

# Effect of Students' Prior Knowledge of Instructional Objectives on Their Achievement in Senior Secondary Chemistry

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## Abstract

This study sought to determine the effect of senior secondary school students' prior knowledge of instructional objectives on their achievement in chemistry. Three research questions and three null hypotheses guided the study. The design employed was a pretest posttest experimental design. The population was four thousand six hundred and ninety-three (4393) SS2 students who were offering chemistry in all the secondary schools in Awgu Educational Zone. Chemistry achievement test (CAT) developed by the researcher was used to collect relevant data from a sample of 184 senior sec. students selected from single sex schools in Awgu Educational Zone. The CAT was face and content validated by experts in educational measurement and evaluation and chemistry education. Reliability coefficient of 0.80 was obtained for CAT using Kuder Richardson formula -20. Mean and standard deviation scores were used to test the three null hypotheses at an alpha level of 0.05. the study revealed that students taught with prior knowledge of instructional objectives (experimental group or Wipkojob) achieved better results than students taught without prior knowledge of instructional objective (control group or Wopkojob) and males achieved better than the females. There is no significant interaction of gender and strategy on students' chemistry mean achievement. The researcher therefore recommended that chemistry teachers in Nigeria should present instructional objectives in their lesson plans to their students ahead of instruction.

**Keywords:** Effect, Prior Knowledge, Instructional Objectives, Achievement, Senior Secondary Students.

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## INTRODUCTION

The National Policy on Education [1] specified objectives for teaching and learning chemistry. The general objective is contained in the National core curriculum for senior secondary schools were stated as follows; to facilitate a transition in the use of scientific concepts, principles and techniques acquired in integrated science with chemistry, to provide the students with basic knowledge in chemical concepts and principles through efficient selection of content and sequencing, to show chemistry and its link with industry, everyday life, benefits and hazards, to provide a course which is complete itself for students not proceeding to higher institutions while at the same time provide a reasonably adequate foundation for a post-secondary chemistry course. On the basis of these stated objectives, chemistry curriculum is aimed at satisfying the chemistry requirements of the senior secondary school programme [1].

The number of researchers in education have shown that a number of factors influences students

attainment of objectives of instructions [2-4]. Some of the factors have to do with students, teachers, socio economic status of parents, resources available, teaching methods, teaching strategies, learning process amongst others, one of such factors being studied is teaching strategy. Teaching strategy is any internally or externally mediated cognitive process that facilitates the transformation of information to be learned from short-term memory to long-term memory. Teaching and learning are closely related. Learning depends on the teaching, it is the set of cognitive processes that transform the simulation from the environment into several phase of information processing necessary for acquiring a new capacity. Learning occurs when the stimulus is selected, processed, encoded and retrieved. Ausbel [5] outlined two kinds of learning in his assimilation theory of learning which are; Meaningful learning and rote learning. In meaningful learning, learners consciously and explicitly tie new knowledge to relevant concepts or propositions already possessed [5]. Meaningful learning occurs when a learner can connect new knowledge to preexisting cognitive framework [6], while Rote learning is verbatim

involving externally dictated stimulus response association as stated by Cilibum [7]. Ausubel [8] believed that three conditions must exist for meaningful learning to occur (a) the learner must sense a relationship of the ideas of the concept to be learned (b) the learner must possess specific relevant ideas to which the new materials can be related and (c) the learner must actually intend to relate these new ideas to ideas already possessed (prior knowledge). Driscoll [9] stated that Prior knowledge is the experience and knowledge a person brings to a new learning situation, which greatly influences how the learning material is comprehended. Prior knowledge of instructional objectives presupposes that these objectives should be stored in existing mental models for interpretation and assimilation of new knowledge that learners bring to the learning environment (concepts and principles) added to their cognitive structure. According to Ausubel [8] the possible relation of new ideas to ideas already known is an essential bridge in the process of learning and this bridge or gap should be linked to facilitate achievement. An instruction is a definition of performance a learner must exhibit before he is considered competent on such performance criterion. An instructional objective is a description of intended learning result. Hartly and Dave [10] suggested that the prior knowledge of instructional objective specify to students what is to be learned and how to demonstrate learning.

