



## Interaction Effect of Motivational Strategies (Intrinsic and Extrinsic) and Gender on Students' Achievement and Retention in Chemistry in Ogidi Education Zone of Anambra State

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### ABSTRACT

This study examined the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on students' achievement and retention in Chemistry in Ogidi education zone of Anambra state. It was quasi-experimental, non-randomized control group design. The study was guided by two research questions and two null hypotheses. The population of the study consisted of 2,154 (1,141 females and 1,013 males) Senior Secondary (SS) 1 Chemistry students in 26 state owned co-educational secondary school in Ogidi Education Zone of Anambra State. Simple random sampling technique (balloting without replacement) was used to select two out of the three local government areas in Ogidi Education Zone. The sample of the study consists of one hundred and fifty eight (158) (76 males and 82 females) Chemistry students. A Simple random sampling technique (balloting without replacement) was used also to select 4 schools while a flip of a coin was used to assign two of the schools to intrinsic group and the other two to the extrinsic group. Chemistry Achievement Test (CAT) developed by the researcher was used as the instrument for data collection. The instrument was duly validated by three experts and the reliability index of .81 was obtained using Pearson Product-Moment Correlation Coefficient (PPMCC). Mean and Standard Deviation was used to answer the research questions while ANCOVA was used to test the null hypotheses at .05 level of significance. The findings of the study showed that there was an interaction effect between motivational strategies and gender on students' achievement in Chemistry. Based on the findings also, there was no interaction effect between motivational strategies and gender on students' retention in Chemistry. It was recommended that secondary school Chemistry teachers should be encouraged to adopt motivational strategies in the teaching of Chemistry. Based on the findings also, conclusion and recommendations were made.

**Keywords:** *Intrinsic and Extrinsic Motivation, Achievement, Retention, Chemistry and Gender*

### INTRODUCTION

Science education is a branch of education that is concerned with imparting to people the knowledge and methods of science. Hornby (2018) defined science as the knowledge about natural and physical world based on the facts that can be proved. Science is a methodical endeavour that creates and arranges information in the form of universe-related hypotheses and tested explanations (Hyacinth 2017). Science Education is very important to the development of any nation that is why every nation must take it very serious in all institutions of learning (Okafor, 2017). Many of the developed nations were able to achieve so much in science and technology because of science education. Science education comprises of three major subjects in senior secondary school namely, Biology, Chemistry and Physics but at the course of this research only Chemistry would be of centre concentration. Over the years there has been low enrolment of Science Education course which Chemistry is included in higher institutions (Aina, 2013).

Chemistry is the study of matter and its characteristics, as well as the changes that matter goes through and the energy that causes such changes. The study of matter including its composition, properties and transformations is the main goal of the scientific field of Chemistry. The basis of future disciplines such as engineering, astronomy, space science, and medicine is laid by understanding of Chemistry. Chemistry is a great subject responsible for some activities in the environment. Chemistry is a subject that expands one's understanding on various things like drugs, certain natural laws and medicine. Chemistry is a major subject for people who aspire to study medicine in their strive to become doctors (Orgill, York & MacKellar, 2019). As Chemistry is needed, in the medical field, so also is needed in disciplines related to environment, food, engineering, metallurgy, cosmetics and so on. For instance, drugs, soaps, detergents, oil, margarine, plastic, drinks and more are all products of Chemistry. These products helping us go through life daily wouldn't have been produced and living would have been accompanied with endless unease.

Chemistry therefore is related to agricultural productions which provide food to man. The food nutrients are chemical elements which are studied in Chemistry education. Chemistry education according to Emendu (2014) equip students with good knowledge to produce goods and services to meet human needs in terms of food, health care products and other materials aimed at improving the quality of life. The ability of plants to derive energy

from sunlight, animals and humans in turn derive energy from plants as food, begins and ends with the principles and laws of Chemistry. Every single material thing in the universe is chemical in nature and the ability to understand and manipulate these chemicals is what brings about the modern food and drugs to plastics and computers that make life more convenient. Chemistry education is therefore imperative for the youths who are the future leaders to acquire deep knowledge about the environment, attitudes and values for social life, skills to explore, utilize and transform available resources for agricultural production both for domestic use and for export (Flynn, Orgill, Ho, York, Matlin, Constable & Mahaffy, 2019).

Chemistry played vital roles in the technological development of many countries. Okeke and Nwadinigwe (2015) stressed that the economic strength of any country is predicted on the quality and quantity of chemical industries in that country. Its significance is underscored by the fact that no day passes without a chemical activity taking place in a typical home anywhere in the world. This implies that everybody is doing Chemistry either through direct consumption of its product or being directly involved in the practice of Chemistry. Ibe (2014) attributes that the contributions of Chemistry to the economic development of any nation includes; skill development, development of human resources, increase in employability, productivity and adaptability throughout life and finally it stimulates self-motivation and widens inquisitiveness. Ibe further stated that Chemistry liberates the mind from the vestige of ignorance and superstition and makes man to be willing to accept change. It breaks man conservatism and prepares the mind to accept modern and improved ideas and techniques.

