International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 43 No. 1 February 2024, pp. 394-412

Factors Affecting The Performance Of Senior Two Students In Chemistry In Rutsiro District Of Rwanda

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Abstract – Performance in chemistry has been observed as an issue in secondary schools based on attitudes of students toward chemistry lesson, how is taught in class and availability of needed infrastructures that help to conceptualize lesson in chemistry. The classroom hands on, mind on activities, change of attitudes of students, and awareness of stakeholders to provide adequate infrastructures are needed to ensure effectiveness of teaching and learning chemistry in schools in order to improve the performance. The present study was carried out to determine the level of senior two students' performance in chemistry and to find out the important factors affecting senior two chemistry performance in Rutsiro district, of Western province of Rwanda. The deductive research design was considered and the research was conducted in 5 schools. The target population was 130 respondents that included 100 students, 5 teachers, 5 head teachers and 5 deputy head teachers in charge of studies and 15 PTC members. In this study, purposive and simple sampling techniques were used to select students, teachers and administrative staff to take part in this study. Two instruments namely questionnaires and documentary class performance reports were used to collect data on the factors affecting senior two students' performance in chemistry. The descriptive statistics were used to present the data and the results were analyzed by SPSS and analysis of frequency, percentage, p value and t- value were used in the present study. The data from the documentary class performance report showed that 71.0% of senior two students have poor performance (performance below 50% marks). The data from questionnaires and respondents showed that factors linked with the poor performance are less activity-based technique of teaching and learning, bad attitudes of students toward chemistry and lack of enough students' resources materials, low back profile of their families, despites the teacher and administrative staff have higher qualifications needed to deliver the quality education. Teachers, parents, school administration have to be mobilized to motivate students in liking chemistry as core subject. Decision makers have to avail equipped laboratory with enough reagents, library with sufficient chemistry books and textbooks, smart classroom and internet connectivity to enhance teaching- learning.

Keywords – Performance, Attitudes, Students' Resources, Activity- Based Technique.

I. INTRODUCTION

Chemistry is very important in our everyday life as it is at the center of producing so many things that we use in our lives like kitchen materials, office materials, infrastructure materials, technological materials. It is the focal science of making things that we use as people like in government, economic development, religion, culture and so on. It is very crucial that we encourage students to have good performance in chemistry, and remove barriers that students may encounter in its performance (Robinson, 2017). Chemistry is viewed by many as tough subject to learn among other science subjects like biology, geology, and physics. Student's performance remains at low level among secondary school students in Nigeria (Nja, 2019).

Students' low performance is mainly caused by unmotivated students towards chemistry, teachers fail to motivate them, and do not show them the role of chemistry in their everyday life, lack of enough equipped infrastructures in schools, lack of opportunities for professional development of science teachers, and negative attitudes of students to chemistry. Other elements such parents' level of education, learning and teaching methodology, abstraction of terms used in chemistry are important factors that influence academic performance. Parents have great role on academic performance of their students, as because the child with parents with high degree of studies have a lot of opportunity to study hard due to his/her access to information on the other hand. Students raise from illiterate homes have limited access to the benefits stated above (Nja *et al.,* 2019).

Gretchenn (2020) attributed the problem with insufficiency of learning facilities like computers, internet connectivity, textbooks, laboratories, models, demonstrations, and wall charts. The insufficiency of classroom practices, group activities, two-way communication in classroom, direct feedback to assignments or exams, and chemical demonstration may contribute to the decrease of performance of senior secondary school students. Once students are not engaged in teaching learning, the learning activity becomes abstract and confusing among students. Teachers have to teach students using hand on, and mind on system enabling students to perform well in class.

In Rwanda, science, mathematics and technology is at the first bench to economy of country. Chemistry is one of the major science subjects that is involved in that development but the way it is taught in classroom, availability of materials needed to teach it, orientation of students, motivation of students and teachers of chemistry, and many other factors decreases the performance of students in classroom and consequently affect their achievement in the National at the end of cycle (Uwizeyimana *et al.,* 2018). Chemistry is an active practical science, and thus its teaching and learning must involve practical (Mwangi & Kibui, 2017). Although the government of Rwanda introduced the competence-based curriculum (CBC), teachers' continuous professional development (CPD), teaching and learning process how chemistry subject is evaluated, teacher- student chemistry classroom activities and chemistry resource materials needed in teaching learning chemistry are still on little influence (Mutsinzi *et al.,* 2017).

