceive, understand, and interpret stimuli such as sights, sounds, tastes, smells, and touch. Perception is influenced by our previous experiences, cultural background, beliefs, and expectations, and it plays a crucial role in shaping our understanding of the world and our interactions with it (Drew, 2023).

Perception of difficult concepts in secondary school chemistry is a common issue that many students face. There are several reasons why students may find certain concepts in chemistry challenging to understand. One of the main reasons for the perception of difficult concepts in secondary school chemistry is the abstract nature of the subject. Chemistry deals with the study of matter, its properties, and how it interacts with other substances. Many of the concepts in chemistry are not tangible and require students to think in abstract terms. This can be challenging for students who are more accustomed to concrete, hands-on learning experiences (Smith, 2018).

Another reason for the perception of difficult concepts in secondary school chemistry is the complex terminology and symbols used in the subject. Chemistry has its own language, with a wide range of terms and symbols that students need to learn and understand. This can be overwhelming for students, especially those who struggle with memorization or have difficulty with language skills (Brown, & Jones, 2019). Additionally, the mathematical nature of chemistry can also contribute to the perception of difficult concepts. Chemistry involves a significant number of calculations and problem-solving, which can be challenging for students who are not comfortable with math. Understanding the mathematical relationships in chemistry requires a strong foundation in algebra and other mathematical concepts, which some students may lack (Johnson, 2020).The students' perceptions in chemistry can vary greatly. Some students may find chemistry fascinating and engaged in learning about the composition, properties, and reactions of different substances (Park and Roehrig, 2021). They may appreciate the

practical applications of chemistry in everyday life, such as understanding the behavior of chemicals in food, medicine, or the environment.

On the other hand, some students may perceive chemistry as challenging and intimidating. They may struggle with understanding complex concepts, equations, and formulas. The abstract nature of chemistry, with its emphasis on atoms, molecules, and chemical reactions, can be difficult for some students to grasp. Additionally, some students may feel overwhelmed by the amount of memorization required in chemistry, as they have to learn the names, symbols, and properties of numerous elements and compounds. They may also find it challenging to apply theoretical knowledge to practical experiments and problem-solving tasks.

Overall, students' perceptions in chemistry can be influenced by their prior knowledge, learning style, and interest in the subject. Teachers' teaching methods, resources, and support can also play a significant role in shaping students' perceptions and attitudes towards chemistry.

To address students' difficulties, teachers can use various teaching strategies, such as using visual aids, providing clear explanations and examples, interactive activities, and offering extra practice and support. Breaking down complex concepts into simpler parts and providing real-world applications can also help students understand and relate to difficult chemistry concepts.

Gender differences in perception of difficult concepts. Studies have shown that there may be gender differences in how difficult concepts in chemistry are perceived by students. For example, a study by (Smith, Johnson., & Brown, 2018) found that male students were more likely to perceive certain concepts in chemistry as difficult compared to female students. This may be due to societal stereotypes and expectations that suggest that males are more adept at science and math subjects, while females are better suited for subjects in the humanities.

Furthermore, female students may be more likely to internalize feelings of inadequacy when faced with difficult concepts in chemistry. This can lead to a lack of confidence in their abilities and a reluctance to seek help or ask questions in class. In contrast, male students may be more likely to exhibit overconfidence in their abilities, which can also hinder their learning and understanding of difficult concepts. Gender as a factor responsible for students' perception of some concepts in chemistry. There are different levels of difficult concepts experienced by chemistry students and these concepts perceived difficult are experienced by both boys and girls. Gender stereotyping also influence the class room interaction patterns of students and teachers. Gender is a major factor that influences career choice and subject interest of students. It is stated that more difficult works are usually reserved for males while the females are considered feminine in a natural setting. Thus, in school males are likely to take difficult subjects areas like chemistry while the females take to career that will not conflict with marriage chances, marriage responsibilities and motherhood (Okeke, 2019). The female students

show higher anxiety towards the learning of chemistry in secondary schools than the male students (Jegede, 2017).