Novak [11] observed that most students in secondary schools learn most of their chemistry in a nearly rote manner. The abstract nature of chemistry by rote as observed above seems to make the storage, retrieval and utilization of facts in chemistry difficult. A knowledge is retained when it can be recalled when needed [12]. Empirical evidence supports those deep, meaningful kinds of information processing that lead to more permanent retention and retrieval than shallow sensory kinds of information processing. Therefore, if teachers present students with instructional objectives, rehearse them so that they acknowledge these specific objectives prior to instruction should facilitate achievement of concepts and principles.

Gender as a factor in academic attainment has been the concern of educators and researchers for years. Those who researched on the influence of gender on academic attainment had divergent views. For instance, Azuogu [13] and Adigwe [14] stated that the performance of girls in science and mathematics is lower than that of boys. Conversely Ocho [15] reported that female students achieve better than their male counterparts in science. Considering these views enumerated above it will be difficult to draw any meaningful conclusion on the effect of gender on academic achievement of students. The researcher therefore considers it worthwhile to determine the influence of students' prior knowledge of instructional objectives on their achievement and see how they

interact with gender. This is what this study sets out to explore.

### Statement of Problem

For many decades, teachers in Nigerian secondary schools have been writing lesson plans containing instructional objectives to guide themselves in their teaching. Conversely the senior secondary students on their own part are not presented with these teachers' written instructional objectives prior to instruction. The scope, extent, level and specifications of these objectives which should have geared the students to learning if they were presented with these objectives prior to instruction, remain latent and obscured to them as the lesson progresses until the lesson ends and even as evaluation comes up. These objectives when presented to the students should be presented in such way that the students should have at least a fair knowledge of them before instruction begins. This gap may probably be one of the reasons why senior secondary chemistry students are not achieving as expected especially in chemistry concepts and principle which require sequential approach learning. The problem of this study is the lack of empirical data on whether students' prior knowledge of instructional objectives facilitates students' achievement in senior secondary chemistry, or affects their achievement.

### Purpose of the Study

The purpose of this study is to explore the effect of students' prior knowledge of instructional objectives on their achievement in senior secondary chemistry.

This work will specifically

- Determine the mean achievement and standard deviation scores of SS2 chemistry students with and without prior knowledge of instructional objectives (Wipkoio and Wopkoio).
- Determine the mean achievement and standard deviation scores of the male and female students in the experimental (Wipkoio) and control (Wopkoio) groups.
- Determine the interactive effect of gender and strategy on students mean achievements of SS2 chemistry.

## LITERATURE REVIEW

### Cognitive human information process and learning process as factors affecting achievement

Cognitive theory seeks to understand internal processes of human learning; how information as stimuli is received, processed, stored in and received from memory. Most models of information processing can be traced to Atkinson and Schiffrrin [16] who offered a multistore, multistage concept of memory. According to Atkinson and Schiffrrin [17], when information is received by human information processing system, it must undergo a series of

transformations until it can be permanently stored in memory. This process is called information processing [9]. It is also known as Multi-store and Multistage model of information process explains how information is processed by the three basic stages of memory system: (a) sensory memory (b) short-term memory and (c) long-term memory [9]. The whole process is monitored by executive control [18]. The executive control process shows that this information processing system is linear, organized, dynamic and active.

