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INFLUENCE OF PERCEIVED CONCEPT DIFFICULTY ON STUDENTS' INTEREST AND ACADEMIC ACHIEVEMENT IN CHEMISTRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN CROSS RIVER STATE, NIGERIA.

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ABSTRACT

This study investigated the Influence of Perceived Concept Difficulty on Students' Interest and Academic Achievement in Chemistry among Senior Secondary School Students in Cross River State, Nigeria. One research question and one corresponding hypothesis guided the study. An ex-post-facto research design was adopted. The population comprised 8,702 SS III Chemistry students (4,418 males and 4,284 females) from 318 public co-educational secondary schools, out of which 162 schools were randomly selected. A sample of 1,150 students (674 males and 476 females) was selected using stratified random sampling with proportionate allocation. Three validated instruments were used for data collection: the Perceived Concepts Difficulty of Chemistry Inventory (PCDCI), Students' Chemistry Interest Scale (SCIS), and Chemistry Achievement Test (CAT). The PCDCI and SCIS each contained 60 structured items, while the CAT consisted of 60 multiple-choice items. Reliability coefficients were 0.82 (PCDCI), 0.90 (SCIS), and 0.72 (CAT). Data were analyzed using descriptive statistics and one-sample t-test at 0.05 level of significance. Findings revealed that students' perceived concept difficulty, interest and academic achievement in Chemistry were significantly higher than expected levels. The study concluded that students' interest strongly influences their academic achievement in Chemistry. It was recommended that teachers should adopt strategies that enhance students' interest to improve achievement in Chemistry.

Keywords: Academic achievement, Chemistry, Perceived concept difficulty and Interest in Chemistry.

Introduction

Chemistry is widely recognized as the "central science" because it connects and supports several scientific disciplines, including Biology, Physics, Medicine, Agriculture and Industrial Technology. In Nigeria, Chemistry is a core subject in the senior secondary school curriculum and serves as a prerequisite for many science-related careers and tertiary education programmes. Despite its importance, students' academic achievement and interest in Chemistry have remained persistently low, particularly in public secondary schools. Reports from the West African Examinations Council (WAEC) have consistently indicated unsatisfactory performance in Chemistry among secondary school students in Nigeria (WAEC, 2022). This persistent poor performance has been linked to several cognitive, affective and instructional factors, among which perceived concept difficulty remains a major concern.

Perceived concept difficulty refers to students' subjective judgement regarding the complexity, abstractness, or difficulty of understanding specific academic concepts (Chandrasegaran, Treagust & Mocerino, 2007). In Chemistry education, students' perception of difficult concepts significantly influences their level of participation, conceptual understanding, interest and academic achievement. Studies have shown that many Chemistry concepts are perceived as difficult because they involve abstract reasoning, symbolic representations, mathematical relationships and microscopic interpretations (Johnstone, 1991; Nakhleh, 1992). These difficulties often reduce students' interest and confidence in learning Chemistry.

The Nigerian senior secondary school Chemistry curriculum is organized into thematic areas such as General Chemistry, The Chemical World, Chemistry and Industry, Chemistry and Environment and Chemistry of Life. These domains differ in conceptual demands and cognitive requirements. General Chemistry includes foundational concepts such as mole concept, atomic structure, chemical equilibrium, thermochemistry and periodicity, which are frequently identified as difficult due to their abstract nature and mathematical applications (Johnstone, 1991). Similarly, topics under The Chemical World, including chemical bonding, reaction mechanisms and kinetics, require students to integrate macroscopic, microscopic and symbolic representations simultaneously.

Chemistry of Life, which covers organic Chemistry and biomolecules, is often perceived as difficult because of its structural complexity, reaction pathways and memorization demands. Chemistry and Industry introduces industrial processes and applications that require contextual understanding, while Chemistry and Environment integrates environmental issues with scientific principles. Research has shown that students' inability to relate theoretical knowledge to practical experiences contributes significantly to perceived difficulty in these areas (Hofstein & Lunetta, 2004).

