INFLUENCE OF MOTIVATION AND SELF-REGULATION ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN CHEMISTRY IN CALABAR EDUCATION ZONE, CROSS RIVER STATE

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Abstract
This study investigated the influence of motivation and self-regulation on secondary school students' academic achievement in chemistry in Calabar Education Zone, Cross River State, Nigeria. The study adopted an ex-post facto design. The study population was made up of 2,375 SS2 Chemistry students in Calabar Education Zone. The sample of the study consisted of 364 (males and females) students selected from the population using a proportionate stratified random sampling technique. Four research questions and four hypotheses were formulated to guide the study. Two instruments namely, Motivation and Self-regulation Questionnaire (MSQ) adapted from Schutte Self- Report Emotional Intelligence Test (SSEIT) and Chemistry Achievement Test (CAT) were used for data collection. The reliability of MSQ using Cronbach's Alpha analysis gave the reliability coefficient of 0.71 while the reliability of CAT determined using Kuder Richardson formula-20 yielded a coefficient of 0.93. The data obtained was analyzed using Means, Standard Deviations, and Analysis of Variance (ANOVA). Results of findings showed that motivation and self-regulation significantly influence students' academic achievement in chemistry. Furthermore, the findings indicated that there was no significant influence of motivation and self-regulation on students' academic achievement by gender. Based on the findings, it was recommended among others that there is need for teachers to adequately motivate and promote self-discipline, self-determination, and goal-oriented behaviour among students to enhance their academic achievement in chemistry.

Keywords: Chemistry, Motivation, Self-regulation, Academic Achievement and Gender

Introduction

Chemistry is a vital subject in the Nigerian science curriculum. It plays a vital role in equipping students with essential knowledge in understanding the composition, structure, properties, and changes of matter (Idris, 2022). Chemistry is crucial for the development of students' 21st century skills such as critical thinking, problem-solving, and analytical skills required to solve real-world problems (Hadinugrahaningsiha et al., 2017). Chemistry serves as a foundation for other scientific fields such as Biology, Physics, Environmental science, and Engineering as well as the path to several careers in industry and medicine. In the contemporary society, the world is relying on research in chemistry and chemistry education to provide solution to emerging issues such pollution, global warming, food insecurity, and disease outbreaks (Udofia & Ekong, 2017; Yadav et al., 2023; Kaur et al., 2024). Therefore, in a rapidly changing world where global issues are becoming increasingly prevalent, it has become imperative to empower students with functional background in chemistry through chemistry education as next generation of scientists, engineers, and policymakers to address emerging challenges and create a more sustainable future.

Despite the importance of chemistry, reports about students' achievement in the subject has been poor (Perera et al., 2019; Kenni, 2020, Karaca et al., 2022; Samuel et al., 2024). Neba

and Niba (2024) stated that the continuous poor achievement in sciences especially in chemistry has threatened students' chances for upward educational mobility. Recent research has focused on understanding factors that influence students' achievement in chemistry (Oladejo et al., 2023, Ayyıldız et al., 2023; Nwafor et al., 2023). For instance, Oladejo et al. (2023) carried out a study aimed at to determine whether factors such as gender, school location and ownership impact students' perception of difficult chemistry concepts in order to address students' underperformance in chemistry in Anglophone West African countries by suggesting how these difficult concepts could be made easy to learn. Several external factors namely, quality of teaching, availability of resources, and classroom environment determine students' achievement in chemistry (Rotkis, 2019). However, Brown (2018) stated that motivation, self-regulation, and study habits affect students' learning outcome. Therefore, there is a need for further research to explore the specific mechanisms through which motivation and self-regulation influence students' achievement.

Motivation is a vital factor that directs the behaviour of individuals (Pala & Başıbüyük, 2021). It is a driving force of action that rouses and sustains behaviour (Okoro et al., 2023). Motivation involves utilizing the available inner drives to guide an individual set goals, take initiative, and strive (Ugoani et al., 2015). Feraco et al. (2023) opined that motivation represents a broad construct that indicates a person's internal drive to achieve a specified goal. By implication, motivation may potentially determine students' subject preferences, interest, engagement, and learning outcome. Tokan and Imakulata (2019) opined that students who possess high motivation to learn tend to acquire the required competency standards in school. Several studies have shown that motivation influence students' achievement (Sivrikava, 2018; Ozen, 2018; Okoro et al., 2023). Fadda et al. (2022) showed that motivation is an important factor influencing students' learning process and academic achievement.