Lack of good performance in chemistry may be caused by poor motivation from their parents and teachers, insufficient and inappropriate or lack of chemistry equipped infrastructures, students disliking of chemistry, not enough trainings for chemistry teachers. There are also other elements namely awareness of students, motivation, teaching – learning methodology, and satisfaction of students to intended school outcome. Family members background like parents' level of education, family economy, culture, and religion have also great influence on performance. Child grow in well-being family, and educated parents possesses enough opportunity to infrastructures like television, radio, internet connectivity, books, has a lot of chance to learn rather than learners grow in miserable families and non-educated parents because there is limitation on good infrastructures like books, radio, newspapers, internet and other benefits (Nja *et al.,* 2019).

Rwanda has encountered pertinent issues of poor performance in chemistry subjects. There are no enough researches conducted on the performance in chemistry compared with other subjects like mathematics (Obanya, 2010). Few studies have been conducted to evaluate the teaching learning like learner centered method and their effect in performance in Science and Mathematics. One related study was conducted by Mugabo (2015) evaluating science teachers understanding of inquiry based science teaching in Rwandan lower secondary schools. Another one was carried out by out by Byusa *et al.* (2020) and analyzed scheme of work and teaching techniques on academic performance. These studies did not deepen the factors that hinder performance, they just generalize the learning of science, which does not give clear consideration to chemistry alone, especially in senior two. Thus, the present study has main purpose to determine different factors affecting the performance of senior two students in chemistry by collecting and evaluating students, and school administrative staff' views in Rutsiro district, with the main focus on methods of teaching and learning, attitudes of students and availability of teaching – learning materials. The main

objective of this study was to investigate the important factors affecting students' performance of senior two students in chemistry in Rutsiro District.

II. METHODOLOGY

2.1 Research Design

The research was carried out in Rutsiro District, in the Western province of Rwanda. It focused on five secondary day schools which both had senior two in their classrooms and schools with both O' level and Chemistry subject in Rutsiro district and the figures came from 2023 school entry report of Rutsiro district.

The population for this study was composed of 363 S2 from five secondary schools were GS Rambura, G.S. Kibara, GS Mukura, GS Rwingongo in Mukura sector and GS Mushubati in Mushubati sector. The codes have been used to hide the school by using School1 up to school5.

The sample composed 123 participants, comprising of 100 students in senior two (S2) five (5) chemistry teachers, five (5) HTs and five (5) Deputy Headteacher of studies (DoS), to ten (10) parents and fifteen (15) PTC committee members were targeted in this research. These schools were selected based on purpose of research, their location, in different sectors and are in different places of Rutsiro district and covers about one third of all students of Rutsiro district.

This study used a survey designed and data were collected through three research tools, (1) questionnaires were given to senior two students, (2) the interview have given to15 selected parents and PTC committee members, then the headteachers and DoS have been used online survey through google link to answer the e-survey.

2.2 Research Instruments and Validation

The questionnaire determined six sections: personal information, attitude of students and teachers towards chemistry, status of teaching and learning methodology, Teachers' qualification and training, parents' education level, then after Families' social - economic background. The academic performance has measured according with in relation with Chemistry subject (at the end of the two terms exams).

Some of the sections composed by open-ended questions where the participants described their views and thoughts about the recent questions. Interview questions were narrated to learning and teaching process with keywords about their opinions on factors that may hindered the performance of senior two students in chemistry in Rutsiro district of Rwanda.

The questionnaire and interview questions were shared to experts who assisted us to check the cleared validity to critically inspect its language clarity, readability, suitability, and lack of ambiguity. They also patterned the appropriateness of the statements and the clearness of questionnaires to the participants. To ensure the reliability of the survey questionnaire tools, the Cronbach's alpha coefficient was applied and calculated in SPSS (2.0), which according to Fraenkel et al. (2012), indicates an acceptable internal consistency among items.