Therefore, gender can indeed be a factor that influences students' perception of difficulty in learning chemistry concepts. It's important to acknowledge that gender stereotypes and societal expectation can impact students' self-perception, motivation and engagement in chemistry as a subject. In other words, knowledge is memorized but it is meaningless and does not translate into thought. This problem could be solved through appropriate teaching methods employed by the teacher.

Teachers' perceptions in chemistry vary greatly depend on their individual experiences, knowledge, and teaching styles. Some teachers may view chemistry as a challenging subject that requires a strong understanding of complex concepts and equations (Park & Roehrig, 2021). They may believe that students need to be highly analytical and detail-oriented in order to succeed in chemistry. Other teachers have a more positive perception of chemistry, seeing it as an exciting and engaging subject that allows students to explore the world of atoms, molecules, and reactions. They emphasize the practical applications of chemistry in everyday life, such as understanding how chemicals interact and how they can be used to solve real-world problems.

Some teachers view chemistry as a foundational science that lays the groundwork for further scientific study. They see it as a subject that helps students develop critical thinking and problem-solving skills, as well as fostering a curiosity about the natural world (Subahan & Ahamad, 2017).

However, there are teachers who struggle with teaching chemistry, finding it difficult to make the subject accessible and engaging for their students. They have limited knowledge or confidence in the subject matter, which can impact their perception of chemistry as a whole.

Teachers' perception of difficult chemistry concepts and their lack of interest in the subject have been reported to be a factor responsible for teacher-student perception of difficulty in science. (Ajayi, 2017).Teachers' perceptions of chemistry can greatly influence their teaching approach, the resources they use, and the level of enthusiasm they bring to the classroom. When encountering difficult concepts in chemistry, there are several effective approaches that are suitable for teaching difficult concepts in chemistry. One of the approaches to overcoming concept difficulty in secondary school chemistry is to provide students with hands-on, interactive learning experiences. Research has shown that students learn best when they are actively engaged in the learning process (Smith & Jones, 2018). By conducting experiments, demonstrations, and simulations in the classroom, students can see the concepts they are learning about in action, which can help them better understand and retain the information. Another approach is to use visual aids and multimedia resources to help students visualize abstract concepts. Studies have shown that visual learning can be particularly effective for students who struggle with traditional textbook-based learning (Brown & White, 2019). Chemistry teachers can use

videos, diagrams, and animations to help students see how molecules interact, how reactions occur, and how elements are arranged on the periodic table.

Additionally, providing students with opportunities for collaborative learning can help them overcome concept difficulty in chemistry. Working in groups allows students to discuss and debate ideas, ask questions, and receive feedback from their peers (Johnson, 2020). This can help students deepen their understanding of the material and develop critical thinking skills.

Furthermore, breaking down complex concepts into smaller, more manageable chunks can help students grasp difficult concepts in chemistry. Chemistry teachers can use scaffolding techniques to guide students through the learning process, providing them with the support they need to build their understanding step by step (Clark & Lewis, 2017). By breaking down complex concepts into smaller parts, students can focus on mastering one concept at a time before moving on to more advanced topics. By implementing these approaches, chemistry teachers can help students develop a deeper understanding of chemistry and build the skills they need to excel in the subject.

In Agbani education zone, the understanding of difficult chemistry concepts among students is a matter of concern. Many students struggle to grasp critical topics, resulting in poor academic achievements and a general lack of enthusiasm for the subject. Understanding the underlying reasons for these difficulties is essential for educators and policymakers to design effective interventions that improve the teaching and learning of chemistry in senior secondary schools; hence, the need for this study.

