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The Relationship between Senior Secondary School Students Analytical Skill and Their Achievement in Chemistry In Anambra State

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ABSTRACT:*This study investigated the relationship between analytical skill and achievement of senior secondary school students in chemistry in Anambra state. Three research questions and three null hypotheses guided the study. The descriptive research design was adopted in the study which involved a co-relational study. This study was carried out in Awka Education Zone of Anambra state of Nigeria. The population used for this study consist of all the SS II chemistry students from the 60 government owned secondary schools in Awka zone, but was delimited to only 4 randomly selected secondary schools and the study lasted for six weeks and was centered on the following topics in SS II chemistry scheme of work; periodic table, water and its pollution, solution and solubility, bases and alkali. The sample consisted of 200 SS II students drawn from 4 government owned secondary schools in Awka Education zone of Anambra state of Nigeria. The Modified Enright-Power Analytical Skill Rating Scale (M-EPASRS) and Chemistry Achievement Test (CAT) were the instruments used for data collection. The instruments were validated by two experts, one is a specialist in Chemistry and the other is a specialist in Measurement and Evaluation. The reliability of the CAT was obtained using test-re-test method and the reliability coefficient was found to be 0.78 which was accepted for the study. Data were analyzed using Pearson Product Moment Correlation Coefficient, Mean and Standard Deviation. Findings revealed that there is a significant positive relationship between students' analytical skill possession and their achievement in chemistry ($\gamma = .82$, $p < .01$); students that possess high analytical skill also achieves better in chemistry and vice-versa, and in both, females did better than males . Therefore as analytical skill increases, achievement also increases and vice versa. Based on these finding, it was recommended that Chemistry teachers should incorporate students analytical skill possession into their instructional programms for improved achievement in chemistry. This could be done starting from lesson planning. The teacher should try as much as possible to make the lesson plan be in such that active participation of the students will be encouraged during lesson. That is, the lesson plan should give room for students to contribute their ideas thereby building their analytical skill possession. Indoctrination should be highly discouraged and also the use of only lecture method will not help matters in this situation.*

I. INTRODUCTION

In a developing country like Nigeria a good number of individuals especially the uneducated youths may be attributing their failure to life with the reason that they did not attain their desired aim in terms of certificate acquisition and education generally, As most of them have no personal plans to make a living, there by waiting for Government to give them a job. Whereas even most of the educated once still have the notion that it is their right as citizens of the country for Government to provide them with a white collar job which has led the country to be crowded by unemployed people (especially the youths) which is one of the greatest challenges being faced by Nigeria as a developing nation.Whereas if youths had posses some good skills (like analytical skill) and also developed in the area of creativity mainly in science right from secondary school or even beyond, the issue of unemployment by its citizens would have been a history by now. Because a lot of them would have been employer of labor rather than waiting for Government to employ them notwithstanding their level of education (Uwaleke, 2013). That is why it was stated that acquiring the highest level of education is not the only solution to the problem of survival, but also the ability to create something out of nothing (Olehi, 2005). Olehi, further stated that creating something out of nothing doe not occur as a result of one having only a great intelligence but it is achieved mostly when an individual acquires and possess good analytical skill.Analytical skill according to Harv-Kay (2010), is defined as the basic tool needed in problem solving and problem is said to be solved effectively well when analytical skill is involved.

From Harv-Kays view it means that analytical skill is a problem solving skill. Anih (2003) said that analytical skill centered on creative thinking. Anih, further stated that analytical skill is, a set of skill used to process and generalize information and beliefs and the habit, based on intellectual commitment of using these skills to guide behaviors, which can be constructed with acquisition and retention of information.Analytical skill therefore can be described as that skill needed to solve a complex problem.Sternberg & Scott (2011) defined analytical skill as the ability to visualize, articulate, and solve both complex and complicated problems and concepts, and make decisions that make sense based on available information. Such skills include demonstration of the ability to apply logical thinking to gathering and analyzing information, designing solutions to problems and testing of hypotheses .(Harv-Kay,2010). Based on the points raised by Sternberg (2003), he pointed out that Analytical skill is made up of some basic components which includes critical thinking and argumentation, drawing inferences and developing conclusion; problem definitions and identification; inductive reasoning, generating alternatives to the problems at hand and lot more. The above components of analytical skill are of vital importance in the teaching and learning of science subjects like Chemistry in a developing country like Nigeria especially at the secondary school level. (Jimoh, 2004; Olehi, 2005, Anusiem, 2006). That is why in Nigeria today great emphasis is being placed on industrial and technological development and advancement; as a result, students mainly at the secondary school level are encouraged to learn chemistry to a greater extent (Odesina, 2008).