Gender is an influential variable in educational settings (Chung & Chang, 2017; Wang & Yu, 2023). Wang & Yu (2023) opined that gender discrepancies in academic self-concept could account for the gap between male students and female students in subject-specific achievement, motivation, performance, and self-efficacy, especially in STEM subjects. Mixed reports exist about the influence of motivation on academic achievement of students by gender. For instance, Rodriguez et al. (2020) and Okoro (2023) reported no significant influence of motivation on academic achievement of students by gender. In contrast, Naz et al. (2020) and Momanyi et al. (2015) stated that the influence of motivation on academic achievement of students by gender is significant. Moreso, Karyaningsih et al. (2023) showed that the level of students' motivation in learning influence their academic achievement in school. for instance, Chung and Chang (2017) found that female students are better motivated compared to their male counterpart. However, gender-moderated influence of motivation on academic achievement are scares in literature and this study aim to contribute to the existing body of knowledge.

Self-regulation is a crucial student-variable of learning involving planning, monitoring, and reflection (Brown et al., 2016). Self-regulation is characterized by the human psychological ability exercise control over the operation of the state and other internal processes (Daniela, 2014). Similarly, Olasehinde and Olatoye (2014) opined that self-regulation involves taking control of and evaluating one's own learning and behaviour. Generally, students who exhibit low self-regulation tendencies are usually misguided and disappointed when faced with difficult tasks (Duru et al., 2014). In contract, students that exhibit high self-regulation tend to be courageous and competent in facing difficult assignments. Self-regulation has been associated with high learning gains (Olakanmi & Gumbo, 2017). Similarly, self-regulation enables students to adjust to the changing school environment needed to reach specific learning goals (Özçelik-Herdem, 2019). In their study, Nwikpo et al. (2024) found that there exists a moderate relationship between self-regulation and academic achievement.

Some studies have shown that self-regulation has no influence on students' achievement by gender (Olasehinde & Olatoye, 2014). In contract, Gestsdottir et al. (2014) stated that female students outperform their male counterparts in relation to academic achievement. Malik and Parveen (2019) showed that male students are better than women in terms of self-regulation. Therefore, the need for more exploration to bridge the gaps in reports about influence of motivation and self-regulation on students' achievement by gender.

Purpose of the study

The purpose of the study is to investigate the influence of motivation and self-regulation on secondary school students' academic achievement in chemistry. Specifically, the study seeks to investigate the:

1. Influence of motivation on secondary school students' academic achievement in chemistry.
2. Influence of motivation on the academic achievement of male and female secondary school students in chemistry.
3. Influence of self-regulation on secondary school students' academic achievement in chemistry.
4. Influence of self-regulation on the academic achievement of male and female secondary school students in chemistry.

Research questions

The following research questions guided the study.

1. What is the influence of motivation on secondary school students' academic achievement in chemistry?
2. What is the influence of motivation on the academic achievement of male and female secondary school students in chemistry.?
3. What is the influence of self-regulation on secondary school students' academic achievement in chemistry?
4. What is the influence of self-regulation on the academic achievement of male and female secondary school students in chemistry?

Hypotheses

The following hypotheses where guided the study.

1. There is no significant influence of motivation on secondary school students' academic achievement in chemistry.
2. There is no significant influence of motivation on academic achievement of male and female secondary school students in chemistry.
3. There is no significant influence of self-regulation on secondary school students' academic achievement in chemistry.
4. There is no significant influence of self-regulation on academic achievement of male and female secondary school students in chemistry.

Methodology

This study adopted an ex-post facto research design. The study was carried out in Calabar Education Zone, Cross River State, Nigeria. The population of the study was made up of 2,375 (1,075 male and 1,300 female students) Secondary School Two (SS2) chemistry students in Calabar Education Zone. A stratified random sampling technique was used to select a sample of 364 students (174 males and 190 females) for the study. Two research instruments namely, Motivation and Self-regulation Questionnaire (MSQ) adapted from Schutte Self-Report Emotional Intelligence Test (SSEIT) and Chemistry Achievement Test (CAT). The reliability of MSQ using Cronbach's Alpha analysis gave the reliability coefficient of 0.71

while the reliability of CAT determined using Kuder Richardson formula-20 yielded a coefficient of 0.93. The mean and standard deviation were used to answer the research questions while the analysis of variance (ANOVA) was used to test the hypotheses at .05 level of significance.

Result

Research question one: What is the influence of motivation on secondary school students' academic achievement in chemistry?

Table 1: Mean and standard deviation of academic achievement of secondary school students with low, average, and high motivation in chemistry

Motivation	Mean	Standard deviation	N
Low	17.23	7.459	176
Average	18.74	7.444	148
High	20.45	8.255	40

Chemistry students were divided into three levels according to their achievement scores (Low 1: 6-11; Average 2: 12-18; High 3: 19-24). The result presented in Table 1 showed that out of 364 students, 176 students had low motivation, 148 students had average motivation, and 40 students had high motivation. The observed means for students with low, average, and high motivation were 17.23, 18.74, and 20.45 respectively.