Perceived difficulty has important implications for students' interest and academic achievement. According to Hidi and Renninger (2006), students develop sustained interest when learning activities are meaningful, understandable and engaging. Conversely, when concepts are perceived as excessively difficult, students

often lose motivation and exhibit low academic engagement. Bandura's (1997) self-efficacy theory further explains that students who perceive themselves as incapable of understanding difficult concepts are more likely to perform poorly academically.

In many Nigerian secondary schools, especially in developing regions, inadequate laboratory facilities, teacher-centred instructional methods and insufficient instructional materials further intensify students' perception of difficulty in Chemistry (Aina & Akintunde, 2013). Consequently, identifying difficult Chemistry concepts across curriculum domains is essential for improving instructional practices, enhancing students' understanding and promoting better academic achievement.

Empirical Review

Oladejo, Ademola, Ayanwale and Tobih (2023) investigated difficult concepts in secondary school Chemistry among students in selected schools in Nigeria and Ghana. The study adopted a descriptive survey design involving 1,292 senior secondary school students drawn from 21 schools. Data were collected using the Difficult Concept in Chemistry Questionnaire (DCCQ) and a Difficult Concepts Interview Guide (DCIG). The instruments were validated by experts in science education, while reliability testing using the test–retest method produced a reliability coefficient of 0.88. Data analysis involved descriptive and inferential statistics. Findings revealed that students perceived concepts involving calculations, industrial processes, environmental applications, and organic Chemistry as highly difficult. Although the study identified several difficult Chemistry domains, it focused mainly on industrial and environmental processes. The present study differs by examining Chemistry and industry, chemical world of curriculum domains.

Kyado, Achor and Adah (2021) examined difficult Chemistry concepts among secondary school students in Makurdi, Benue State, Nigeria. The study involved 100 students selected through random sampling techniques. Data were collected using a structured questionnaire on perceived difficult Chemistry concepts. Descriptive statistics and t-test analysis were used to analyze the data. Findings showed that concepts related to mole calculations, thermodynamics, kinetics, and organic Chemistry were perceived as difficult by students. While the study focused on selected domains such as General Chemistry and Chemistry of Life, the current study extends the investigation to additional domains including Chemistry and Industry as well as Chemistry and Environment.

Uzezi, Ezekiel and Auwal (2017) assessed conceptual difficulties in the Nigerian senior secondary school Chemistry curriculum using 198 students selected from six schools in Jalingo, Nigeria. Data were collected using the Chemistry Concept Difficulty Assessment Scale (CCDAS) and Chemistry Achievement Test (CAT). The instruments demonstrated acceptable reliability indices based on internal consistency measures. The study identified stoichiometry, equilibrium, and organic reactions as highly difficult concepts among students. The present study expands beyond specific concepts to examine perceived difficulty

across general Chemistry, Chemistry of life domains.

Dauda and Shoge (2024) investigated difficult Chemistry concepts among secondary school students in Zaria Local Government Area of Kaduna State, Nigeria. The study adopted a descriptive survey design involving 120 students selected through stratified random sampling. The Chemistry Concept Difficulty Questionnaire (CCDQ) was used for data collection, while reliability analysis using Cronbach Alpha produced a coefficient above 0.70. Results indicated that students perceived organic Chemistry and biochemistry concepts as difficult due to the complexity of molecular structures and reaction mechanisms. Unlike the reviewed study, the present study investigates difficulty across multiple Chemistry domains rather than focusing mainly on organic Chemistry.

Similarly, Iliya, Babafemi and Mohammed (2018) examined students' perception of difficult topics in the Chemistry curriculum in Osun State, Nigeria. The study involved 400 SS3 students selected randomly from five educational zones. Data were collected using the Perceived Difficult Chemistry Topics Questionnaire (PDCTQ), which yielded a Cronbach Alpha reliability coefficient of 0.81. Findings revealed that environmental Chemistry concepts such as water treatment, atmospheric Chemistry, and environmental pollution were perceived as difficult due to limited practical demonstrations and abstract explanations. The present study differs by examining perceived difficulty across chemical world, Chemistry of life and general Chemistry.