Statement of the Problem

Chemistry education plays a crucial role in developing students' scientific literacy and in preparing them for future careers in science-related fields. However, it has been observed that students in senior secondary schools within Agbani education zone encounter difficulties in understanding and mastering chemistry concepts. These difficulties may hinder their overall academic achievement, and interest in the subject. Furthermore, the perceptions of difficult chemistry concepts among students and teachers may vary, leading to discrepancies in instructional practices and assessment approaches.

The specific problems to be addressed in this research study include: Lack of specific understanding of the difficult concepts in chemistry, reasons why chemistry concepts are difficult to teach and learn in senior secondary schools and the approaches employed to solve the problems.

Addressing these issues will provide valuable insights into the difficulties faced in teaching and learning chemistry concepts in senior secondary schools within Agbani education zone. The concern of this study is therefore set to provide answers to the problems of the research which is posed in a question form: what are the difficult chemistry concepts as perceived by students and teachers in senior secondary schools in Agbani education zone of Enugu State.

Research Questions

The study was anchored on the following research questions:

1. What concepts in the senior secondary school chemistry do students and teachers perceived difficult to teach and learn?
2. What difference exists between male and female student's perceived difficult concepts in senior secondary school chemistry?

Method

A descriptive survey design was adopted for the study. A survey design, according to Nworgu (2015) is a design where peculiar characteristics of a known or identified population are studied through a sample, which is deemed to be representative of the population. Such study is only interested in describing certain variables in relation to the population. Ojo (2019) opined that survey is the best technique for obtaining the necessary data from a group in which the sample drawn from the population and their opinion will be used to generalize the opinion of the entire population. It is used in studies that involve finding individual opinions (Olaitan,2018). This design was considered appropriate for the study because it made use of questionnaire in obtaining the opinions of the respondents used in the study. Hence, the study sought the opinion of the students and teachers in Agbani Education Zone on their perception of difficult chemistry concepts in senior secondary schools. The study was conducted in Agbani Education Zone of Enugu State. Agbani Education Zone is one of the six Education Zones in Enugu State. It is made up of three Local Government Areas thus: Enugu South, Nkanu East and Nkanu West. There are 45 public secondary schools in Agbani Education Zone. Enugu South has a total of 14 public secondary schools, Nkanu East 19 and Nkanu West 12, this amounting to a total of 45 public secondary schools within the context of Agbani Education Zone. The population for the study consisted all the senior secondary school three (SS3) students who offered chemistry and all the chemistry teachers in the 45 public secondary schools within Agbani Education Zone. The population size was 1462 chemistry students and 45 chemistry teachers. A sample size of 359 (314 students and 45 teachers) was used for the study. To determine the sample size of students, Taro Yamane's formula was used and a sample of 314 students (132 male and 182 female) were drawn from the population of 1462. In addition, all the 45 chemistry teachers were used for the study. Therefore, 314 SS3 students and 45 chemistry teachers sum up to a total sample size of 359 respondents.

A 46- item structured questionnaire titled Difficult Chemistry Concept Questionnaire (DCCQ) was used as instrument for data collection, which was designed by the researcher in line with research questions that guided the study. The questionnaire was arranged in two parts, Section A, and Section B. Section A was concerned with the bio-data of the respondents, while section B consists of items raised to answer the research questions. The items of the DCCQ were structured to have four points' scales of: Very Difficult (VD), Difficult (D), Moderately Difficult (MD) and Not Difficult (ND).

Numerical values of 4, 3, 2 and 1 were given to the options respectively in each line of scale.

The Instrument was subjected to face and content validation. The instrument was validated by three experts, two from Science Education Department, and one from Mathematics and Computer who majors in Measurement and Evaluation, all from Faculty of Education, Enugu State University of Science and Technology, ESUT). The validators made some constructive comments which formed the basis for the modification of the items before using it. In order to determine reliability of the instrument, the researcher administered 30 copies of the questionnaire to 28 SS3 chemistry students and 2 teachers in two schools in Enugu Education Zone to determine the overall reliability index of the instrument. Cronbach alpha reliability coefficient formula was used to estimate the reliability of the instrument, and overall reliability coefficient of .75 was established. To distribute the instrument, the researcher visited the schools with two research assistants. At spot delivery method was used in data distribution, this was to ensure 100% return rate of the distributed instrument. The data were collected by the researcher with the help of two research assistants. The collected data were answered using mean scores and standard deviation. Therefore, the decision rule for interpreting the results was based on the values of the calculated means. Item responses on each of the research questions were considered high and difficult when the mean is 2.50 and above, and low and not difficult when less than 2.50.