Research Question two What is the influence of motivation on the academic achievement of male and female secondary school students in chemistry?

Table 2: Mean and standard deviation of the academic achievement of male and female secondary school students with low, average, and high motivation in chemistry

Motivation	Gender	Mean	Standard deviation	N
Low	Male	17.92	7.914	87
	Female	16.55	6.964	89
Average	Male	18.35	6.955	71
	Female	19.09	7.896	77
High	Male	19.31	7.821	16
	Female	21.21	8.612	24

The result of the descriptive statistics presented in Table 2 showed that out of 364 students,87 males (17.92) and 89 females (16.55) possessed low motivation. 71 males (18.35) and 77 girls (19.09) possessed average motivation. On the other hand, 16 males (19.31) and 24 females (21.21) possessed high motivation.

Research question three: What is the influence of self-regulation on secondary school students' academic achievement in chemistry?

Table 3: Mean and standard deviation of academic achievement of secondary school students with low, average, and high self-regulation in chemistry

Self-regulation	Mean	Standard deviation	N
Low	16.89	7.731	76
Average	17.80	7.776	176
High	19.71	7.022	112

Chemistry students were divided into three levels according to their self-regulation scores (Low 1: 6-11; Average 2: 12-18; High 3: 19-24). The result presented in Table 3 showed that out of 364 students, 76 students had low self-regulation, 176 students had average self-regulation, and 112 students possess high self-regulation. The observed means for students with low, average, and high self-regulation were 16.89, 17.80, and 19.71 respectively. The result indicated that there was an observed mean difference between the achievement scores of students with high and low self-regulation (2.82).

Research question four: What is the influence of self-regulation on the academic achievement of male and female secondary school students in chemistry?

Table 4: Mean and standard deviation of the academic achievement of male and female secondary school students with low, average, and high self-regulation in chemistry

Motivation	Gender	Mean	Standard Deviation	N
Low	Male	17.38	7.829	26
	Female	16.64	7.748	50
Average	Male	17.91	7.840	92
	Female	17.67	7.751	84
High	Male	19.12	6.769	56
	Female	20.29	7.281	56

The result presented in Table 4 specified that out of 364 students, 26 males (17.38) and 50 females (16.64) had low self-regulation. 92 males (17.91) and 84 females (17.67) had average self-regulation. Moreso, 56 males (19.12) and 56 females (20.29) had high self-regulation. The result indicated that students with high self-regulation had the highest mean scores in chemistry (19.71) while those with low self-regulation had the lowest mean scores in chemistry (16.89).

Hypothesis one:

The one-way between-groups analysis displayed in Table 5 indicated that there was a significant influence of motivation on secondary school students' academic achievement in chemistry ($F = 3.617$; $p < .05$). Thus, the null hypothesis was rejected at a.05 significance level.

Table 5: Summary of one-way analysis of variance of the influence of motivation on students' academic achievement in chemistry (n=364)

Sources of Variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	411.619	2	205.810	3.617	.028
Within Groups	20539.532	361	56.896		
Total	20951.151	363			

***P<.05, df (2,361), Critical F = 3.02**

Based on this result, a post HOC test using Fisher's Least Significant Difference (LSD) was used to correct alpha for simple and complex mean comparisons to determine the differences between groups. Table 6 indicated that low motivation was statistically different from high motivation (t =-3.223*). The low motivation was not statistically different from average motivation (t =-1.509*). Also, there was no significant difference between high and average motivation (t =-1.714*).

Table 6: Fisher's Least Significant Difference (LSD) multiple comparison analysis of the influence of motivation on students' academic achievement in chemistry (n = 364)

	(I) motivation	(J) motivation	Mean Difference (t)	Std. Error	Sig.
LSD	6-11	12-18	-1.509	.841	.074
		19-24	-3.223*	1.321	.015
	12-18	6-11	1.509	.841	.074
		19-24	-1.714	1.344	.203
	19-24	6-11	3.223*	1.321	.015
		12-18	1.714	1.344	.203

Hypothesis two:

This was tested using a two-way analysis of variance (ANOVA). Table 7 showed that there was a significant main influence of motivation (F=3.216; p<.05). The analysis also revealed that the influence of gender did not reach statistical significance (F=.183; p>.05). Furthermore, the influence of motivation on secondary school students' academic achievement in chemistry by gender was not significant (F=1.182; p>.05). Therefore, the null hypothesis was retained at a .05 level of significance.