### **Teaching Strategies as Factors Affecting Achievement**

Any internally or externally mediated cognitive process that facilitates the transfer of information to be learned from short-term memory into long-term memory can be defined as a learning strategy [19]. Learning strategies are used to rehearse, organize and elaborate information to make it more meaningful. Some commonly used strategies include: - Advance organizers, underlying, repetition, outlining, categorizing, concept mapping, mental imaging, queuing, forming analogous, inserting questions, paraphrasing, analyzing key points, note taking and providing instructional objectives prior to instruction [20]. All of these strategies are not equally effective in facilitating achievement of different learning objectives. In other words which learning strategy is appropriate depends upon many factors such as learning objectives to be achieved, individual differences of the learners, level of prior knowledge, learning conditions and environments etc. Research in education has shown that a number of factors influence student's attainment of objectives of instruction. Some of the factors have to do with students, teachers, socio-economics status of the parents, resources available for teaching and learning, instructional methods, instructional strategies adopted by the teacher and even more [8, 21, 22, 3, 23-25].

### **Gender as a Factor Affecting Science Achievement**

Sometimes, some of the researchers and psychologists who studied gender and its effect on academic achievement were of the opinion that gender has no overall effect on the academic achievement. Their line of argument is that any difference that exists in academic achievement of males and females cannot be directly linked to sex difference. Pinder [26] state that male and females compete favorably in science subjects. He warned that the view that males perform better than females in science is un-acceptable and has no scientific proof. In complete agreement with this, Obodo [27] stated that there was no significant difference in the mean achievement score of 14 years old students (Males and Females) in quantitative aptitude tests. Some authors opined that the achievement of girls in science and mathematics is lower than that of boys. Azuogu [13], Adigwe [14], Duckworth and Entwistle [28] confirmed that students particularly girls consider physics and chemistry more difficult than biology. The imbalance between the level

of achievement, motivation of boys and that of girls has also been confirmed by Onibokun [29]. Achebe [30] indicated that as a result of social limitations, which include extra burden with domestic chores, girls generally do not perform as well as boys in school especially in the sciences. Macker [31] maintained that males are intrinsically and genetically superior to females in cognitive abilities that determine excellence particularly in the physical sciences. Jenkins [32] stated that in choosing a career, girls are strongly influenced by the need to choose a career which fits in well with marriage.

According to Jenkins [32], girls do not choose physical sciences as frequently as boys do is a fact. Girls generally have lower intrinsic abilities is a hypothesis. Billington [33] reported that girls are clustered in the arts, languages and social sciences and are far less likely to pursue scientific, mathematical and technical subjects. Peter and Peter [34] reported that males showed more remarkable improvement in the development of science process skills than females. Harding and Packer [35] posited that science education is strongly influenced by gender in most but not in all cultures. According to them, where choices exist, girls are found in large numbers in biology, fewer in chemistry and fewest in physics. Ango and Silias [36] collaborated this view when they reported that biology classes are dominated by girls simply because biology is the softest branch of science. Obodo [37] however attributed the apparent differences in the achievement of boys and girls in mathematics to poor attitude of some parents to mathematics. According to him these parents encourage differential activities for their boys and girls. They encouraged to build toy houses and cages. The effect of the parents' attitude according to him will indirectly encourage boys to tackle difficult problems and encourage the girls to shy away from difficult tasks. In accordance with the above, Obodo [38] pointed out that Nigerian females are most of the time negatively socialized towards studying mathematics and sciences because it has been drummed into their heads that the subject is tough indeed and should be left for the boys. Tyler [39] discovered that differences exist between the academic achievement of boys and girls but indicated that these differences are in favor of the girls. According to him, girls are less frequently retarded (below normal expectation) and more frequently accelerated than boys. Jenkins [40] quoted the widely held belief about women who marry and leave their profession to start a family. There are no good opportunities for women in scientific fields. Girls are known to be less confident than boys. Jenkins [32] stated that the widely held beliefs about women scientists are as follows:-

- It is being unwomanly to study science.
- Scientific education is wasted in women who marry and leave their professions to start a family.
- There are not good enough opportunities for women in scientific fields.

- Girls are known to be less confident about their abilities than boys and possible at early stage in school before they realized that attending higher institutions are real possibilities. All these go a long way to affect the achievement of girls in science subjects than boys.