Chemistry is concerned with the utilization of natural substances and the creation of artificial ones. It is an artistic enterprise which offers a lot of occupational opportunities in areas like: manufacturing of goods such as pharmaceutical, foodstuffs, packaging, detergents, pulp and paper, textile, metals etc., sales of goods, analytical and consultancy services, researching, laboratory services, and consumer education (Leong, Mercer, Danczak, Kyne & Thompson, 2021). The acquisition of professional qualification in Chemistry equips an individual with the skills of being self-employed and self-reliant. Functional Chemistry education emphasizes applicability or transferability of the acquired knowledge to the immediate environment. This is stated in National Policy on Education (2013), which includes the acquisition of appropriate skills and development of mental, physical and social abilities and competence to contribute to the development of his society.

A trained-Chemist should be able to utilize the knowledge and skills acquired and become a successful entrepreneur in goods manufacturing, sales, consultancy and laboratory services, etc, once the government is able to provide the enabling environment. Also, a trained Chemist should be able to manufacture some goods and services. Some of these products include; soaps, hair cream, shoe polish, herbicides, gum, sanitizers, after shave lotion, and many more (Tal, Herscovitz & Dori, 2021). Exposure of students to manufacturing of these goods at the secondary school level bring students to standard world activities. Through this exposure, students gain scientific skills, which they will use in future for self-reliance. Chukwunke and Nwachukwu (2015), was of the opinion that, if any science subject is to be taught well, it should be done practically so that students be able to use certain tools, produce some equipment, make and record an accurate observation, as the case may be. As soon as the students acquire the right attitude and skills in science for self-reliance and educational development, then the nation becomes developed.

In Nigeria, students' achievement in Chemistry has not been encouraging in the senior secondary school certificate examinations. There has been a decline in the performance of students in public examinations conducted by the West African examination council (WAEC) and National Examination Council (NECO) in Chemistry across the country over the years (Uchegbu, et al., 2015). Furthermore WAEC Chief Examiners' report (2018) pointed out that Chemistry students have poor knowledge of acids, bases and acid-base reactions and are unable to report results of acid-base titration experiments, unable to make calculations on molar and mass concentration. These topics are fundamental and basic concepts in Chemistry. This is why motivation of secondary school students in Chemistry using motivational strategies is very necessary.

Motivation is a complex part of human psychology and behavior that influences how individuals choose to invest their time, how much energy they exert in any given task, how they think and feel about the task, and how long they persist in the task. Motivation also reflects in students 'choices of learning tasks, the time and effort they devote to them, their persistence on learning tasks, and in coping with the obstacles they encounter in the learning process (Bakar, (2014).

In its most basic sense, motivation is the need or desire to do something, whether social or emotional. Education, just like the rest, requires a lot of motivation. Motivation is of particular interest to educational psychologists because of the crucial role it plays in student learning (Sivrikaya, 2019). However, the specific kind of motivation that is studied in the specialized setting of education differs qualitatively from the more general forms of motivation studied by psychologists in other fields. Motivation in education can have several effects on how students learn and how they behave towards subject matter (Shahzad, Xiu, Khan, Shahbaz, Riaz & Abbas, 2020). It can:

- Direct behavior towards particular goals.
- Lead to increased effort and energy.
- Increase initiation of, and persistence in activities.
- Enhance cognitive processing.
- Determine what consequences are reinforcing.
- Lead to improved performance.

There are two types of motivation; Intrinsic and Extrinsic motivation

Intrinsic motivation refers to the spontaneous tendency “to seek out novelty and challenges, to extend and exercise one’s capacity, to explore, and to learn”. When intrinsically motivated, students engage in an activity because they find it interesting and inherently satisfying (Shahzad, Xiu, Khan, Shahbaz, Riaz & Abbas, 2020). By contrast, when extrinsically motivated, students engage in an activity to obtain some instrumentally separable consequence, such as the attainment of a reward, the avoidance of a punishment, or the achievement of some valued outcome. Early evidence for the distinction between these types of motivation came from experimental studies demonstrating that tangible rewards can undermine intrinsic motivation. That is, contrary to the ideas that intrinsic and extrinsic motivation are additive or synergistically positive, studies show that students exhibit less spontaneous engagement with activities for which they were initially intrinsically motivated after receiving tangible rewards for performing the activities (Fernández-Espínola, Abad Robles, Collado-Mateo, Almagro, Castillo-Viera & Gimenez, 2020).