Inspite of the great importance of chemistry to a developing country like Nigeria, the low achievement in it at Senior School Certificate Examinations (SSCE) and Joint Admission and Matriculation Board (JAMB) has been of a great concern to chemistry teachers and other professional body like Science Teacher Association of Nigeria (STAN) (Njoku, 2004, Onuekwusi, 2011, & Uwaleke, 2013). All the studies carried out on the course of this low achievement in chemistry where all saying that bad teaching method is the major courses of low achievement in chemistry (Offiah & Akusoba, 2009). Other factors raised where factors like poor motivation of students, ill-equipped laboratories; poor student attitude to science and student laziness.Irrespective of the fact that this low achievement in chemistry have been said to be identified, yet achievement of students in chemistry has not improved (Onuekwusi, 2011). Few students who are doing well in chemistry are applying rote learning method just to pass their exams after which they forget what they have learnt (Olehi, 2005). Due to the fact that rote learning does not lead to retention of knowledge, therefore analytical skill possession will have a good role to play because it involves critical thinking, drawing of inferences and developing conclusions, problem definitions and identification, inductive reasoning; it also involves the generation of alternative to immediate problems, and many more.

Studies carried out by (Pisa, 2003; Jimoh, 2007; Fredrick, 2008; and Meece, 2011) have indicated that some relationship exist between analytical skill and students achievement. There studies were all carried out outside Nigeria. Unfortunately, not much attention to the researchers' knowledge has been given to the relationship between analytical skill of senior secondary school students and their academic achievement in Chemistry here in Nigeria and Awka Educationa Zone of Anambra state in particular. Whereas in this competitive global economy, no nation can survive without identifying and developing the skills of its students (Osisioma, 2012, Uwaleke, 2013), and such skill like analytical skill is one, and Nigeria being one of the developing countries of the world is yet to identify and also inculcate into its citizens and students generally such a unique skill especially at secondary school level and Chemistry subject in particular. It is against this background that this study is aimed at finding out the relationship between senior secondary school student analytical skill and their achievement in chemistry in Anambra State of Nigeria.

II. STATEMENT OF THE PROBLEMS

There is persistent low achievement of student in chemistry and there is diverse opinion on the courses of this low achievement over the years. Analysis of students achievement in chemistry at SSCE level as noted by Njoku (2007) revealed that between 2004 and 2006, the annual average pass rate at credit level (grade 1-6) was 15.4% while the failure rate was 61.8%. In a related study carried out by Onwukwe (2011), it was reported that between 2006 and 2010, students of chemistry recorded low achievement rate as high as 97.6%. Although many reasons have been given by various researchers on the causes of this low achievement in chemistry yet there is no improvement till date.Whereas there are some skills these students will possess (lke analytical skill) that will likely help to enhance their achievement. The need therefore arises to find out the relationship between senior secondary school students analytical skill and their achievement in chemistry in Anambra State of Nigeria which is the problem of this present study..

2.1.Purpose Of The Study :
The main purpose of this study is to find out the relationship between senior secondary school students analytical skill and their achievement in chemistry in Anambra State of Nigeria.. The specific objective of the study are:

1. To determine the relationship between analytical skill possession and achievement of SS II students in chemistry.
2. To determine the relationship between analytical skill possession and achievement of male students in chemistry.
3. To determine the relationship between analytical skill possession and achievement of female students in chemistry.
4.

2.2.Scope of the study

This study covered the analytical skill of SS II students from the sixty government owned secondary schools in Awka Education Zone of Anambra state and its relationship to their academic achievement in Chemistry. The study is limited to only the male and female SS II Chemistry students from four randomly selected secondary schools in Awka Education Zone of Anambra state of Nigeria and it lasted for six weeks. The study also centered on the following topics in SS II chemistry scheme of work. Periodic table; water and its pollution; solution and solubility; bases and alkalis.

2.3.Research Questions
The following research questions were raised to guide this study:

1) What is the relationship between analytical skill possession and achievement of SS II students in Chemistry?
2) What is the relationship between analytical skill possession and achievement of male students in chemistry?
3) What is the relationship between analytical skill possession and achievement of female students in chemistry?

2.4.Hypotheses

The following hypotheses were formulated to guide this study. They were all tested at 0.05 levels of significance.

1) There is no significant relationship between analytical skill possession and achievement of SS II students in chemistry
2) There is no significant relationship between analytical skill possession and achievement of male students in chemistry.
3) There is no significant relationship between analytical skill possession and achievement of female students in chemistry

2.5.Design of the Study

The research design used for this study is correlation research design, which seeks to establish what relationship exists between two or more variables (Nworgu, 2006). A correlation research design is used because this study aims at establishing the relationship between senior secondary school students' analytical skill and their academic achievement in chemistry in Awka education zone of Anambra state of Nigeria.

2.6.Sample and Sampling Techniques

The sample of the study consists of 200 SS II chemistry students drawn from 4 out of the 60 government owned secondary school in Awka education zone of Anambra state, by simple random sampling technique. Out of the 4 schools selected for this study, 2 were coeducational, while the other 2 were single sex of male and female only. A total number of 200 SS II chemistry students (100 males and 100 females) formed the sample of the study.

2.7.Instruments for Data Collection

Two instruments were used for this study. The first was The Modified Enright-Powers Analytical Skill Rating Scale (M-EPASRS) it was used to identify and assess the analytical skill level possession of students. The second instrument was tagged Chemistry Achievement Test (CAT). Four lesson plans on each of the topics were prepared by the researcher which he used in teaching the students.