## RESEARCH METHODOLOGY

### Research Design

This study is a quasi-experimental study. In a quasi-experimental study, there is no random assignment of research subjects (Ss).

Intact classes were therefore used for the study. The specific design the researcher used for the study is a pretest – posttest design. The choice of this design is because the researcher was not in a position to assign subjects randomly to treatment conditions. There was Wipkoiob group and Wopkoiob group. The design is represented thus.

$$\frac{M_1 W_1 O_2}{M_2 W_0 O_2}$$

Where,

M<sub>1</sub> = First measurement taken before treatment

M<sub>2</sub> = Second measurement taken after treatment

W<sub>1</sub> = Wipkoiob treatment

W<sub>0</sub> = Wopkoiob treatment

### Area of the Study

The area of study is Awgu Education Zone of Enugu State. Awgu Education Zone is made up of three local government areas, namely, Aninir, Awgu and Oji-River Local Government Areas. The researcher used Awgu Education Zone so as to ensure that all the

students in both the Wipkoiob and Wopkoiob groups share common socio-cultural environment.

### Population of the Study

The population of the study comprises all the 4693 senior secondary class two (SS 2) chemistry students in Awgu Education Zone. This figure was the indicated in the Post Primary School Management Board of the statistical unit (statistical unit, PPSMB of Awgu Education Zone, 1<sup>st</sup> term 2004/2005 session). There are 46 state secondary school in all. 12 all-female schools, 7 all male schools and 27 co-educational schools.

### Sample and Sampling Technique

Single sex secondary schools were purposely sampled from the 46-secondary schools in Awgu Education Zone. Awgu Education Zone has 19 single-sex secondary schools (7 all male secondary schools and 12 all-female secondary schools). Single sex secondary schools were used to avoid gender interactions since gender is a factor in this study. To ensure that all the single sex secondary schools have equal chances of being drawn, balloting was used to draw two schools from each stratum, four schools, two schools (one all male and the other all-female) were assigned to the Wipkoiob group while the remaining two schools were assigned to Wopkoiob group. The assignment of the school to the Wipkoiob or the Wopkoiob treatment conditions was done through one intact SS2 chemistry class which was drawn for the study through simple random sampling technique (ballotin). On the whole the number of subjects sampled for the study was 184 SS2 chemistry students (males = 90, females = 94).

The distribution of subjects in the intact classes for the study is shown in the Table-1.

**Table-1: Distribution of Subject in the various intact classes used for the study**

Group	Name of School	No. of Males	No. of Females	Round Total
WIPKIOIB	Rosary High School Awgu	-	45	45
	Corpus Christ	46	-	46
Subtotals	-	46	45	91
WOPKIOIB	Girls High School Nenwe	-	49	49
	Boys sec. School Agwu	44	-	44
Subtotals	-	44	49	93
<b>Grand total</b>	-	90	94	184

For the Wipkoiob treatment group a total of 91 SS2 chemistry students were used (46 males and 45 females) while for the Wopkoiob treatment group a total of 93 SS 2 chemistry students (44 males and 49 females) were used. Therefore, the sample size for this study is 184.

### Instrument for data collection

The instrument for data collection was Chemistry Achievement Test (CAT) developed by the

researcher. The CAT is a 40-item multiple choice achievement test. The instrument contains four options A – D for each of the 40 items. The CAT was designed to measure chemistry students’ achievement on hydrocarbon and alkanol. The CAT was found to have discriminating power of between 0.50 and 0.66 and difficulty index of between 0.45 and 0.57. the instrument was used for both pretest and posttest.

### Validation of the instrument

The CAT was face and content validated by five experts in measurement and evaluation and chemistry education selected from the faculty of education, Enugu State University of Science and Technology (ESUT), Enugu. Two validators were selected from measurement and evaluation the

remaining three were selected from chemistry education.

The CAT item was based on hydrocarbons and alkanols [1] which were identified and weighted based on period of tasks coverage. The educational objectives were specified at various levels of Bloom's taxonomy (see Table-2).