Results

Research Question 1: What Concepts in the Senior Secondary School Chemistry do Students and Teachers Perceived Difficult in Agbani Education Zone?

Table 1: Mean and Standard Deviation scores of Students and Teachers Perceived Difficult Concepts in Secondary School Chemistry.

S/N	Difficult chemistry Concepts as Perceived by Teachers and Students	X	Std. Deviation	Decision
1	Particulate nature of matter	2.40	1.131	Not Difficult
2	Chemical combination	2.58	1.080	Difficult
3	Gas law	2.36	1.123	Not Difficult
4	Periodic table and periodicity	2.46	1.113	Not Difficult
5	Rates of chemical reaction	2.47	1.064	Not Difficult
6	Mass volume relationship (stoichiometry)	2.51	1.138	Difficult
7	Quantitative analysis	2.33	1.106	Not Difficult
8	Acid, base reactions	2.55	1.142	Difficult
9	Water and solution (solubility)	2.47	1.088	Not Difficult
10	Oxygen and its compounds	2.55	1.081	Difficult

11	Hydrogen and their compounds	2.65	1.156	Difficult
12	Sulphur and their compounds	2.36	1.094	Not Difficult
13	Nitrogen and their compounds	2.58	1.130	Difficult
14	Oxidation and reduction (redox reaction)	2.58	1.087	Difficult
15	Electrolysis	2.37	1.121	Not Difficult
16	Petroleum	2.42	1.113	Not Difficult
17	Metals and their compounds	2.60	1.104	Difficult
18	Carbon and their compounds	2.45	1.117	Not Difficult
19	Hydrocarbons	2.53	1.118	Difficult
20	Alkanols	2.45	1.053	Not Difficult
21	Alkanoic acid	1.65	.669	Not Difficult
22	Qualitative analysis	2.04	.863	Not Difficult
23	Giant molecules (sugar, starch and proteins)	2.26	1.032	Not Difficult
	Grand Mean	**2.41**	**1.074**	**Not Difficult**

The data in Table 1 above shows that 9 out of 23 concepts in senior secondary school chemistry concepts were perceived as difficult by teachers and students of senior secondary schools in Agbani Education Zone. The high mean scores of Chemical Combination 2.55, mass volume relationship (stoichiometry) 2.51, acid, base reaction 2.55, Oxygen and its compounds 2.55, Hydrogen and their compounds 2.65, Nitrogen and their compounds 2.58, Oxidation and reduction (redox reaction) 2.58, Metals and their compounds 2.60, and Hydrocarbons 2.53 were perceived difficult. While the mean scores of particulate natures of matter 2.40, Gas law 2.36, Periodic table and periodicity 2.46, Rates of chemical reaction 2.47, Quantitative analysis 2.33, Water and solution (solubility) 2.47, Sulphur and their compounds 2.36, Electrolysis 2.37, Petroleum 2.42, Carbon and their compounds 2.45, Alkanols 2.45, Alkanoic acid 1.65, Qualitative analysis 2.04, and Giant molecules (sugar, starch and protein) 2.26 have low mean scores and were considered not difficult. Generally, items in cluster 1 above have a grand mean score of 2.41 which is below the 2.50 mean benchmark of set for the study. This indicates that respondents are in disagreement that all items1-23 in Table 1 are difficult chemistry concepts perceived by chemistry teachers and students in Agbani Education Zone of Enugu State.