2.3 Data Collection and Analysis

A permit to conduct the data collection was obtained from University of Rwanda, then submitted to Rut District for official reception, then after to host Sector Education officers in which the school is belonging in. Lastly the letter was also submitted to the head-teachers of all five selected secondary schools. During the observation, the researcher has collected the preliminary data like number of students by trades and ages within recognizing the classroom which has introduced the chemistry subjects.

Descriptive statistics were used to analyze quantitative data. Data collected from interview questions were coded and presented in frequency distribution, percentage and tabulation as well as in narrative to describe methods. Data analysis involved scrutinizing the acquired information and making inferences (Kombo & Tromp, 2006). The past terms results have been recorded and analyzed descriptive statistics marks for each respondent while the data from the interview have been sorted, edited, and recorded in excel sheet to be transferred in SPSS. were also analyzed by SPSS.

2.4 Data Presentation and Results discussion

This chapter goes in deep by presenting findings based on the order according to the formulated two objectives, viz. to determine the level of senior two students' performance in chemistry in Rutsiro district for term one, and to find out the important factors

affecting senior two chemistry performance in Rutsiro district. The data collected and analyzed are from five schools. The results of the statistical description are summarized in tables, frequency, and percentage distribution.

2.4.1 Personal identification of respondents

A sample design is a process or plan to obtain small representation from big number of individuals without losing the main characteristics. It refers to the procedure the researcher adopts in selecting items from the sample. Sample cannot go beyond the overall set of individuals (Kabir, 2018).

Where S2: senior two, HT: Head teacher, DOS: deputy head teacher in charge of studies, PTCs: Teacher Parent committee members.

The Sloven's formula was utilized to determine the sample size from the population using 8.5% of margin error and confidence interval of 95%. The formula used was

$\mathbf{n}=N/(1+N\times e^2)$, where N= population size, n= sample size, e= margin error.

By calculating, we find that $\mathbf{n}=363/(1+363\times 0.085^2)$ = 100. Hence 100 students were selected using random sampling purposively.

The study comprised 100 students from 5 schools (20 students from each school). They were randomly selected. On average, the secondary students classroom size was 33 students (Statistics, 2017). In addition, five S2 chemistry teachers, 5 Deputy Head Teachers in Charge of Studies (DOS) and 5 head teachers (HT) were also taken part in the study. Teachers and administrative staff (HTs and DOS) were also selected based on their role in the research because they are expected to have relevant information on factors that affect performance of senior two classes.

Table 1. Population and sample structure of the participants

No	**School**	**Population chosen**			***Sample of selected respondents***			
No	**School**	**S2 students**	**S2 Chemistry Teacher**	**HTs & DOS**	**Number of S2 students**	**S2 Chemistry Teacher**	**HTs DOS**	**PTCs members**
1	School1	63	1	2	20	1	2	3
2	School2	36	1	2	20	1	2	3
3	School3	57	1	2	20	1	2	3
4	School4	108	1	2	20	1	2	3
5	School5	99	1	2	20	1	2	3
Total		**365**	**5**	**10**	**100**	**5**	**10**	**15**

Source: from document of sampled schools (March, 2023)

The choice of number of boys' students and girls' students was based on the ratio in number of students. As among 363 students, 223 (62%) were girls and 140 (38%) were boys, 62 girls and 38 boys were taken in this research.

III. Results and Discussion

3.1 Teachers' Qualification Level

Both head teachers and DoS have required qualification at level of 90%, and 60% of teachers posses Bachelor degree in related chemistry course, the 40% of teachers have Advanced Diploma in fields with Chemistry.

Table 2.Gender ,Qualification and teaching experience of Teachers and administrators

		Headteachers	**DOS**	**Chemistry Teachers**
Trends of participants	**Participants by Characteristics**	**Number**	**Number**	**Number**
Participants by gender	Female	1	2	4
	Male	4	3	1
	Total	5	5	5
Participants by Qualifications	A2	0	0	0
	A1	0	1	2
	Ao	5	4	3
Working experience.	0-3 Years	1	3	2
	4-6 Years	2	1	2
	7-10 Years	2	1	0
	<10 Years	0	0	1

Source: Primary data (February, 2023)

According to the results presented on above records, all teachers and leaders have the required qualification to initiated and implement the Competence based curriculum and facilitate the learners to attain the best scores in chemistry, as conclusion there isn't any problem in teaching staffs and leaders 'qualification which can inhibit them to deliver the quality education indeed.