**Table-2: Test blue print of forty items test content objective**

	Knowledge	Comp.	Application.	Analysis	Synthesis	Evaluation	Total
15% petroleum	1	1	1	1	1	1	6
15% Hydrocarbon	1	1	1	1	1	1	6
15% Alkanes	1	1	1	1	1	1	6
20% Alkenes	2	2	1	1	1	1	8
15% Alkynes	1	1	1	1	1	1	6
20% Alkanol	2	2	1	1	1	1	8
Total	8	8	6	6	6	6	40

### Reliability of the instrument

The reliability of CAT was established through trial – testing the instrument on 40 SS2 chemistry students at College of the Immaculate Conception, Enugu, (CIC). These students were similar to those selected for the study. The researcher employed the Kuder-Richardson formula -20 for computing the reliability coefficient of CAT. this formula was because it is the most appropriate for determining the internal consistency for items scored dichotomously. Dichotomous items are scored one or zero for the presence or absence of characteristic under investigation. The internal consistency index obtained for the CAT is 0.80.

### Experimental procedure

Two levels of treatment conditions were used for this study. These treatment conditions are Wipkoio and Wopkoio. With prior knowledge of institutional objectives (Wipkoio) strategy the teacher made known the instructional objectives to the students before content development.

This strategy has five steps namely:

- Writing down the instructional objectives for students' consumption.
- Discussing the instructional objectives items one after the other.
- Entry behavior of the students
- Content development
- Summarizing of the lesson.

The other treatment is the treatment Wopkoio without prior knowledge of instructional objective strategy. The teacher did not make known to the student the instructional objectives at all. This strategy has three steps namely:

- Putting the entry behavior of students
- Content development
- Summarizing the lesson

Both strategies (Wipkoio and Wopkoio) are expository methods. The Wipkoio is identical to the Wopkoio in terms of content, basic instructional objectives and mode of evaluation. The major difference is the instructional activities. The Wipkoio was used for one treatment group whereas the Wopkoio was used for other treatment group. Before the onset of the experiment subjects in both treatment groups were given the pre-test. After the pretest, the regular chemistry teachers started the experiment in their respective schools adhering strictly to the lesson procedure developed from the strategies during the pre-experimental conference. The experimental was conducted during the normal school periods following the normal timetable of the school. At the end of the experimental which lasted five weeks, the teachers administered the post-test to the SS in two groups. Data collected from the pretest and posttest on the achievement scores were collated separately for the two groups and were used to answer the research questions and test the hypothesis that guided the study.

### Method of Data Collection

The CAT was administered on the students two weeks before the experiments. This measure reduced the Hawthorne effect. Score of the students on the pretest were recorded and kept for use after the experiment. At the end of the experiment posttest (CAT) was rearranged and administered to the classes. For each of the groups, data for the pretest and posttest were recorded separately. The test items were scored one mark each. A student scores a maximum of 40 marks and minimum of zero.

### Method of Data Analysis

Data or research questions one, two, three, and four were analyzed using mean and standard deviation. Analysis of covariance was used to test the three hypotheses that were formulated for this study. ANCOVA was used to correct the error of initial

difference in the ability levels among the research subjects.

**Decision Rule**

Reject the null hypotheses if the calculated value of test statistics f-ratio is equal to or greater than the critical or table value ( $f\text{-cal} \geq f\text{-critical}$ ) at 0.05 level

of significance, and appropriate difference, otherwise accept.

**Data Presentation, Analysis and Results**

**Research Question 1**

What is the mean achievement and standard scores of SS2 Students taught with prior knowledge of instructional objectives (Wipkoio) and those taught without prior knowledge of the objectives (Wopkoio)?