2.8.Validity of the Instruments

The instruments were validated by two experts. One is from the Department of Chemistry Education and the other is from Department of Educational Foundation (Specialist on Measurement and Evaluation). They were requested to assess the two instruments including their items in terms of clarity and relevance to the topic. All corrections were taken into consideration in producing the final copy of the instrument. The reliability of the instrument was established using test re-test method using an equivalent sample of 50 students in SS II chemistry class from two schools in Aguata Education zone which is outside the research area. They were administered with the CAT questionnaire. After two weeks interval, the CAT was readministered to the sample subjects. The reliability coefficient was found to be 0.78 which was ascertained to be reliable for the study.

Data collection started after the researcher had taught all the SS II chemistry students in the four schools using the same scheme of work and the some lesson plan for six weeks. The researcher also did this work with the help of four research assistant who were chemistry teachers from the four schools randomly selected. The researcher trained them a day properly on how to guide; administer and collect the CAT questionnaire. The researcher first rated their analytical skill level on the fifth week; then administered the test on the sixth week. Also the data were analyzed using the mean, standard deviation and Pearson correlation coefficient (r) statistics.

III. RESULTS

The result of this study was presented in line with the research questions and hypotheses.

3.1.Research Question 1

What is the relationship between analytical skill possession and achievement of SS II Students in Chemistry?
Answer to this research question is present in Table 1

Table 1: The Relationship Between Analytical Skill Possession and Achievement of SS II Students in Chemistry.

Variables		Analytical Skill	Chemistry achievement
Analytical skill	Pearson Correlation	1.000	.823**
	Sig. (2-tailed)		.000
	N	200	200
Chemistry Achievement	Pearson Correlation Sig. (2-tailed)	.823**	1.000
		.000	
	N	200	200

The result in Table 1 shows that r coefficient is 0.82 which is high and positive. Therefore the relationship between analytical skill possession and achievement of SS II students in Chemistry is positive in all because there is no negative relationship between analytical skill and achievement of SS II students in Chemistry.

3.2.Research Question 2

What is the relationship between analytical skill possession and achievement of male students in chemistry?

Table 2: The relationship between analytical skill possession and achievement of male students in chemistry.

Variables		Analytical skill	Chemistry achievement
Analytical Skill	Pearson Correlation	1.000	.828**
	Sig. (2-tailed)		.000
	N	100	100
Chemistry Achievement	Pearson Correlation	0.828**	1.000
	Sig. (2-tailed)	0.000	
	N	100	100

The Pearson Correlation in Table 2 shows that r coefficient is 0.83 which is high and positive.

3.3.Research Question 3

What is the relationship between analytical skill possession and achievement of female students in chemistry?

Table 3: Relationship between analytical skill possession and achievement of female students in chemistry

variables		Analytical Skill	Chemistry Achievement
Analytical Skill	Pearson Correlation	1.000	.807**
	Sig. (2-tailed)		.000
	N	100	100
Chemistry Achievement	Pearson Correlation	.807**	1.000
	Sig. (2-tailed)	.000	
	N	100	100

The result in Pearson Correlation in Table 3 shows that r coefficient is 0.81 which is also high and positive.

3.4.Hypothesis 1. (Ho_1)

There is no significant relationship between the analytical skill possession and achievement by SS II Chemistry Students.

Table 4: The correlation between analytical skill possession and achievement of SS II students in chemistry

Variables	N	r	P-value	Remark
Analytical Skill and Achievement in Chemistry	200	.823**	.000	significant

The Pearson correlation coefficient in Table 4 shows P value of 0.00 which is less than 0.05 levels of significant. It also shows that the r coefficient is 0.82 which is very high. Therefore, there is a significant positive relationship between analytical skill possession and achievement in chemistry at P = < 0.01, therefore hypothesis 1 is rejected and the alternative accepted. Which indicates that there is a significant relationship between analytical skill possession and achievement of SS II students in chemistry.

3.5.Hypothesis 2

There is no significant relationship between analytical skill possession and achievement of male students in chemistry.

Table 5: Correlation between analytical skill possession and achievement of male students in chemistry.

Variables	N	r	P-value	Remark
Analytical Skill and Achievement in Chemistry	100	.828xx	.000	significant

The Pearson correlation in Table 5 shows P-value of 0.00 which is less than 0.05 level of significant and also the correlation coefficient is 0.83 which is high, indicating a significant high positive relationship at 0.01 levels of significant. Therefore the null hypothesis 2 is rejected and the alternative accepted.

3.6.Hypothesis 3

There is no significant relationship between analytical skill possession and achievement of female students in chemistry.

Table 6: Correlation between analytical skill possession and achievement of female students in chemistry

Variable	N	r	P-value	Remark
Analytical Skill and Achievement in Chemistry	100	.807xx	.000	significant

The Pearson correlation coefficient in Table 6 shows p-value of 0.00 which is less than 0.05 levels of significance and the correlation coefficient is 0.81 which is high, indicating a significant positive relationship. Therefore the null hypothesis 3 is rejected and alternative accepted.

IV. DISCUSSION OF RESULTS

The result revealed that there was a significant positive relationship between analytical skill possession and achievement of SS II students in chemistry (r = .82, P = < .00).