Intrinsic motivation is understood to be universally characteristic of health and well-being across all human cultures and stages of the life course, understanding the antecedents and consequences of supporting or undermining intrinsic motivation has practical implications in a very wide range of contexts and applied life domains. In particular, this includes educational contexts — formal and informal, from early childhood and throughout our life’s spans. By understanding the factors that impact intrinsic motivation, school administrators, teachers, and parents can promote intrinsic motivation, and consequently better learning outcomes and well-being (Ginsberg & Wlodkowski, 2019). Intrinsic motivation contrasts with extrinsic motivation, which involves engaging in a behavior in order to earn external rewards or avoid punishment. Intrinsic motivation comes from within, while extrinsic motivation arises from external factors. Both extrinsic and intrinsic motivation play a significant role in learning. Experts have argued that education’s traditional emphasis on external rewards (such as grades, report cards, and gold stars) undermines any existing intrinsic motivation that students might have (Al-Mansoori & Koç, 2019). Others have suggested that extrinsic motivators help students feel more competent in the classroom, which in turn enhances their intrinsic motivation.

Because students are not always internally motivated, they sometimes need situated motivation, which is found in environmental conditions that the teacher creates. Intrinsic motivation occurs when students are internally motivated to do something because it either brings them pleasure, they think it is important, or they feel that what they are learning is significant. Students are intrinsically motivated if they love or enjoy what they are doing even if there is no reward or incentive for it. Teachers often encourage intrinsic motivation as it is best for their students in the long run. Some action plans for elevating intrinsic motivation include triggering their interests, keeping up with their curiosity, assisting them in goal setting, and making sure that they are really learning during the process (Ibrahim & Nat, 2019). Extrinsic motivation comes into play when a student is compelled to do something or act a certain way because of factors external to him or her (like money or good grades). Students are extrinsically motivated if they do not enjoy what they do, they will still do so to obtain the rewards or tokens.

Extrinsic motivation may be more effective for some students than it is for others. Certain situations may also be better suited for this form of motivation. For some students, the benefits of external rewards are enough to motivate high-quality continuous work. For others, value-based benefits are more motivating. Extrinsic motivation is best used in circumstances when the reward is used sparingly enough so it does not lose its impact. The value of the reward can decrease if the reward is given too much. Extrinsic motivation can be useful for persuading someone to complete a task (Ibrahim & Nat, 2019). Before assigning a reward-based task, it is important to know if the student doing the task is motivated by the reward being offered. Extrinsic motivators may be a useful tool to help students learn new skills when used in moderation.

Aside from being motivated intrinsically, being motivated extrinsically can also be helpful. However, this should be used only if the students are uninterested in what they need to do or learn. Extrinsic motivation can help in developing intrinsic motivation if the students are not just doing their tasks because of the reward but tend to enjoy and are comfortable in learning these “uninteresting” things. It is a thing of joy to experience the completion of a particular level of education which is considered as an achievement. Martin and Dowson (2019) observed that motivation predicts students’ course engagement; and student engagement predicts their achievement and retention in the course. Therefore it is obvious that motivation encourage hands on learning and also it is vital for students’ high academic achievement in Chemistry. This study aims at determining the interactive effect of intrinsic and extrinsic motivation and gender on students’ achievement in Chemistry.

Academic achievement is defined as a thing done successfully, typically by efforts, courage or skill. It is the process of actualizing something. Hornby (2010) defined achievement as an issue that identified that something is done successfully especially by the use of effort or skill. Hornby also defined achievement in education as an actor process of raising standard of achievement in education which shows success among school teachers and students. Achievement in teaching and learning process means attainment of set objectives of instruction (Okoli & Ebgunonu, 2012). Attah (2014) referred to academic achievement as the scholastic standing of a student at a given moment which states the individual intellectual abilities measured by grades obtained from examinations or continuous assessment (test or quiz). It is also referred to, as person’s learning ability which could be positive or negative performance. Academic achievement is used to measure students’ cognitive, affective and psychomotor domains.