**Table-3: mean achievement, standard deviation and gain score of Students of experimental (Wipkoio) and Control (Wopkoio) groups**

Group	No. of Students	Pretest Mean	Posttest Mean	Gain Mean Score	Pretest SD	Posttest SD	Gain SD
Experimental	90	1.37	26.90	25.53	0.95	9.34	8.39
Control	94	1.31	12.13	10.82	0.90	6.05	5.9

Table-3 indicates that the experimental group obtained mean achievement score of 1.37 and 26.90 respectively in the pretest and posttest. The subject also got standard deviations of 0.95 and 9.34 respectively in the pretest and posttest. On the other hand, control group had mean scores of 1.31 and 12.13 respectively in the pretest and posttest. The standard deviation for the control group in the pretest and posttest were 0.90 and 6.05 respectively. The result presented in the Table-

3 indicates that the experimental group obtained a mean gain score of 25.53 as against the mean gain score of 10.82 by the control group.

**Research Question 2**

What is the mean achievement and standard deviation scores of the male students in the experimental (Wipkoio) and control (Wopkoio) groups?

**Table-4: Mean achievement, Standard deviation and gain scores of male and female students of the experimental (Wipkoio) and control (Wopkoio) groups**

Gender	Group	Pretest Mean	Posttest Mean	Mean gain Score	Pretest SD	Posttest SD	Gain SD	No. of Students
Males	Experimental (WIPKOIOB)	1.56	29.47	27.91	0.93	4.52	3.59	43
	Control (WOPKOIOB)	1.40	14.62	13.21	0.90	3.73	2.83	47

Table-4 indicates that the experimental group males obtained mean achievement scores of 1.56 and 29.47 respectively in the pretest and posttest. The subjects also got standard deviation of 0.93 and 4.52 respectively in the pretest and posttest. On the other hand, the control group males obtained mean scores of 1.40 and 14.62 respectively in the pretest and posttest. The standard deviation for the control group males in

the pretest and posttest were 0.90 and 3.73 respectively and standard deviation of 0.94 and 6.81.

**Research Question 3**

What is the mean achievement and standard deviation scores of the female students in the experimental (Wipkoio) control (Wopkoio) group?

**Table-5: Mean achievement scores and standard deviation of Female students in experimental and control group**

Gender	Group	Pretest Mean	Posttest Mean	Mean gain Score	Pretest SD	Posttest SD	Gain SD	No. of Students
Female	Experimental (WIPKOIOB)	1.29	24.55	32.36	0.94	6.81	5.87	47
	Control (WOPKOIOB)	1.21	9.46	8.43	0.83	4.01	3.18	47

In table-5 the experimental group females obtained 1.29 and 24.55 in pretest and posttest respectively and standard deviations of 0.94 and 6.81 in the pretest and posttest respectively. In the control group females obtained 1.21 and 9.64 in the pretest and posttest respectively. The result showed that males

achieved better than the females in the experimental and control groups.

**Research Question 4**

What is the influence of gender on the mean achievement and standard deviation score of the students of the experimental (Wipkoio) and control (Wopkoio) groups?

**Table-6: Mean achievement scores and standard deviation of males students in experimental and control group**

Group	Mean ( $\bar{x}$ )			Standard Deviation			
	Pretest	Posttest	Mean gain Score	Pretest	Posttest	Gain Score	N
Experimental (WIPKOIOB)	1.56	29.47	27.91	0.93	4.52	3.59	46
Control (WOPKOIOB)	1.40	14.62	13.21	0.90	3.73	2.83	44

Table-6 indicates that in the experimental group males obtained mean scores of 1.56 and 29.47 in the pretest and posttest respectively and standard deviations of 0.93 and 4.52. in the pretest and posttest

respectively. In the control group males obtained mean scores of 1.40 and 14.62 in the pretest and posttest respectively and standard deviations of 0.90 and 3.73 in the pretest and posttest respectively.