The review of related literature revealed conceptual, empirical, methodological and contextual gaps that justify the present study. Previous studies focused mainly on isolated Chemistry concepts such as stoichiometry, equilibrium, organic Chemistry and environmental Chemistry without comprehensively examining all major domains of the Nigerian senior secondary school Chemistry curriculum. Most studies also concentrated on identifying difficult concepts without adequately investigating the relationship among perceived concept difficulty, students' interest and academic achievement.

Methodologically, many of the studies used descriptive survey designs with relatively small samples, limiting the generalizability of their findings. In addition, little attention was given to comparing students across different levels of perceived difficulty in relation to their interest and achievement outcomes. Furthermore, most studies were conducted outside the present study area despite differences in instructional facilities, laboratory resources and learning environments that may significantly influence students' perception of Chemistry difficulty.

These gaps appear to be common within the Nigerian educational system due to persistent poor performance in Chemistry, inadequate instructional resources, and teacher-centred teaching approaches, and are particularly evident in Cross River State, Nigeria, where students continue to experience challenges in understanding difficult Chemistry concepts. Hence, the need for the present study to provide empirical evidence that will contribute to improving students' interest, understanding

and academic achievement in Chemistry in Cross River State, Nigeria.

Research Question

One research question guided the study:

1. What is the level of perceived concept difficulty, students' interest and academic achievement in Chemistry among secondary school students?

Statement Of Hypothesis

One null hypothesis formulated for the study:

1. The levels of perceived concept difficulty, students' interest and academic achievement in Chemistry among secondary school students are not significantly different from their expected levels.

Methodology

This study adopted an *ex-post-facto* research design to investigate the influence of perceived concept difficulty on students' interest and academic achievement in Chemistry among secondary school students in Cross River State, Nigeria. The design was appropriate because it allowed the researcher to investigate relationships among variables without manipulating any of them. The population comprised 8,702 Senior Secondary III (SS III) Chemistry students (4,418 males and 4,284 females) from 318 public co-educational secondary schools. A sample of 1,150 students was selected from 162 schools using a multistage sampling technique involving stratified random sampling with proportionate allocation. Specifically, 50% of schools were selected from each Local Government Area, while students were proportionately selected to ensure representativeness.

Three instruments were used for data collection: the Perceived Concept Difficulty in Chemistry Inventory (PCDCI), the Student Chemistry Interest Scale (SCIS), and the Chemistry Achievement Test (CAT). The PCDCI measured students' perceived difficulty of Chemistry concepts, while the SCIS assessed students' interest in Chemistry. The CAT measured students' academic achievement in Chemistry. The PCDCI and SCIS were adapted from Christopher's (1977) Modified Vocational Interest Inventory Scale and were structured on a four-point Likert scale of Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1). The CAT was developed by the researcher based on the Senior Secondary School Chemistry curriculum and aligned with West African Examinations Council (WAEC) standards, consisting of 60 multiple-choice objective items with four options (A–D). The instruments were validated by experts in Chemistry Education and, Measurement and Evaluation at the University of Cross River State, Calabar to ensure clarity, relevance and content validity.

A pilot test was conducted using 50 SS III Chemistry students from government secondary schools in Afaha Oku, Uyo Local Government Area of Akwa Ibom State. Reliability was determined using Cronbach's Alpha, yielding coefficients of 0.82 for PCDCI and 0.90 for SCIS, while the CAT yielded a reliability coefficient of 0.72 using Kuder-Richardson Formula 20 (KR-20), indicating acceptable internal consistency. Permission was obtained from school authorities prior to data collection, and trained research assistants assisted in administering the instruments to ensure

uniformity and reduce bias. Data collected were analyzed using descriptive statistics and one-sample t-test, and the hypothesis was tested at the 0.05 level of significance.

Results

Table 1: Descriptive statistics for all study variables.