Students’ achievement reflects the extent the students has prepared for the examination. To perform well, one must study hard applying all the rules of learning. Academic achievement refers to how well students deal with their studies and how they cope or accomplish different tasks given to them by their teachers. It is the ability to study and remember facts and being able to communicate your knowledge verbally or down on paper (Siddiqui, Thomas & Soomro, 2020). It is a term used for students based on how well they are doing in their studies and classes. In educational institutions, success is measured by academic achievement, or how well a student meets standards set out by local government and the institution itself. According to Ibrahim and Nat (2019), academic achievement is the ability of the student to study and remember facts and being able to communicate the knowledge verbally or down on paper. Related factors influencing academic achievement provide exposition on student’s adjustment to the learning situation and such factors that directly relate to the achievement of the student as integrated into the individual factor such as motivation and ability variable (Tal, Herscovitz & Dori, 2021). Ozen (2017) and Karagüven (2012) showed a significant relationships between motivation and student achievement in science. They revealed

that the use of motivational strategies did not only increase students' interest in science subject but also resulted in students' high achievement and retention. They demonstrated that the use of motivational strategies to teach makes learning of science interesting, motivating, less boring and enjoyable. Muhammad, Bakar, Mijinyawa & Halabi (2015) revealed from their study that a strong positive relationship exist between motivation and students' academic achievement. Afzal, Ali, Khan & Hamid (2010) found a positive relationship between students' motivation and academic achievement. Intrinsically motivated students performed better academically, and achievement remained consistent while extrinsically motivated students performed well for a short period (to achieve the reward) with inconsistent achievement overall (Afzal et al., 2010).

Retention is the ability to store what has been learnt and recall what has been stored in the memory. Retention is a progress tests, feedback oriented education assessment tool for evaluation of development and sustainability of cognitive knowledge during a learning process (Mayer, 2011). Emeka and Okeke (2020) opined that retention is the ability to recall or recognize what has been learnt or experienced. Retention works hand in hand with achievement. Retention has an area of focus to some science educators in recent years. Adeniyi (2017) described retention as a form of reaction which has been presented in the past. In other words, it is as a result of orientation or attitude which marked an original perception. The author further opined that retention and what is retained depends on the individual frame or references. He further opined that retention can hardly be measured and the problem is how to maximize the level of retention and future recall of what is learnt. According to Ibe (2021), retention is the ability to retain and later remember information or knowledge gained after learning into memory. The nature of the resources to be coded contributes to the level of retention (Ibrahim, 2012). Retention is, therefore, the ability to recall learning experiences after about three weeks of learning and beyond. The use of motivational strategies in teaching and learning Chemistry improves academic achievement and retention. However, poor learning environmental conditions without motivational strategies contributes a lot to forgetfulness which invariably leads to poor achievement as well as retention in Chemistry. Knowledge gained can become worthless if it is not retained so as to be useful in future. This study aims to investigate the interactive effect of intrinsic and extrinsic motivation and gender on students' achievement and retention in Chemistry.

Gender related issues in science education have continued to receive serious attention judging from the number of studies done to that effect. Gender refers to a psychological term, which describes behaviours and attributes expected of individual on the basis of being a male or a female (Peter, Gabrael & Johnson, 2020). Gender refers to a state of being male or female, men or women. Babajide (2010) opined that science subjects, which include Physics, Biology and Chemistry, are given masculine outlook by educational practitioners. In addition, studies by Ogunleye and Babajide (2011) lend credence to the significant of gender on science achievement. Agomuoh (2010) found that gender influences student's conceptual shift in favour of male students. The issue of gender and students' achievement and retention especially in Chemistry has been inconclusive. In most societies, gender role has relegated females to the side-lines, preventing them from participating in and benefiting from educational and development efforts (Ogbuanya & Owodunni, 2015). In recent times, the gender factor has assumed prominence in science education discourse. It has been documented that disparity exists between male and female students' achievement. Therefore, one sees that the issue of gender has not yet been resolved particularly in relation to students' poor achievement and low retention in Chemistry and the extent motivational approach can change the indecisiveness of the problem hence the need for the study. In this study, the researcher is interested in using intrinsic and extrinsic motivation in the learning of Chemistry to find out its effect on achievement and retention among male and female students.

Gender results from cultural learning and socialization in a society which continues throughout one's life. It is a social construct and not biologically determined. Gender refers to the socially, culturally constructed characteristics roles which are ascribed to male and female in any society (Erinsho, 2015). Gender is a concept equivalent to class and race. It has many social constructs in different societies, (Okoro, 2013). Gender is not enforced through law; it is imposed through social institution and self-perception (Chang, 2013). From the explanations above, gender is a social term that relates to males and females in terms of their different roles and responsibilities. Gender appears more often in recent science education research studies. This may be in an attempt to find ways of closing the gap between the participation rates of the two sexes in science education. Influence of gender in teaching and learning cannot be overemphasized. In Mathematics as stated by Datum (2014), female are more verbal than male. However, Onasanya and Ahmed (2011) observed significance difference existing between the cognitive achievement of male and female students in Biology.