The r coefficient is .82 which is very high, which indicates that there is a significant positive relationship between analytical skill possession and achievement in chemistry at p = < 0.01. This shows that as analytical skill increases, chemistry achievement also increases and vice-versa. That is why there is a significant positive relationship between analytical skill possession and achievement in chemistry at P = < 0.01. This shows that as analytical skill increases, chemistry achievement skill increases, and vice verser.A number of studies have identified that there is a relationship between analytical skill and academic achievement (Wagner, 2000; Pisa, 2003; Williams, 2003; Jimoh, 2007; Frederick, 2008; Meece, 2011; Sternberg, 2011) .From these studies it was revealed that there is a significant relationship between students analytical skill and academic achievement. Although all these researchers carried out their study outside Nigeria and their study were mainly on mathematics and psychology, it was only Jimoh (2007) that carried out his study on chemistry here in Nigeria but was done at the university level on south west zone of Nigeria. That is the reason why this present study was done on chemistry at secondary school level but now in South East part of Nigeria to justify the finding of these studies. Some of them came out with the findings that show that students who possess high analytical skill also had good achievement. But in terms of gender, Pisa (2003) found out that girls are better than boys in both their analytical skill and their academic achievement.

Therefore the findings of previous studies are in agreement with the result of this present study in the aspect of relationship being significant.

V. CONCLUSION

Possession of analytical skill can be taken as one of the factors that possibly play a significant role on the achievement of students more especially in the area of chemistry. The relationship is high and significant. Though females tend to do better than their males. This could be the major reason for the persistent low achievement in chemistry found amongst secondary school student in Nigeria and Awka Education Zone of Anambra State in particular. Therefore, secondary school chemistry teachers should put into consideration the analytical skill possession of their students in their instructional strategies and also in academic planning generally and also enlighten and counsel their students on the future benefits and need attached to analytical skill possession and achievement generally. These could be done starting from lesson planning. The teacher should try as much as possible to make the lesson plan be in such that active participation of the students will be encouraged during lesson. That is, the lesson plan should give opportunity for students to contribute their ideas thereby building their analytical skill possession. Indoctrination should be highly discouraged and also the use of only lecture method will not help matters in this condition.

VI. RECOMMENDATIONS

The following recommendations were made among others;

1. The Education Policy Makers, Professional bodies like STAN and Curriculum Organization of Nigeria (CON) should introduce and implement in the Education Curriculum for Secondary School, programmes that will incorporate the concept of analytical skill in all the science subjects and chemistry in particular and also in education programme planning generally.
2. Teachers, Educational Sectors of the Federal Government of Nigeria and Awka Education zone in particular should enlighten and also create an awareness programme that will educate chemistry students on the importance of analytical skill possession which may likely predict achievement and improve their competence in chemistry.

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Appendix A

MODIFIED ANALYTICAL SKILL RATING SCALE FOR SS II CHEMISTRY STUDENTS' ON THE RELATIONSHIP BETWEEN SENIOR SECONDARY SCHOOL STUDENTS' ANALYTICAL SKILL AND THEIR ACHIEVEMENT IN CHEMISTRY

Please read the instructions carefully before completing this forms

The attached rating scales is intended for research purposes only, and have been designed to help you provide further information about the analytical skill of each of your students. The scales were prepared base on the information obtained in a nationwide survey of both graduate, undergraduate, secondary school and primary school teacher, which identified several dimensions of analytical skills thought to be especially important for success among students.Six analytical skill components were described; one component is in each form separately. Name and sex of the students to be rated are listed on the left. Please when making your rating, think of each student in terms of the description provided on each page, and write the number that describes each student. Please maintain the same serial number for each of the student. Some students will undoubtedly be more difficult to rate than others, but please attempt to rate each student as much as you have known him/her as your student. Write from the day you start teaching them. The symbols and ratings used are;

Significantly Less Able SGLA=1

Slightly Less Able SLLA=2

Slightly More Able SLMA=3

Significantly More Able SGMA=4

As you proceed through the different ratings, think of each student only in terms of the particular component being rated. Please do not refer back to previous ratings, but instead make each rating as independent as possible from the previous ones. The researcher has tried to design the forms so that one will be less likely to be influenced by previous ratings.Please make your ratings in reference to only the students you have randomly selected for the study, not just in terms of the student who are currently new in the class but these students must be randomly selected from those who are members of the class and that have been attending lessons all through, till the time of the rating proper. As you think about students you are encouraged to remember both positive and negative instances of skill generally. One major strategy you might wish to use is to read the list of the students who you will rate, and to become generally familiar with each component. Then, put the scales aside for a period of four weeks, during which you may observe examples of behaviors that exemplify the component of

analytical skill to be rated.After the ratings have been done completely it will be treated confidentially, and result will be reported only in terms of relationship among tests scores, grades and ratings. No individual student, teacher or school will be identified, and all identifying information will be deleted from files when data matching is complete. Your cooperation and effort is highly appreciated in completing these forms.

Thank you.

Uwaleke Chidebe Chijioke (The Researcher).