Variable Name	Category	N	Mean	Std. Deviation	Std. Error	Min.	Max.
Chem. indus.	Not difficult	143	26.5245	4.508	.377	15	37
Difficulty	Moderately difficult	824	31.4454	5.772	.201	17	44
	Highly difficult	183	34.1585	5.616	.415	25	45
	Total	1150	31.2652	5.960	.176	15	45
Chem. world	Not difficult	143	56.4965	7.284	.609	38	68
difficulty	Moderately difficult	824	58.8883	8.302	.289	36	80
	Highly difficult	183	68.8415	7.703	.569	50	81
	Total	1150	60.1748	8.953	.264	36	81
Chem. and	Not difficult	143	49.2587	8.326	.696	36	66
environ.	Moderately difficult	824	61.3908	9.185	.320	44	92
Difficulty	Highly difficult	183	68.3279	6.737	.498	58	79
	Total	1150	60.9861	10.100	.298	36	92
Chem. of life	Not difficult	143	21.6434	5.144	.430	15	34
difficulty	Moderately difficult	824	23.9527	4.917	.171	11	36
	Highly difficult	183	30.0710	4.377	.324	18	36
	Total	1150	24.6391	5.456	.161	11	36
Interest in	Not difficult	143	30.0420	6.754	.565	21	40
Chem. and	Moderately difficult	824	30.8568	7.075	.246	11	44
industry	Highly difficult	183	29.5137	7.828	.579	20	44
	Total	1150	30.5417	7.174	.215	11	44
Interest in	Not difficult	143	59.1608	6.309	.528	43	70
Chem. World	Moderately difficult	824	60.3325	8.388	.292	32	79
	Highly difficult	183	62.7432	9.414	.696	45	78
	Total	1150	60.5704	8.390	.247	32	79
Interest in	Not difficult	143	65.2587	11.387	.952	46	95
Chem. and	Moderately difficult	824	61.5449	8.903	.310	46	86
environment	Highly difficult	183	63.6557	6.782	.501	53	75
	Total	1150	62.3426	9.049	.267	46	95
Interest in	Not difficult	143	25.7902	3.411	.285	18	32
Chem. of life	Moderately difficult	824	25.9782	4.645	.162	15	36
	Highly difficult	183	25.6448	3.925	.290	15	34
	Total	1150	25.9017	4.399	.130	15	36
Chem. and	Not difficult	143	27.5105	2.198	.184	19	30
industry	Moderately difficult	824	27.5789	2.391	.083	19	37
achievement	Highly difficult	183	27.7814	2.277	.168	19	37
	Total	1150	27.6026	2.350	.069	19	37
Chemical world	Not difficult	143	27.2449	1.773	.148	23	30
achievement	Moderately difficult	824	27.2816	2.100	.073	21	30
	Highly difficult	183	27.4100	1.831	.135	21	30
	Total	1150	27.2975	2.020	.060	21	30
Chem. and	Not difficult	143	26.8392	2.178	.182	17	30
environ.	Moderately Difficult	824	26.9405	2.213	.077	17	34
Achievement	Highly Difficult	183	27.3169	2.013	.149	20	34
	Total	1150	26.9878	2.181	.064	17	34
	Not difficult	143	27.4825	2.142	.179	20	35

Chem. of life achievement	Moderately difficult	824	26.8665	2.298	.080	19	35
	Highly difficult	183	27.1038	2.227	.165	19	30
	Total	1150	26.9809	2.276	.067	19	35
Chem. concept difficulty	Not difficult	143	153.9231	6.054	.506	139	161
	Moderately difficult	824	175.7257	7.953	.277	163	191
	Highly difficult	183	201.4645	4.731	.350	194	209
	Total	1150	177.1104	14.701	.434	139	209
Chem. Interest	Not difficult	143	181.5804	15.850	1.325	166	221
	Moderately difficult	824	179.9733	14.199	.495	144	214
	Highly difficult	183	183.5082	11.722	.867	167	213
	Total	1150	180.7357	14.105	.416	144	221
Chem. Achievement	Not difficult	143	109.2099	4.900	.410	97	120
	Moderately difficult	824	108.7938	5.309	.185	92	120
	Highly difficult	183	109.7051	4.462	.330	95	119
	Total	1150	108.9905	5.141	.152	92	120

Interpretation

The descriptive statistics in Table 1 revealed variations in students' perceived Chemistry concept difficulty, interest and achievement across the three categories of difficulty levels: not difficult, moderately difficult, and highly difficult. For Chemistry and Industry difficulty, students in the highly difficult category recorded the highest mean score (M = 34.16, SD = 5.62), followed by the moderately difficult category (M = 31.45, SD = 5.77), while the not difficult category recorded the lowest mean score (M = 26.52, SD = 4.51). Similar trends were observed for Chemical World difficulty with mean scores of 68.84, 58.89, and 56.50 respectively; Chemistry and Environment difficulty with mean scores of 68.33, 61.39, and 49.26 respectively; and Chemistry of Life difficulty with mean scores of 30.07, 23.95, and 21.64 respectively for the highly difficult, moderately difficult, and not difficult categories.