Many studies have suggested that gender proved a significant determinant in retention on the use of motivation to teach Chemistry. Eze (2012) is of the opinion that gender issue is a pertinent factor in an educational setting in Nigeria and could be a factor that leads to the poor achievement of learners in Chemistry as a science subject. Trumper (2016) reported that gender difference in senior secondary school students' retention of Chemistry concepts is inevitable. He found that girls retained more towards the learning of Chemistry than the boys. According to Buchi (2019) female students enjoy learning Chemistry more than male students. He opined that girls retain Chemistry more than boys but when it comes to Physics and Mathematics boys retain more. Many studies have suggested that gender proved a significant determinant of achievement on the use of motivational strategies to teach Chemistry and in others, it did not. For instance, Uzezi and Jonah (2017), discovered that the use of motivational strategies in instructional process increases students' achievement, attitude and retention towards Chemistry. This could have been responsible for gender blending in the achievement and retention of students in Chemistry. They, therefore, deduced that the use of motivational strategies in the teaching/learning process enhances higher achievement as well as induces gender parity in Chemistry achievement.

The low participation of female students in science related subjects were attributed to factors such as attitudes of teachers, students and parents to the idea that it is not proper for women to engage in male careers such as engineering, technology, architecture and so on. Ifumuyiwa (2012) reported that 215 candidates sat for further Mathematics in school certificate Examination, 181 males and 34 females, the analysis indicates low participation of females 16% to 84% male but yet the females performed better than their male counterparts at credit levels in the subjects. Barnes (2015) in the study on sex difference on students' retention found that males retained Chemistry more than females. Woldeamanuel (2019) found out that motivational strategies bridged the attendant achievement gap between male and female students in Chemistry.

Boys appear to have a natural positive attitude to technical and science subjects while girls show negative attitude. This negative attitude appears to be due to the acceptance of the myth that boys are better in science subjects than girls. Nwanna (2012) is of the opinion that science and technology is a male dominated subject and females tend to shy away from scientific and technological fields. Mbajorgu (2013) opined that science subjects such as Physics and Chemistry are given masculine outlook by education practitioners. Supporting her, Eze (2012) pointed out that a number of alternative explanations have been proposed for gender inequalities in science and technology. Such explanations among other things include; Biological determinism proposed that inequality in science and technology is sex-linked. It is a biological inheritance. This means that spatial ability is sex-linked in favour of males while verbal expression is sex-linked in favour of females. This claim is debunked by Attah (2014), who is against that statistics on the ground that there is no biological evidence which shows that males have intrinsic superior intellectual abilities over females. Another factor is School-type which is single-sex school type versus co-educational type. It is argued that the type of school female attended directly influence their achievement in science subjects. This argument initially tilted in favour of girls in single-sex schools as being more advantaged in science than females in co-educational schools. Eze (2012) concluded that the issue of single-sex school fostering enrolment and achievement of girls is being challenged, rather exposure of the girls to better learning condition should be considered. Furthermore, the preponderance of many male science teachers make science appear masculine. These influence girls' achievement in sciences.

From the analysis of the factors influencing male and female achievement and retention in sciences including Chemistry which in most cases are inconclusive, proper use of motivation will initiate interactions and build positive drives on students towards Chemistry. Thus the aim of this study is to determine the interactive effect of intrinsic and extrinsic motivation and gender.

### ***Statement of the Problem***

An efficient and effective teacher can lift up the moral of the students using motivational strategy in their process of teaching. Chemistry is terse and abstract in nature as well as activity oriented. It needs motivational strategy that can create the desire to learn them and meet the needs of the students. The use of motivation (intrinsic or extrinsic) may be a solution to the problems of poor achievement and low retention in learning Chemistry. Motivation takes care of the needs of students which could lead to self-actualisation. Motivation enhances the ability to retain learned ideas because it energizes students actively during the learning process.

The use of motivation in the teaching process may bring solution to the gender persistent inconclusiveness in Chemistry. The use of motivational strategy is likely to raise the moral of boys and girls to learn Chemistry and this improves and creates eagerness to learn. Teachers are encouraged to engage in motivational strategy to avoid teaching Chemistry in boredom. Thus, the problem of the study if put into question is: What is the interactive effect of intrinsic and extrinsic motivation and gender in enhancement of students' achievement and retention in Chemistry?

### **Purpose of the Study**

The purpose of the study is to ascertain the interactive effect of intrinsic and extrinsic motivation and gender on secondary school students' achievement and retention in Chemistry in Ogidi Education zone. Specifically, the study seeks to:

- i. Find the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' achievement in Chemistry.
- ii. Find the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry.

### **Research Questions**

The following research questions guided the study:

1. What is the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' achievement in Chemistry?
2. What is the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry?

### **Hypotheses**

The following hypotheses guided the study at .05 level of significance:

1. There is no significant interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' achievement in Chemistry.
2. There is no significant interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry.