ANALYTICAL SKILL RATING SCALE

Rating Scale A

Date: ..... School:

CRITICAL THINKING: ARGUMENTATION

Description: Ability to understand, analyze, and evaluate arguments

Name of Rater:

S/No	Name of Student	Sex	Write the number from the scale that best describes each student
1.	_____	____	( )
2.	_____	____	( )
3.	_____	____	( )
4.	_____	____	( )
5.	_____	____	( )
6.	_____	____	( )
7.	_____	____	( )
8.	_____	____	( )
9.	_____	____	( )
10.	_____	____	( )
11.	_____	____	( )
12.	_____	____	( )
13.	_____	____	( )
14.	_____	____	( )
15.	_____	____	( )
16.	_____	____	( )
17.	_____	____	( )
18.	_____	____	( )
19.	_____	____	( )
20.	_____	____	( )
21.	_____	____	( )
22.	_____	____	( )
23.	_____	____	( )

Generally, a student possessing this trait:

- Tend to know what kind of evidence will support or refute a hypothesis
- Can typically recognise the central argument or thesis in a work
- Can usually identify both stated and unstated assumptions in an argument
- Is likely to recognize fallacies and logical

SCALE

Compare with other students I have known, this student is:

1. = Significantly Less AbleSGLA
2. = Slightly Less Able SLLA
3. = Slightly More Able SLMA
4. = Significantly More Able SGMA

24. _____ ____ ( )
25. _____ ____ ( )
26. _____ ____ ( )
27. _____ ____ ( )
28. _____ ____ ( )
29. _____ ____ ( )
30. _____ ____ ( )
31. _____ ____ ( )
32. _____ ____ ( )
33. _____ ____ ( )
34. _____ ____ ( )
35. _____ ____ ( )
36. _____ ____ ( )
37. _____ ____ ( )
38. _____ ____ ( )
39. _____ ____ ( )
40. _____ ____ ( )
41. _____ ____ ( )
42. _____ ____ ( )
43. _____ ____ ( )
44. _____ ____ ( )
45. _____ ____ ( )
46. _____ ____ ( )
47. _____ ____ ( )
48. _____ ____ ( )
49. _____ ____ ( )
50. _____ ____ ( )

Rating Scale B

Date: ..... School: .....

CRITICAL THINKING: DRAWING INFERENCES AND DEVELOPING CONCLUSIONS

Description: Ability to construct sound inference and conclusions

Name of Rater:.....

S/No Name of Student Sex Write the number from the scale that best describes each student

1. _____ ____ ( )
2. _____ ____ ( )
3. _____ ____ ( )
4. _____ ____ ( )
5. _____ ____ ( )
6. _____ ____ ( )
7. _____ ____ ( )
8. _____ ____ ( )
9. _____ ____ ( )
10. _____ ____ ( )
11. _____ ____ ( )
12. _____ ____ ( )
13. _____ ____ ( )
14. _____ ____ ( )
15. _____ ____ ( )
16. _____ ____ ( )
17. _____ ____ ( )
18. _____ ____ ( )
19. _____ ____ ( )
20. _____ ____ ( )
21. _____ ____ ( )
22. _____ ____ ( )
23. _____ ____ ( )
24. _____ ____ ( )

Generally, a student possessing this trait:

- Is able to generate valid explanations to account for observation
- Usually draws sound inference from observation
- Can typically determine whether conclusions are logically constant with, and adequately supported, by the data
- Is likely to qualify conclusions as appropriate and to recognize ways in which they could be

SCALE

Compare with other students I have known, this student is:	
1. = Significantly Less Able	SGLA
2. = Slightly Less Able	SLLA
3. = Slightly More Able	SLMA

25. _____ ____ ( )
26. _____ ____ ( )
27. _____ ____ ( )
28. _____ ____ ( )
29. _____ ____ ( )
30. _____ ____ ( )
31. _____ ____ ( )
32. _____ ____ ( )
33. _____ ____ ( )
34. _____ ____ ( )
35. _____ ____ ( )
36. _____ ____ ( )
37. _____ ____ ( )
38. _____ ____ ( )
39. _____ ____ ( )
40. _____ ____ ( )
41. _____ ____ ( )
42. _____ ____ ( )
43. _____ ____ ( )
44. _____ ____ ( )
45. _____ ____ ( )
46. _____ ____ ( )
47. _____ ____ ( )
48. _____ ____ ( )
49. _____ ____ ( )
50. _____ ____ ( )

Rating Scale C

Date: ..... School:

DEFINING PROBLEMS

Description: Ability to define and set up problems

Name of Rater:

S/No	Name of Student	Sex	Write the number from the scale that best describes each student
1.	_____	____	( )
2.	_____	____	( )
3.	_____	____	( )
4.	_____	____	( )
5.	_____	____	( )
6.	_____	____	( )
7.	_____	____	( )
8.	_____	____	( )
9.	_____	____	( )
10.	_____	____	( )
11.	_____	____	( )
12.	_____	____	( )
13.	_____	____	( )
14.	_____	____	( )
15.	_____	____	( )
16.	_____	____	( )
17.	_____	____	( )
18.	_____	____	( )
19.	_____	____	( )
20.	_____	____	( )
21.	_____	____	( )
22.	_____	____	( )
23.	_____	____	( )
24.	_____	____	( )
25.	_____	____	( )
26.	_____	____	( )
27.	_____	____	( )
28.	_____	____	( )
29.	_____	____	( )
30.	_____	____	( )
31.	_____	____	( )
32.	_____	____	( )
33.	_____	____	( )
34.	_____	____	( )
35.	_____	____	( )
36.	_____	____	( )
37.	_____	____	( )
38.	_____	____	( )
39.	_____	____	( )
40.	_____	____	( )
41.	_____	____	( )
42.	_____	____	( )
43.	_____	____	( )
44.	_____	____	( )
45.	_____	____	( )
46.	_____	____	( )
47.	_____	____	( )
48.	_____	____	( )
49.	_____	____	( )
50.	_____	____	( )

Generally, a student possessing this trait:

- Can usually break down complex problems into simpler ones
- Can typically identify most of the variables or factors involved in a problem
- Can, when appropriate, set up a formal model for a problem under consideration
- Is usually able to translate graphs or other

SCALE

Compare with other students I have known, this student is:

1. = Significantly Less Able SGLA
2. = Slightly Less Able SLLA
3. = Slightly More Able SLMA

Rating Scale D

Date: ..... School:

INDUCTIVE REASONING

Description: Ability to reason from specific instances to more general principles

Name of Rater:

S/No	Name of Student	Sex	Write the number from the scale that best describes each student
1.	_____	____	( )
2.	_____	____	( )
3.	_____	____	( )
4.	_____	____	( )
5.	_____	____	( )
6.	_____	____	( )
7.	_____	____	( )
8.	_____	____	( )
9.	_____	____	( )
10.	_____	____	( )
11.	_____	____	( )
12.	_____	____	( )
13.	_____	____	( )
14.	_____	____	( )
15.	_____	____	( )
16.	_____	____	( )
17.	_____	____	( )
18.	_____	____	( )
19.	_____	____	( )
20.	_____	____	( )
21.	_____	____	( )
22.	_____	____	( )
23.	_____	____	( )
24.	_____	____	( )

Generally, a student possessing this trait:

- Shows ability to derive general or abstract principles from disparate facts or cases
- Can often solve problems in situations in which all the necessary information is not known
- Typically is able to recognize structural similarities between one type of problem, theory, or idea and another
- Is capable of synthesizing two different positions

SCALE

Compare with other students I have known, this student is:

1. = Significantly Less Able SGLA
2. = Slightly Less Able SLLA
3. = Slightly More Able SLMA

25. _____ ____ ( )
26. _____ ____ ( )
27. _____ ____ ( )
28. _____ ____ ( )
29. _____ ____ ( )
30. _____ ____ ( )
31. _____ ____ ( )
32. _____ ____ ( )
33. _____ ____ ( )
34. _____ ____ ( )
35. _____ ____ ( )
36. _____ ____ ( )
37. _____ ____ ( )
38. _____ ____ ( )
39. _____ ____ ( )
40. _____ ____ ( )
41. _____ ____ ( )
42. _____ ____ ( )
43. _____ ____ ( )
44. _____ ____ ( )
45. _____ ____ ( )
46. _____ ____ ( )
47. _____ ____ ( )
48. _____ ____ ( )
49. _____ ____ ( )
50. _____ ____ ( )

Rating Scale E

Date: ..... School:

GENERATING ALTERNATIVES

Description: Ability to generate alternative explanations or hypotheses

Name of Rater:

S/No	Name of Student	Sex	Write the number from the scale that best describes each student
1.	_____	____	( )
2.	_____	____	( )
3.	_____	____	( )
4.	_____	____	( )
5.	_____	____	( )
6.	_____	____	( )
7.	_____	____	( )
8.	_____	____	( )
9.	_____	____	( )
10.	_____	____	( )
11.	_____	____	( )
12.	_____	____	( )
13.	_____	____	( )
14.	_____	____	( )
15.	_____	____	( )
16.	_____	____	( )
17.	_____	____	( )
18.	_____	____	( )
19.	_____	____	( )
20.	_____	____	( )
21.	_____	____	( )
22.	_____	____	( )
23.	_____	____	( )
24.	_____	____	( )

Generally, a student possessing this trait:

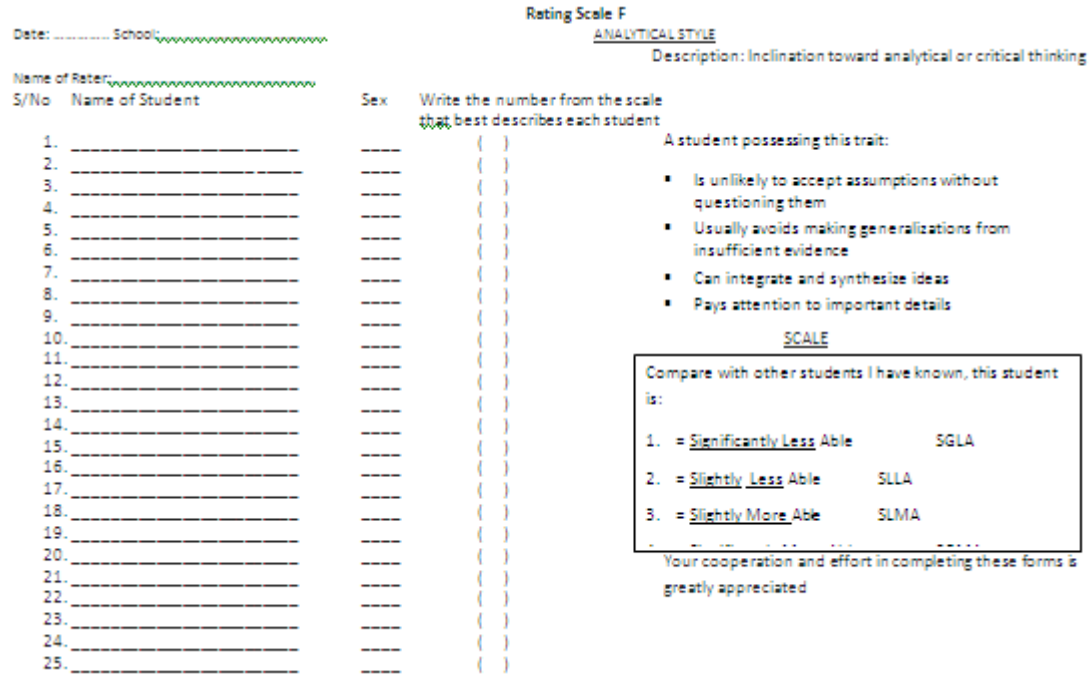
- Can find alternative explanations for observations
- Is able to generate alternative hypotheses
- Is inclined to search for counterexamples to test the validity of an argument or explanation
- Can often generate new questions or experiments to extend or support an

SCALE

Compare with other students I have known, this student is:

1. = Significantly Less Able SGLA
2. = Slightly Less Able SLLA
3. = Slightly More Able SLMA

25. _____ ____ ( )
26. _____ ____ ( )
27. _____ ____ ( )
28. _____ ____ ( )
29. _____ ____ ( )
30. _____ ____ ( )
31. _____ ____ ( )
32. _____ ____ ( )
33. _____ ____ ( )
34. _____ ____ ( )
35. _____ ____ ( )
36. _____ ____ ( )
37. _____ ____ ( )
38. _____ ____ ( )
39. _____ ____ ( )
40. _____ ____ ( )
41. _____ ____ ( )
42. _____ ____ ( )
43. _____ ____ ( )
44. _____ ____ ( )
45. _____ ____ ( )
46. _____ ____ ( )
47. _____ ____ ( )
48. _____ ____ ( )
49. _____ ____ ( )
50. _____ ____ ( )



Rating Scale F

ANALYTICAL STYLE

Description: Inclination toward analytical or critical thinking

Date: ..... School:

Name of Rater:

S/No	Name of Student	Sex	Write the number from the scale that best describes each student
1.	_____	____	( )
2.	_____	____	( )
3.	_____	____	( )
4.	_____	____	( )
5.	_____	____	( )
6.	_____	____	( )
7.	_____	____	( )
8.	_____	____	( )
9.	_____	____	( )
10.	_____	____	( )
11.	_____	____	( )
12.	_____	____	( )
13.	_____	____	( )
14.	_____	____	( )
15.	_____	____	( )
16.	_____	____	( )
17.	_____	____	( )
18.	_____	____	( )
19.	_____	____	( )
20.	_____	____	( )
21.	_____	____	( )
22.	_____	____	( )
23.	_____	____	( )
24.	_____	____	( )
25.	_____	____	( )
26.	_____	____	( )
27.	_____	____	( )
28.	_____	____	( )
29.	_____	____	( )
30.	_____	____	( )
31.	_____	____	( )
32.	_____	____	( )
33.	_____	____	( )
34.	_____	____	( )
35.	_____	____	( )
36.	_____	____	( )
37.	_____	____	( )
38.	_____	____	( )
39.	_____	____	( )
40.	_____	____	( )
41.	_____	____	( )
42.	_____	____	( )
43.	_____	____	( )
44.	_____	____	( )
45.	_____	____	( )
46.	_____	____	( )
47.	_____	____	( )
48.	_____	____	( )
49.	_____	____	( )
50.	_____	____	( )

A student possessing this trait:

- Is unlikely to accept assumptions without questioning them
- Usually avoids making generalizations from insufficient evidence
- Can integrate and synthesize ideas
- Pays attention to important details

SCALE

Compare with other students I have known, this student is:

1. = Significantly Less Able SGLA
2. = Slightly Less Able SLLA
3. = Slightly More Able SLMA

Your cooperation and effort in completing these forms is greatly appreciated

APPENDIX B
CHEMISTRY ACHIEVEMENT TEST (CAT)

CAT consists of questions from topics in SS II chemistry scheme of work, such as periodic table, water and its pollution, solution and solubility and bases/Alkalis.

INSTRUCTION: Answer all questions from one to twenty. There are four options in each of the questions, i.e. A, B, C and D. please tick √ for each correct answer. All question carries equal mark.