Research Question 2: What Difference Exist Between Male and Female Students on Perceived Difficult Concepts in Secondary School Chemistry in Agbani Education Zone?

Table 2: Mean and Standard Deviation scores of Male and Female Students on Perceived Difficult Concepts in Secondary Schools chemistry.

S/N	Difficult chemistry Concepts as Perceived by male and female Students	MALE X	MALE SD	MALE Decision	FEMALE X	FEMALE SD	FEMALE Decision
24	Particulate nature of matter	2.45	1.142	ND	2.37	1.127	ND
25	Chemical combination	2.55	1.058	D	2.59	1.094	D
26	Gas law	2.33	1.130	ND	2.38	1.120	ND
27	Periodic table and periodicity	2.47	1.101	ND	2.46	1.122	ND
28	Rates of chemical reaction	2.48	1.073	ND	2.46	1.061	ND
29	Mass volume relationship (stoichiometry)	2.55	1.174	D	2.48	1.118	ND
30	Quantitative analysis	2.39	1.089	ND	2.30	1.117	ND
31	Acid, base reactions	2.55	1.148	D	2.56	1.141	D
32	Water and solution (solubility)	2.47	1.059	ND	2.48	1.106	ND
33	Oxygen and its compounds	2.58	1.042	D	2.54	1.106	D
34	Hydrogen and their compounds	2.65	1.152	D	2.64	1.160	D
35	Sulphur and their compounds	2.39	1.089	ND	2.34	1.099	ND
36	Nitrogen and their compounds	2.56	1.154	D	2.59	1.118	D
37	Oxidation and reduction (redox reaction)	2.56	1.086	D	2.60	1.090	D
38	Electrolysis	2.35	1.105	ND	2.38	1.132	ND
39	Petroleum	2.45	1.114	ND	2.40	1.114	ND
40	Metals and their compounds	2.61	1.123	D	2.59	1.095	D
41	Carbon and their compounds	2.47	1.115	ND	2.43	1.120	ND
42	Hydrocarbons	2.58	1.094	D	2.53	1.134	D
43	Alkanols	2.49	1.015	ND	2.43	1.076	ND
44	Alkanoic acid	1.70	.709	ND	1.62	.644	ND
45	Qualitative analysis	2.06	.880	ND	2.02	.854	ND
46	Giant molecules (sugar, starch and proteins)	2.58	.996	D	2.07	1.008	ND
	Grand Mean	**2.44**	**1.071**	**ND**	**2.40**	**1.076**	**ND**

The Table 2 above shows that male and female students of senior secondary schools in Agbani Education Zones differs in their mean scores on difficult chemistry concepts. Only the male students perceived mass volume relationship (stoichiometry) 2.55, and Giant molecules (sugar, starch and protein) 2.58, to be difficult while it was not difficult for the female student. Generally, items in cluster 2 above have a grand mean score of Male and Female respondents are 2.44 and 2.40 respectively which are below the 2.50 mean benchmark of set for the study. This however, indicates that the responses of male and female respondents show difference in the chemistry concept perceived difficult by the students.

Discussion of the Findings

The discussion is presented under the following captions:

Perception of Difficult Concepts in Secondary School Chemistry by Teachers and Students.

The findings of the study in Table 1 revealed that teachers and students perceived 9 out of 23 concepts in senior secondary school chemistry as difficult. The test for null hypothesis in Table 5 indicates that there was a significant difference between the mean scores of teachers and students. The findings are in line with the results of Musounda (2022), which revealed that most difficult concepts were mole concept, stoichiometry, electrolysis, organic chemistry and redox reaction. This means that students may not perform well in their final year examination if the sources of difficulties are not removed. The findings are also in agreement with Jonah (2021) which indicated that students and teachers perceived 15 out of 19 concepts difficult to comprehend in chemistry. This implies that there were significant differences in perception of mean difficulty between teachers and students on such concepts. This finding concurs with Inibehe (2018) who noted that students perceived particulate nature of matter, chemical bonding, periodic table, acid, bases and salts, oxidation reduction reaction, mass volume relationship, quantitative analysis, electrolysis and hydrocarbons as difficult concepts. The above noted is supported by the report of Fatima (2020) which revealed that concepts students perceived as difficult in chemistry exceed that of the concepts perceived not difficult.