## METHOD

The study adopted quasi experimental research design. This is in support of Nworgu (2015) which stated that quasi-experimental design is where random assignment of subjects to experimental or control groups is not possible rather intact classes are used. It is quasi-experimental because treatment groups was used. The population of the study comprised all the 2,154 (1,141 females and 1,013 males) SS 1 Chemistry students in public secondary schools in Ogidi Education Zone of Anambra State. A total of 158 (76 males and 82 females) SS1 Chemistry students were selected by simple random sampling technique. The instrument for data collection was Chemistry Achievement Test (CAT) which consisted of 25 multiple choice items. CAT was divided into two sections; Section A was designed to get bio data of the students and Section B contained the objective questions. CAT was used for achievement and retention tests. The instrument was validated by three experts drawn from department of Chemistry and Education Foundation of Nwafor Orizu College of Education, Nsugbe. Pearson Product Moment Correlation was used to establish the reliability of the instrument with an overall reliability coefficient of .81 which was considered adequate for the study. The experimental procedure was conducted in two phases. The first phase was training of the research assistants who were the regular Chemistry teachers of the sampled students. The second phase involved teaching of the students and administration of the instrument (CAT) by the class teachers. Research assistants were guided by the researcher who organised three days training for them on how to use the lesson plan prepared by the researcher. Research assistants gave both group of student the instrument to serve as their pre-test before teaching. Research assistants used the same lesson plan but different method, taught for 2 weeks after which the instrument was rearranged and served as post-test. After 2 weeks, it was rearranged again which was given to the same groups to serve as the retention test. Data collected were analyzed using mean, standard deviation and ANCOVA. Mean and standard deviation was used to answer research questions while ANCOVA was used to test the null hypothesis at .05 level of significance.

## RESULT

### Research Question 1

What is the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' achievement in Chemistry?

**Table 1: Pre-test and Post-test Comparative Mean and Standard Deviation Scores of the Achievement Scores of Male and Female Students Taught Chemistry Applying Intrinsic Motivational Strategy and those Taught Applying Extrinsic Motivational Strategy.**

Motivational Strategies	Gender	Pre-test			Post-test		
		N	M	SD	M	SD	Adj. M
Intrinsic	Male	39	26.77	15.95	69.44	14.58	69.18
	Female	42	18.19	13.46	74.76	11.43	74.98
Extrinsic	Male	37	22.59	13.86	71.57	12.28	71.54
	Female	40	21.40	11.33	63.65	10.72	63.69
Total	Male	76	24.74	15.02	70.47	13.47	70.36
	Female	82	19.76	12.50	69.34	12.36	69.34

As shown in Table 1, the adjusted mean achievement score for male students taught Chemistry applying extrinsic motivational strategy (Adj.  $M = 71.54$ ) was greater than the adjusted mean achievement score of those taught Chemistry applying intrinsic motivational strategy (Adj.  $M = 69.18$ ). Conversely, female students taught Chemistry applying intrinsic motivational strategy had greater mean achievement (Adj.  $M = 74.98$ ) than those taught Chemistry applying extrinsic motivational strategy (Adj.  $M = 63.69$ ) which suggests that there was an interaction between gender and motivational strategies on students' achievement in Chemistry. This was depicted in Figure 1.

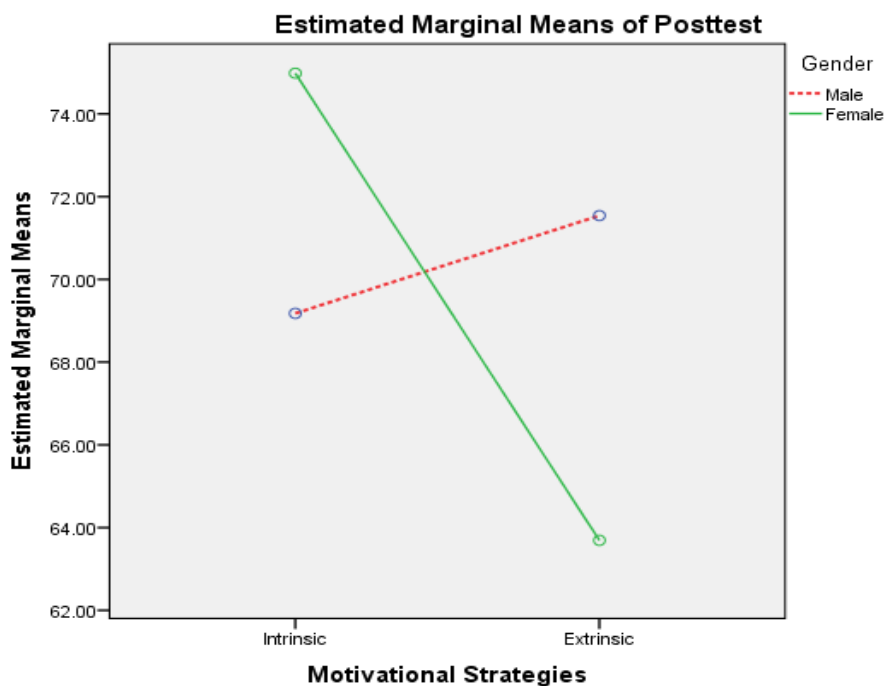


Figure 1: Plot of adjusted mean achievement scores by motivational strategy and gender