TIME: 1 hour

Please fill the following before answering the main question

Name of your School" ……..

Name of the student: ……..

Sex: Male [ ] Female [ ]

Type of school: Boys only [ ] Girls only [ ] boys and Girls (mixed) [ ]

Questions:

[1] What is a periodic table?

A. It is a table that shows the names of chemicals
B. It is a table of the chemical elements arranged in order of atomic numbers
C. It is a chart showing the chemicals that are reactive
D. It is a table that is used in chemistry to draw the structures of atoms easily

[2] How many groups does the periodic table have?
A. 4 groups
B. 2 groups
C. 8 groups
D. 6 groups

[3] What is the first element in group Seven of the periodic table?
A. Chlorine
B. Bromine
C. Fluorine
D. Iodine

[4] What other name is the group seven elements called?
A. Inert gases
B. Noble gases
C. Halogens
D. Strong elements

[5] What did the periodic law say?
A. It says that equal volume of all gases at the same temperature and pressure contains the same number of molecule
B. It says that, the physical and chemical properties of the element are periodic function of the atomic number
C. It says that all elements are made up of small indivisible particles called atoms
D. It says that the pressure of a fixed mass of gas is inversely proportional to the volume provided the temperature remains constant.

[6] What is Water?
A. Water is a liquid that boils at 90^0C
B. Water is a colorless liquid found as the most abundant of all the elements, it is colorless and boils at 100^0C and freezes at 0^0C
C. Water is a heavy liquid used by man
D. Water is a colored, odorless liquid, which boils at 100^0C and freezes at 100^0C also

[7] which of the following is a type of natural water?
A. Colored water
B. Spring water
C. Soluble water
D. Colorless water

[8] which of the following is a type of hardness that exist in water?
A. strong and weak hardness
B. light and heavy hardness
C. strong and permanent hardness
D. Temporary and permanent hardness

[9] What is water pollution?
A. This is the introduction of unwanted materials or substance into the water
B. It is the increase in the quantity of water in the river
C. This is the removal of an unwanted materials or substance into water
D. This is the addition of some important material into the water to make it pure

[10] One of the following is the most appropriate means of controlling water pollution
A. Chemical waste must be converted to harmless biodegradable substances before being dumped into the sea or river
B. Chemical should be deposited into the rivers and seas to make our surrounding to be neat
C. Refuse and wastes should be burnt before purring it into the water
D. No living thing should come closer to our rivers and seas.

[11] What is a solution?
A. It is the process by which two or more liquids did not mix together.
B. It is the complete mixture of the solute and the solvent
C. It is the process by which a metal mix with a liquid.
D. It is the mixture of a solute and a solute

[12] All the following is not true about a dilute Solution except____
A. It is a type of solution that contains both acid and base
B. It is a solution that contains a high concentration of the solute
C. It is a solution that is pure in nature
D. It is a solution that contains a relative low concentration of solute

[13] What do you understand by some thing being soluble?
A. When something (a substance or solid) is unable to dissolve, especially in water.
B. When something (a substance or solid) is able to dissolve, especially in water
C. When something (a substance or solid) is able to dissolve on it own without the addition of any other thing
D. What a solid is able to melt completely.

[14] A solid is said to be in suspension in a liquid when _____?
A. The solid is completely removed out of the liquid
B. When the solid dissolves completely in the liquid
C. When small particles of the solid are contained in the liquid
D. When the solid is on its own without any form of liquid on it.

[15] Which of the following is a type of solution?
A. Aqueous and chemical solution
B. Aqueous and water solution
C. Aqueous and Aqueous solution
D. Water and aqueous solution

[16] What is a base?
A. A base is substance that does not dissolve in an acid
B. A base is a substance that dissolve in salt only
C. A base is a substance that neutralizes an acid to form or produce more acid
D. A base is a substance that neutralizes an acid to form salt and water only.

[17] Which of the following is a type of Base or Alkali
A. Strong and weak alkali
B. Strong and strong Alkali
C. Heavy and weak alkali
D. Weak and weak alkali

[18] Identify the one that is correct as regards to the physical property of a base or alkali
A. Alkali have sweet taste
B. Alkali turns red litmus paper to blue
C. Alkalis are not corrosive in nature
D. Alkalis are black in color and sometimes colorless

[19] Which of the following is an example of a base?
A. Teraoxosulphate (vi) (H_2SO_4)
B. Sodium hydroxide (NaOH)
C. Hydrochloric acid (HCl)
D. Sodium chloride (Nacl)

[20] An Alkali is a basic hydroxide which is soluble in ____
A. Petroleum
B. Salt
C. Water
D. Acid

APPENDIX F
MARKING SCHEME FOR THE CAT

S/N	Correct Answers	Marks
1	B	5
2	C	5
3	C	5
4	C	5
5	B	5
6	B	5
7	B	5
8	D	5
9	A	5
10	A	5

11	B	5
12	D	5
13	B	5
14	C	5
15	A	5
16	D	5
17	A	5
18	B	5
19	B	5
20	C	5
		5 x 20 = 100

TOTAL MARK = 100
0 – 49 Marks is low
50 – 100 Marks is high