The findings are also in agreement with Abdul-Kadir (2018) which revealed that students perceived 12 concepts 63% as difficult out of the 19 concepts in the questionnaire. In the same vein, the findings of the study are in agreement with the report of Peter (2017) which observed that the student in mass volume relationship, hydrogen reactivity series, ionic theory, hydrocarbon, alkanols and alkanoic perceived difficult to learn. Balancing chemical equations and performing stoichiometric calculations require strong mathematical skills and an understanding of mole concepts.

Perception of Difficult Concepts in Secondary School Chemistry by Male and Female Students

The finding of the study revealed that male and female students of senior secondary schools in Agbani Education Zones differs in their mean scores on perceived difficult chemistry concepts. Gender consideration in Table 2 revealed that only male students perceived 10 out of 23 concepts as difficult while female students perceived 8 out of 23 concepts as difficult to learn. The test for null hypothesis in table 6 was rejected indicating that there is significant difference between the mean scores of male and female students in favor of the female students because the male students perceived more concepts (mass volume relationship and giant molecules) difficult. The findings of the study are in agreement with the report of Peter (2017) which posited that there is level of concepts difficulty experienced by male and female students in the study of chemistry science subject especially chemistry. The findings are also in agreement with Oladejo,

Ademola and Ayanwale (2023) which revealed that there is a slight difference in the perception of male and female students.

The findings of the study are in line with Inibehe (2018) who revealed that only male students perceived stoichiometry, water and solution, oxidation and reduction reaction, electrolysis, carbon and its compounds, as difficult concepts while only female students perceived sulphur and its compounds, and halogens and its compounds difficult to learn. The findings are also in agreement with Jonah (2021) which indicated that there are significant between male and female students in their mean difficulty in some concepts. The findings of the study however were in disagreement with the findings of Fatima (2020) which found out that gender difference has no influence on their perception of difficult concepts in chemistry. The finding of the study is in conformity with the finding of Adul-Kadir (2018) who revealed that the result based on gender showed that the male perceived 15 concepts in SSS3 chemistry concepts as difficult, while the female perceived 11 concepts as difficult; there was significant influence of gender on students' concepts perceived as difficult in the chemistry syllabus. The findings of the study were in disagreement with the findings of Peter (2017) which indicated that there is no significant difference between male and female chemistry students in their perception of difficult concepts in chemistry.

Conclusion

The purpose of the study was to identify difficult concepts in chemistry as perceived by teachers and students in senior secondary schools in Agbani Education Zone. The results of the analysis revealed that the chemistry concepts in the senior secondary school that teachers and students perceived as difficult are: chemical combination, mass volume relationship (stoichiometry), acid, base reaction, oxygen and its compounds, hydrogen and their compounds, nitrogen and their compounds, oxidation and reduction (redox reaction), metals and their compounds and hydrocarbons. The study also revealed that there was a significant difference between male and female students as well as teachers in their mean difficulty in some concepts.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Teachers and students should devote greater attention to the teaching and learning of these difficult concepts. The teacher should devise a means on how to make students understand the concepts identified to be difficult. Both male and female chemistry students should be encouraged to learn chemistry with greater emphasis on male students.
2. The areas of difficulties identified by students should be noted and the chemistry department with its team of teachers should devise means on how to make students understand the concepts identified to be difficult.

3. Workshops and seminar should be organized for chemistry teachers to train them on how to effectively teach the identified areas where students struggle.
4. Use a combination of data collection instrument such as questionnaires, interviews and classroom observations to triangulate data and reduce bias.

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