Regarding interest, Chemistry and Industry interest was highest among the moderately difficult group (M = 30.86, SD = 7.08), followed by the not difficult group (M = 30.04, SD = 6.75), while the highly difficult group recorded the lowest mean score (M = 29.51, SD = 7.83). For Chemical World interest, the highly difficult group recorded the highest mean score (M = 62.74, SD = 9.41), followed by the moderately difficult (M = 60.33, SD = 8.39) and not difficult groups (M = 59.16, SD = 6.31). In Chemistry and Environment interest, the not difficult group recorded the highest mean score (M = 65.26, SD = 11.39), followed by the highly difficult (M = 63.66, SD = 6.78) and moderately difficult groups (M = 61.54, SD = 8.90), while interest in Chemistry of Life remained relatively stable across the categories with mean scores of 25.98, 25.79, and 25.64 respectively.

Achievement scores across the domains showed only slight differences. In Chemistry and Industry achievement, the highly difficult, moderately difficult, and not difficult groups recorded mean scores of 27.78, 27.58, and 27.51 respectively; Chemical World achievement recorded mean scores of 27.41, 27.28, and 27.24 respectively; Chemistry and Environment achievement recorded mean scores of 27.32, 26.94, and 26.84 respectively; while Chemistry of Life achievement recorded mean scores of 27.48 for the not difficult

group, 27.10 for the highly difficult group, and 26.87 for the moderately difficult group.

Overall, Chemistry concept difficulty scores were highest among students in the highly difficult category (M = 201.46, SD = 4.73), followed by the moderately difficult (M = 175.73, SD = 7.95) and not difficult categories (M = 153.92, SD = 6.05). However, overall Chemistry interest scores were relatively similar across the highly difficult (M = 183.51, SD = 11.72), not difficult (M = 181.58, SD = 15.85), and moderately difficult categories (M = 179.97, SD = 14.20), while overall Chemistry achievement scores also showed minimal differences across the highly difficult (M = 109.71, SD = 4.46), not difficult (M = 109.21, SD = 4.90), and moderately difficult categories (M = 108.79, SD = 5.31), indicating that perceived Chemistry concept difficulty had limited influence on students' overall interest and academic achievement in Chemistry.

Testing of hypothesis

Hypothesis one: The level of perceived concept difficulty, students' interest and academic achievement among secondary school students are not significantly different from expected levels.

To test this hypothesis, one sample t-test was applied with the expected computed mean using the relation.

μ = 2.5n for difficulty and interest.

= 0.5n for Chemistry achievement.

This give μ = 27.500 for Chemistry and industry difficulty and interest.

μ = 55.000 for Chemistry world and, Chemistry and environment difficulty and interest.

μ = 22.500 for Chemistry of life difficulty and interest.

μ = 300.000 for Chemistry industry difficulty and interest.

μ = 15.000 for Chemistry achievement in the four section.

μ = 60.000 for overall Chemistry achievement.

The results were as presented in Table 2.