Table 7: Summary of two-way analysis of variance of the influence of motivation on the academic achievement of secondary school male and female students in chemistry (n = 364)

Sources of variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9941.008[a]	5	1988.202	64.647	.000	.474
Intercept	104682.332	1	104682.332	3403.796	.000	.905
Motivation	9826.492	2	4913.246	159.757	.000*	.472
Gender	1.147	1	1.147	.037	.847	.000
Motivation *Gender	36.981	2	18.491	.601	.549	.003
Total	141457.000	364				

*p<0.05, R Squared = .474 (Adjusted R Squared = .467) F(2,358) critical= 3.02

Hypothesis three:

This was tested using a one-way analysis of variance (ANOVA). Table 8 showed that there was a significant influence of self-regulation on secondary school students' academic achievement in chemistry (F=3.621; p<.05). Therefore, the null hypothesis was rejected at a .05 level of significance and the alternate hypothesis was accepted.

Table 8: Summary of one-way analysis of variance of the influence of self-regulation on secondary school students' academic achievement in chemistry(n=364)

Sources of Variation	Sum of Squares	Df	Mean Squares	F	Sig.
Between Groups	412.080	2	206.040	3.621	.028
Within Groups	20539.071	361	56.895		
Total	20951.151	363			

*P<.05, F (2,361), Critical = 3.02

Based on this result, a post HOC test using Fisher's LSD was used to correct alpha for simple and complex mean comparisons to determine the differences between groups.

Table 9: Fisher's Least Significant Difference (LSD) multiple comparison analysis of the influence of self-regulation on students' academic achievement in chemistry (n = 364)

	(I) self-regulation	(J) self-regulation	Mean Df (t)	Std. Error	Sig.
LSD	6-11	12-18	-.901	1.035	.385
		19-24	-2.811*	1.121	.013
	12-18	6-11	.901	1.035	.385
		19-24	-1.910*	.912	.037
	19-24	6-11	2.811*	1.121	.013
		12-18	1.910*	.912	.037

Table 9 indicated that low self-regulation was statistically different from high self-regulation (t =-2.811*). Low self-regulation was not statistically different from average self-regulation (t =-.901*). Also, there was a significant difference between high and average self-regulation (t =-1.910*).

Hypothesis four:

This hypothesis was tested using a two-way ANOVA. Table 10 showed that there was a significant main influence for self-regulation (F=3.313; p<.05). The influence of gender was not statistically significant (F=.004; p>.05). Furthermore, the influence of self-regulation on secondary school students' achievement by gender was not significant (F= .428; p>.05). Therefore, the hypothesis was retained at a .05 level of significance.

Table 10: Summary of two-way analysis of variance of influence of self-regulation on the academic achievement of secondary school male and female students in chemistry (n = 364)

Source of Variation	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	548.735[a]	5	109.747	1.926	.089	.026
Intercept	82103.829	1	82103.829	1440.671	.000	.801
Gender	10.404	1	10.404	.183	.669	.001
Motivation	366.550	2	183.275	3.216	.041	.018
Self-regulation*Gender	134.717	2	67.359	1.182	.308	.007
Total	141457.000	364				

a. R Squared = .026 (Adjusted R Squared = .013) F (2,358), Critical = 3.02

Discussion of findings

The finding of hypothesis one showed that motivation influence students' achievement in chemistry. Students who were highly motivated acquired a higher score in the academic achievement test than those that were lowly motivated. The significant result in this study could be because students with low motivation may lack the ability to set the target for their learning and thus cannot take responsibility to improve their achievement in chemistry. This result agrees with the findings of Ozen (2018) and Okoro et al. (2023) who reported that students who are highly motivated display different attitudes intentionally to achieve certain goals.

The result of hypothesis two was not significant. This is because gender does not interfere with students' biological and psychological traits readiness, and ability to be motivated towards learning. The finding of this work agrees with that of Rodriguez et al. (2020) and Okoro et al. (2023) who accounted for differences between the achievement of male and female students by motivation. In contrast, the findings of this study disagree with the findings of Momanyi et al. (2015), and Naz et al. (2020) who in their separate studies showed that male and female students differ in academic achievement by motivation.

The finding of hypothesis three was significant. The significance of the result could be because self-regulation is connected to an individual's ability to consciously channel his or her efforts toward achieving a set goal. The finding of this study corroborated the views of Olakanmi and Gumbo (2017) who maintained that self-regulation is linked to students' academic success and achievement.

The finding of hypothesis four was not significant because gender role does not factor into students' emotions as both male and female students have equal abilities to self-regulate their emotions. The sex organs of students neither limit female nor male students to direct their best possible potentials to study chemistry concepts effectively. The finding contrasts with Olasehinde and Olatoye, (2014) who reported that self-regulation has no influence students' academic achievement by gender. In contrast, Gestsdottir et al. (2014) stated that female students outperform their male counterparts in relation to academic achievement.

Recommendation

1. There is need for teachers to adequately motivate and promote self-discipline, self-determination, and goal-oriented behaviour among students to enhance their academic achievement in chemistry.
2. Teachers should be fair in giving rewards and tasks to male and female students as they are not so different in terms of learning and achievement.

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