#### Research Question 2

What is the interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry?

**Table 2: Comparative Mean and Standard Deviation Scores of the Retention Score for Male and Female Students Taught Chemistry Applying Intrinsic Motivational Strategy and those Taught Applying Extrinsic Motivational Strategy.**

Motivational Strategies	Gender	Retention			
		N	M	SD	Adj. M
Intrinsic	Male	39	62.67	8.91	62.80
	Female	42	63.71	9.65	63.60
Extrinsic	Male	37	55.35	9.07	55.36
	Female	40	58.20	7.79	58.18
Total	Male	76	59.11	9.66	59.08
	Female	82	61.02	9.17	60.89

The adjusted mean retention scores displayed in Table 2 suggest that there was no interaction between motivational strategies and gender on students' retention in Chemistry since mean retention scores for male students taught Chemistry applying intrinsic motivational strategy (*Adj. M* = 62.80) and that of the female students (*Adj. M* = 63.60) were greater than the mean retention score of male students (*Adj. M* = 55.36) and that of female students (*Adj. M* = 58.18) taught Chemistry applying extrinsic motivational strategy. This was depicted in figure 2.

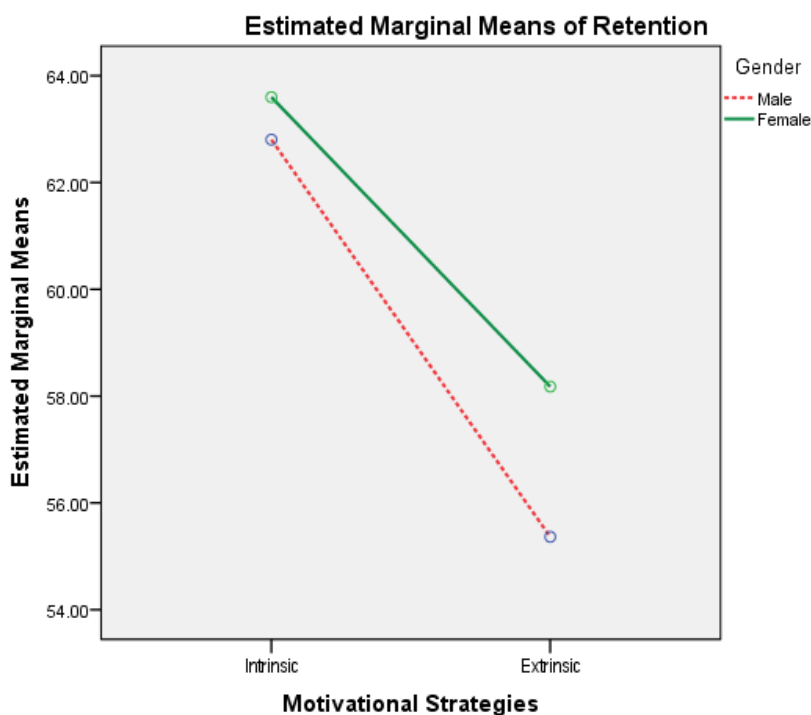


Figure 2: Plot of adjusted mean retention scores by motivational strategy and gender

### Hypothesis Testing

#### Hypothesis 1

There is no significant interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' achievement in Chemistry.

**Table 3: Analysis of Covariance for Students' Post-test Achievement Scores by Instructional Strategies and Gender**

Source	SS	Df	MS	F	P	$\eta^2$
Corrected Model	2756.96 <sup>a</sup>	4	689.24	4.53	.00	.11
Intercept	201360.45	1	201360.45	1324.46	.00	.90
Pretest	90.40	1	90.40	.59	.44	.00
Motivational Strategies	784.95	1	784.95	5.16	.02	.03
Gender	39.96	1	39.96	.26	.61	.00
Motivational Strategies * Gender	1804.22	1	1804.22	11.87	.00	.07
Error	23260.99	153	152.03			
Total	797700.00	158				
Corrected Total	26017.95	157				

a. R Squared = .106 (Adjusted R Squared = .083)

Table 3 displays the results for interaction between motivational strategies and gender on students' achievement in Chemistry. The result shows that there was a significant interaction between motivational strategies and gender on students' achievement in Chemistry,  $F(1,153) = 11.87$ ,  $p = 0.00$ , partial eta square = 0.07. Since the obtained p-value was less than the stipulated .05 level of significance, the null hypothesis was rejected. This implies a small effect.