Table 2
One-sample t-test of Mean Difficulty, Interest and Achievement

Scale Name	No. of items	Mean	Std. dev.	Std. Error	Expected Mean	t-value	p-value
Chem. and indus. Difficulty	11	31.265	5.960	.176	27.500	21.423*	.000
Chem. world difficulty	22	60.175	8.953	.264	55.000	19.601*	.000
Chem. and environ. Difficulty	22	60.986	10.100	.298	55.000	20.100*	.000
Chem. of life difficulty	9	24.639	5.456	.161	22.500	13.295*	.000
Chemistry difficulty	64	177.110	14.701	.434	160.000	39.469*	.000
Chem. and indus. Interest	11	30.542	7.174	.211	27.500	14.378*	.000
Chemical world interest	22	60.570	8.390	.247	55.000	22.515*	.000
Chem. and environ. Interest	22	62.343	9.049	.267	55.000	27.517*	.000
Chem. of life interest	9	25.902	4.399	.130	22.500	26.224*	.000
Chemistry interest	64	180.736	14.105	.416	160.000	39.424*	.000
Chem. and indus. Achieve.	30	27.603	2.350	.069	15.000	181.890*	.000
Chemical world Achievement	30	27.298	2.020	.060	15.000	206.409*	.000
Chem. and environ. Achieve.	30	26.988	2.181	.064	15.000	186.389*	.000
Chem. of life achievement	30	26.981	2.276	.067	15.000	178.518*	.000
Chemistry achievement	120	108.991	5.141	.152	60.000	323.188*	.000

significant at .05 level.

The results presented in Table 2 revealed that the observed mean scores for all the sub-variables of Chemistry concept difficulty, students' interest, and academic achievement were higher than their respective expected mean values, indicating that the respondents demonstrated significantly high levels across the variables examined. Specifically, the observed mean scores for Chemistry and Industry difficulty (M = 31.265), Chemical World difficulty (M = 60.175), Chemistry and Environment difficulty (M = 60.986), Chemistry of Life difficulty (M = 24.639), and overall Chemistry difficulty (M = 177.110) were all greater than their corresponding expected mean values of 27.500, 55.000, 55.000, 22.500, and 160.000 respectively. Similarly, the observed mean scores for Chemistry and Industry interest (M = 30.542), Chemical World interest (M = 60.570), Chemistry and Environment interest (M = 62.343), Chemistry of Life interest (M = 25.902), and overall Chemistry interest (M = 180.736) exceeded their expected mean values.

In the same manner, the observed mean scores for Chemistry and Industry achievement (M = 27.603), Chemical World achievement (M = 27.298), Chemistry and Environment achievement (M = 26.988), Chemistry of Life achievement (M = 26.981), and overall Chemistry achievement (M = 108.991) were substantially higher than their expected mean values of 15.000 and 60.000 respectively. Furthermore, the computed t-values for all the variables ranged from 13.295 to 323.188, while the associated p-values (.000) were all less than the .05 level of significance. Consequently, the null hypothesis was rejected in all cases. This implies that the levels of perceived Chemistry concept difficulty, students' interest in Chemistry, and academic achievement among secondary school students were significantly higher than the expected levels. The findings further suggest that although students perceived

many Chemistry concepts as difficult, they still maintained high levels of interest and achievement in the subject.

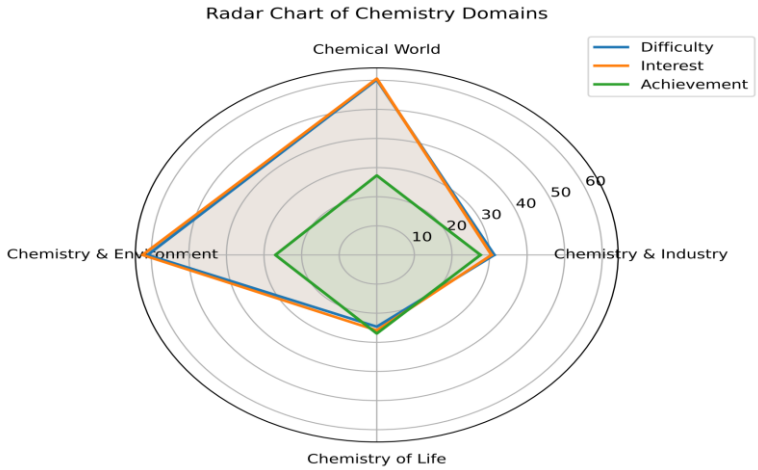


Figure 1: Radar Chart of Chemistry Domains

The radar chart shows that students recorded the highest mean scores in Chemical World and Chemistry and Environment for both perceived difficulty and interest, while achievement scores remained relatively lower and stable across all Chemistry domains. This suggests that although students perceived some domains as more difficult and interesting, academic achievement was comparatively consistent across the domains.