**Table-7: Mean achievement scores and standard deviations of female students in experimental (Wipkoiob) and control (Wopkoiob) groups**

Group	Mean ( $\bar{x}$ )			Standard Deviation			
	Pretest	Posttest	Mean gain Score	Pretest	Posttest	Gain Score	N
Experimental (WIPKOIOB)	1.29	24.55	32.36	0.94	6.81	5.87	45
Control (WOPKOIOB)	1.21	9.64	8.43	0.83	4.01	3.18	49

Table-7 indicates that the experimental group females obtained means score of 1.29 and 24.55 in the pretest and posttest respectively and standard deviations of 0.94 and 6.81 in the pretest and posttest respectively. In the control group females obtained mean score of 1.21 and 9.64 in the pretest and posttest respectively and standard deviations of 0.83 and 4.01 in the pretest and posttest respectively

### Test of the Null Hypotheses

The six hypotheses were tested at 0.05 level of significance, using analysis of covariance (ANCOVA).

Summary of the result for the hypotheses is in table-8 below

**Table-8: A 2 x 2 ANCOVA of strategy and gender on students mean achievement scores of the chemistry achievement test**

Source of variation	Sum of squares	d.f	Mean squares	f-cal	f-crit.	Sign	Decision
Covariance	25730.52	1	25730.52	818.85	3.84	0.00	S
Main effect	205.62	1	205.62	6.54	4.39	0.011	S
Gender	1246.58	1	1246.58	39.67	2.21	0.00	S
Strategy	10264.31	1	10264.31	36.67	3.32	0.030	S
Strategy x gender	217	1	217	0.007	1	0.93	S
Error	5624.65	179	31.42	0.007	1	0.93	NS
Total	85905.00	184					

S = Significant, NS = Not significant at 0.05 level of probability

### Null Hypothesis 1

There is no significant difference in the mean achievement of SS2 chemistry students who have prior knowledge of instrument objective (Wipkoiob) and those who do not have prior knowledge of instructional objectives (Wopkoiob).

Table-8 shows that the calculated F-ratio (F-cal) due to strategy is 36.67 while F-critical is 3.32. since the calculated F value is greater than the critical value, the null hypothesis is rejected.

### Null Hypothesis 2

There is no significant difference in the mean achievement scores of the male and female students taught chemistry.

Table-8 shows that the F-cal due to gender is 39.67 while F-critical is 2.21. since the calculate value is greater than the critical value, the null hypothesis is rejected. The researcher concludes that there is a significant difference in the mean achievement of male and female students as measured by chemistry achievement test.

### Null Hypothesis 3

There is no interaction effect of gender and the strategy on students' mean achievement in SS 2 chemistry.

Result presented in table 7 shows that for the two-way interaction, the f-cal is 0.007 while the f-critical is 1. Null hypothesis is not rejected. It is

accepted. The researcher therefore, concluded that there is no significant interaction of gender and strategy on students' mean achievement in chemistry.

## SUMMARY OF RESULTS

Result presented in this chapter revealed the following:-

- Students taught with prior knowledge of instructional objectives (experimental or Wipkoiob) group achieved better than students taught without prior knowledge of instructional objectives (control or Wopkoiob) group.
- Male and female students in the experimental (Wipkoiob) group achieved better than the control (Wopkoiob) group
- Males achieved than females. In the experimental (Wipkoiob) and the control (Wopkoiob) groups.
- There is no significant interactions of strategy and gender on students mean achievement of SS 2 chemistry.

## DISCUSSION OF FINDINGS

The evidence obtained in this study shows that students taught with prior knowledge of instructional objectives experimental group achieved better than the (control group). There is significant difference in the mean achievement of the achievement of the experimental (Wipkoiob) and control (Wopkoiob) groups in favor of the experimental group. The finding is in conformity with the findings of Mkpa [2], Nzewi and Okeke [41] and Olarewaji and Balogun [42]. The researcher views that when students are not provided with instructional objectives of the lesson ahead of instruction, the objectives of the lesson for them become a matter of their seeking and guessing as the instruction progress until evaluation eventually comes up. The fact remains that when these students seek objectives with guesses, they are not geared to learning effectively and consequently achieve poorly. This view may partly explain the reason why secondary school students still achieve poorly in chemistry examinations.