#### Hypothesis 2



There is no significant interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry.

**Table 4: Analysis of Covariance for Students' Retention Scores by Instructional Strategies and Gender**

Source	SS	Df	MS	F	P	$\eta^2$
Corrected Model	1809.24 <sup>a</sup>	4	452.31	5.70	.00	.13
Intercept	157256.06	1	157256.06	1981.71	.00	.93
Pretest	24.93	1	24.93	.31	.58	.00
Motivational Strategies	1628.66	1	1628.66	20.52	.00	.12
Gender	124.38	1	124.38	1.57	.21	.01
Motivational Strategies * Gender	39.38	1	39.38	.50	.48	.00
Error	12141.14	153	79.35			
Total	584672.00	158				
Corrected Total	13950.38	157				

a. R Squared = .130 (Adjusted R Squared = .107)

ANCOVA results displayed in Table 4 shows that there was no statistically significant interaction between motivational strategies and gender on students' retention in Chemistry,  $F(1,153) = 0.50$ ,  $p = 0.48$ , partial eta square = 0.00. Since the obtained p-value was more than the stipulated .05 level of significance, the null hypothesis was not rejected. Therefore, there is no significant interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry.

### Discussion of Findings

The discussion of findings is organized under the following:

1. There was an interaction effect between motivational strategies and gender on students' achievement in Chemistry.
2. There was no interaction effect between motivational strategies and gender on students' retention in Chemistry.

#### There was an interaction effect between gender and motivational strategies on students' achievement in Chemistry

The findings of the study showed an interaction effect of gender on students' achievement in Chemistry using both intrinsic and extrinsic motivational strategies. This implies that male students improved in their academic achievement when taught Chemistry applying extrinsic motivational strategy and female students improved in their academic achievement when taught Chemistry applying intrinsic motivational strategy, hence an interaction effect was recorded. The findings is line with the findings of Tamunosisi (2015) whose result indicated that there was a significant interaction effect of treatment, achievement and gender on students in science. Baser (2006) also reported significant interaction effect between gender and instructional strategies on students' conceptual change in Physics using cognitive conflict instructional model. This result is in contrary with Ifeakor (2006) who observed that the interaction effect due to teaching method and gender on the students' achievement towards Chemistry was not significant. In this study, a significance interaction effect implies that teaching with extrinsic motivational strategy enhances male students' achievement while teaching with intrinsic motivational strategy enhances female students' achievement.

#### There was no interaction effect between gender and motivational strategies on students' retention in Chemistry

The findings of the study showed no interaction effect of gender on students' retention in Chemistry applying both intrinsic and extrinsic motivational strategy. This implies that both male and female students had better retention when taught applying both intrinsic and extrinsic motivational strategy, hence no interaction effect was recorded. The findings is line with Ibe (2014) and Ugwu (2014) who observed no significant interaction effect between gender and retention. Ajayi and Angura (2017) also revealed that there is no significant interaction effect between strategy and gender on the mean retention scores of students in electrolysis. In this study, no significance interaction effect implies that teaching with motivational strategy be it intrinsic and extrinsic enhances students' retention.

### Conclusion

Motivation is an important concept in psychology whose relevance to teaching and learning is underscored every day in every classroom. Its knowledge is worthwhile for a professional teacher. Based on the findings of this study, the following conclusions were drawn: The result shows that there was a significant interaction between motivational strategies and gender on students' achievement in Chemistry. This implies a small effect.

Secondly, there is no significant interaction effect of motivational strategies (intrinsic and extrinsic) and gender on senior secondary school students' retention in Chemistry. By employing motivational strategies in teaching and learning process, students will be enjoying Chemistry teaching.

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## Recommendations

The following recommendations were made in the light of the findings of the study:

1. Teachers should use motivation to increase positive behavior from students, which results in a conducive learning environment to retain.
2. It is important that teachers should provide as many opportunities as possible for catching children doing good things in the classroom and making positive comments to motivate the behavior exhibited.
3. It is also important to sensitize teachers that adequate use of motivation could serve as a basis for improving students' achievement and retention.
4. Ministry of education (federal and state) should organize seminars and workshops to keep teachers abreast of the applications of motivational strategies for instruction delivery.
5. School administrators should also provide financial support for the acquisition of the educational materials that their teachers can make use of.

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