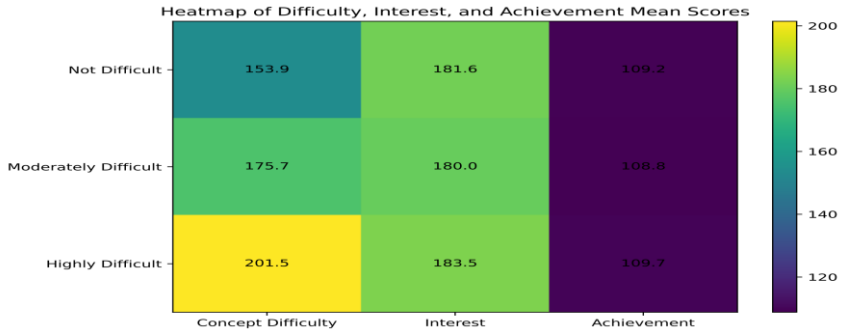


Figure 2: Heatmap of Difficulty, Interest and Achievement Mean Scores

The heatmap indicates that perceived Chemistry concept difficulty increased steadily across the three difficulty categories, with the highest mean score recorded among students in the Highly Difficult group. In contrast, students' interest and academic achievement remained relatively consistent across all groups, suggesting that increased perceived difficulty did not substantially reduce students' interest or achievement in Chemistry.

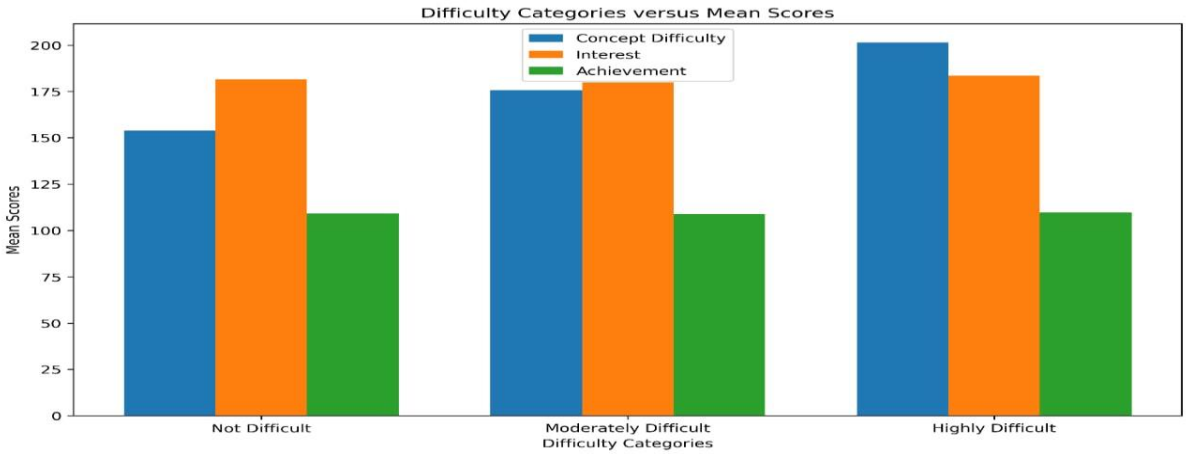


Figure 3: Difficulty Categories versus Mean Scores

The bar chart shows that the mean scores for perceived Chemistry concept difficulty increased progressively from the Not Difficult group to the Highly Difficult group. However, students' interest and academic achievement remained relatively stable across the three difficulty categories, with only slight variations in mean scores. This suggests that although students perceived some Chemistry concepts as highly difficult, their interest and academic performance in Chemistry were not substantially affected.

Discussion of Findings

The findings of the study revealed that secondary school students recorded significantly high levels of perceived Chemistry concept difficulty across all the Chemistry domains examined, including Chemistry and Industry, Chemical World, Chemistry and Environment, Chemistry of Life, and overall Chemistry difficulty. The observed mean scores for all the difficulty domains were significantly higher than their respective expected mean values, indicating that students generally perceived Chemistry concepts as difficult. This finding may be attributed to the abstract nature of Chemistry concepts, mathematical computations, symbolic representations, and students' difficulties in relating theoretical concepts to practical experiences.