What is the mean achievement and standard deviation score of the male and female students in the experimental (Wipkoiob) and control (Wopkoiob) group?

It was found that males achieved better than females in both the experimental (Wipkoiob) and control (Wopkoiob) groups. Also, there is significant difference in the mean achievement of the males and females in favor of the males. The finding is in agreement with Nzewi [41] and Poplan and Baker [43]. On the other hand, the finding as it affects gender is in disagreement with the finding of Abdullahi [44]. This finding is also in line with the view of Harding and Packer [35] who posited that science education is strongly influenced by gender in most but not all cultures. It is their view that girls are found in large

numbers in biology fewer in chemistry and fewest in physics. However, the present finding is in disagreement with the work of Tyler [39] who discovered that difference exist between the academic performance of male and females but maintained that this difference is in favor of girls and Lavin [45] who reported that academic performance of girls is generally more predicated than that of the boys. In the view of the researcher, boys achieved better than girls in chemistry because the unit of chemistry taught requires some amount of mathematical calculations, which make some girls shy away from chemistry. There is significant difference in the mean achievement and standard deviation of the male experimental (Wipkoiob) and male control (Wopkoiob) groups in favor of the male experimental group. Also, there is a significant difference in the mean achievement and standard deviation of the female experimental (Wipkoiob) and female control (Wopkoiob) groups in favor of the female experimental group. The result is in agreement with the work of Mkpa [2] and Olanrewaju [46] who reported that male and female students provided with instructional objectives ahead of instruction have more focus than those not provided with the objectives. The finding is also in agreement with Nzewi and Okeke [41] who reported that when students are provided with instructional objectives prior to instruction alerts them and gears them to learn and achieve more. The finding is also in agreement with the work of Mager [47] and Mkpa [2] but is disagreement with the work of Abdullahi [44] who found no significant difference in the mean achievement of the male and female students provided with instructional objectives. Some authors opined that the performance of girls in science and mathematics is lower than that of boys [13, 14]; Macker [31] maintained that males are intrinsically and genetically superior of females in cognitive abilities, which determine excellence particularly in the sciences. Lawin [45] also reported that academic performance of girls is generally more predicable than boys.

For about three decades now or more there has been mounting research into the nature and origin of gender difference in ability, achievement [48]. It is possible that the mean achievement of males is higher than the females because girls are often preoccupied with domestic chores at home and they hardly find sufficient time to read their books as most of them are day students.

The result of the analysis test of interaction between revealed that for the two-way interaction, the  $f$ -cal is 0.007 while the  $f$ -critical value is 1. The  $f$ -cal is less than the  $f$ -critical and therefore the null hypothesis is not rejected. The researcher found, that there is no significant interaction effect of gender and strategy on students' chemistry mean achievement. The finding is in line with the work of Mager [47] and Mkpa [2] who found no significant interaction effect of gender and

strategy on achievement which is similar to the findings of this study.

## CONCLUSIONS

From the result obtained in the investigation into the effect of students' prior knowledge of instructional objectives on their achievement in chemistry; the researcher concluded that there is a significant difference in the chemistry mean achievement of senior secondary two (SS 2) students taught with and without prior knowledge of the objectives (Wipkoib and Wopkoib). Gender is a significant factor in chemistry achievement. There is no interaction effect of gender and strategy of secondary students' mean achievement.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made.

- Chemistry teachers should present and discuss their written instructional objectives ahead of instruction to their students.
- The chemistry teachers should bear in mind that their written instruction will guide themselves as well as their students.
- They should harmonize author's written instructional objective with their own written objectives before presenting them to their students.
- Chemistry curriculum planners and developers should emphasize the prior and proper presentation of these instructional objectives during curriculum revision in Nigeria.
- Conferences and workshops should be organized for serving teachers and curriculum developers on the prior and proper presentation of instructional objectives before instructional proper.

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