The finding supports the views of Johnstone (1991) and Nakhleh (1992), who explained that the abstract and symbolic nature of Chemistry contributes significantly to students' perceived difficulty. The finding also corroborates the empirical studies of Oladejo, Ademola, Ayanwale and Tobih (2023), Kyado, Achor and Adah (2021), Uzezi, Ezekiel and Auwal (2017), Dauda and Shoge (2024), and Iliya, Babafemi and Mohammed (2018), who reported that students perceived concepts such as stoichiometry, thermodynamics, kinetics, organic Chemistry, industrial Chemistry, and environmental Chemistry as difficult. The high level of perceived difficulty observed in the present study may further be associated with inadequate laboratory facilities, teacher-centred instructional methods, insufficient practical activities and poor instructional resources commonly experienced in many Nigerian secondary schools, particularly in Cross River State.

The study further revealed that students demonstrated significantly high levels of interest and academic achievement in Chemistry despite the high perceived level of concept difficulty. The observed mean scores for Chemistry and Industry interest, Chemical World interest, Chemistry and Environment interest, Chemistry of Life interest, and overall Chemistry interest were all significantly higher than the expected mean values, indicating that students maintained strong interest in Chemistry regardless of perceived difficulty. Similarly, the observed mean scores for Chemistry and Industry achievement, Chemical World achievement, Chemistry and Environment achievement, Chemistry of Life achievement, and overall Chemistry achievement were significantly higher than their respective expected mean values, suggesting that perceived difficulty did not necessarily translate into poor academic performance. One possible explanation for these findings is that students recognize the relevance of Chemistry to everyday life, medicine, environmental sustainability, industrial development, and science-related careers, thereby sustaining their interest and motivating them to achieve academically despite conceptual challenges.

The finding supports the position of Hidi and Renninger (2006) that meaningful and valuable learning experiences promote sustained interest among learners. The findings also align with previous empirical studies reviewed in this study, which reported that students can maintain moderate or high interest and still achieve academically in Chemistry despite perceived conceptual difficulty because interest encourages persistence, curiosity and continuous engagement in learning activities. Furthermore, the finding supports Bandura's (1997) self-efficacy theory, which posits that students who remain motivated, confident and persistent despite learning challenges are more likely to attain higher academic achievement. Therefore, the present study demonstrates that perceived Chemistry concept difficulty, students' interest and academic achievement can co-exist simultaneously among secondary school students in Cross River State, Nigeria.

Conclusion

The study concluded that secondary school students in Cross River State, Nigeria, perceived many Chemistry concepts across the major curriculum domains as significantly difficult due to the abstract nature of the subject, mathematical demands, limited practical exposure, inadequate laboratory facilities, and teacher-centred instructional approaches commonly experienced in Nigerian secondary schools. Despite these perceived difficulties, students still demonstrated significantly high levels of interest and academic achievement in Chemistry, indicating that perceived concept difficulty did not necessarily hinder their academic performance. The findings suggest that students' sustained interest, motivation, examination-oriented study habits, peer collaboration and recognition of the relevance of Chemistry to everyday life, environmental sustainability, science-related careers and technological development may have contributed to their continued engagement and achievement in the subject.

The study therefore established that perceived Chemistry concept difficulty, students' interest and academic achievement can co-exist simultaneously,

while also highlighting the important role of interest and motivation in moderating the influence of perceived difficulty on students' academic achievement. Consequently, the study emphasizes the need for improved instructional strategies, adequate laboratory facilities, learner-centred teaching approaches, and increased practical activities to enhance students' understanding, sustain their interest and further improve academic achievement in Chemistry among secondary school students in Cross River State, Nigeria.

Recommendations

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

1. Teachers should sustain students' interest through real-life applications while providing structured guidance to help them cope with difficult Chemistry concepts.
2. Students should adopt effective learning strategies and remain actively engaged to translate their interest into improved academic achievement.
3. School heads should provide supportive learning environments and ensure the availability of resources that enhance students' interest in Chemistry.
4. Curriculum planners should design curricula that integrate real-life applications and stimulate sustained student interest alongside conceptual rigor.
5. The Ministry of Education should ensure equitable distribution of resources and support teacher training in interest-driven instructional strategies.

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