3.2 Teaching and learning Methods and materials

The sector education inspectors, head teachers, and the teachers themselves indicated difficulties encountered in teaching, among which we mention predominantly lecture, a method that did not address prior knowledge of learners who are, in this case, passive audience. Also, the inadequate facilities like libraries, laboratories, and teaching/learning materials that factors affecting senior two chemistry students' performance in Rutsiro secondary schools.

as instructional materials such as textbooks and science equipment for both teachers and students are key variables at all levels for students' learning and performance which in turn affect learners' motivation and the effectiveness of their lessons as well.

Students' responses

Table 3. Students' responses frequency on Activity based techniques and performance

Activity based techniques and performance						
Statement	**Total responses**	**SD**	**D**	**U**	**A**	**SA**
In a classroom, a chemistry teacher gives task to perform in groups (like exercises, problems, experiment?)	100	2 2%	16 16%	10 10%	70 70%	2 2%
We have given opportunity to go in laboratory for experiment?	100	33 33%	35 35%	17 17%	12 12%	3 3%
I can do one experiment for each of the unit that we covered in Chemistry for term one	100	18 18%	41 41%	17 17%	21 21%	3 3%
I can manipulate chemicals and perform the reaction	100	17 17%	43 43%	17 17%	19 19%	4 4%

Source: Primary data (March, 2023)

Where, SD:Strongly disagree, D: Disagree, U: Undecided (Not sure), A: Agree, SA: Strongly agree

For the activity-based technique as a factor affecting performance, the following results were obtained from students. For the statement "in class, a chemistry teacher gives task to perform in groups (like exercises, problems, experiment)", 2 (2%) answered strongly disagree, 16 (16%) disagree with the statement, 10 (10%) not sure or undecided, 70 (70%) agree with that statement and finally 2 (2%) are strongly agreed with statement.

For the statement, "we have given opportunity to go in laboratory for experiment"; the following results were obtained SD: 33 (33%), D: 35 (35%), U: 17 (17%), A: 12 (12%) and SA 3 (3%). For the statement "I can do one experiment for each of the unit that we covered in chemistry for term one", the following results were obtained SD: 18 (18%), D: 41 (41%), U: 17 (17%), A: 21 (21%) and SA 3 (3%). Finally, for the statement "I can manipulate chemicals and perform the reaction", the following answers were obtained SD: 17 (17%), D: 43 (43%), U: 17 (17%), A: 19 (19%) and SA 4 (4%).

The findings are in the same agreement as that studies were done in 2014 in Rwanda also outlined this traditional way of teaching and authoritative role of the teacher and following role of learners (Nzeyimana & Ndihokubwayo, 2019). However, of Mupa and Isaac (2015), who discovered that when teachers' instructional materials are limited, learners perform poorly.

Table 4.Students' view on the resources availability to support students

Students' resources availability						
Statement	**Total responses**	**SD**	**D**	**U**	**A**	**SA**
My school has enough books for Senior 2 chemistry	100	13 13%	42 42%	17 17%	14 14%	14 14%
My school has equipped laboratory for experiment	100	36 36%	39 39%	14 14%	7 7%	4 4%

I regularly read chemistry books to complete what teacher taught me	100	9 9%	63 63%	16 16%	12 12%	0 0%
We use laboratory in studying chemistry	100	25 25%	42 42%	15 15%	9 9%	9 9%

Source: Primary data (March, 2023)

About "students perception on students' resources availability and performance, my school has enough books for Senior 2 chemistry", the results are SD: 13 (13%), D: 42 (42%), U: 17 (17%), A: 14 (14%) and SA 14 (14%). For "My school has equipped laboratory for experiment", the results are SD: 36 (36%), D: 39 (39%), U: 14 (14%), A: 7 (7%) and SA 4 (4%). For "I regularly read chemistry books to complete what teacher taught me", the results are SD: 9 (9%), D: 63 (63%), U: 16 (16%), A: 12 (12%) and SA 0 (0%). For "We use laboratory in studying chemistry", the results are SD: 25 (25%), D: 42 (42%), U: 15 (15%), A: 9 (9%) and SA 9 (9%).

Besides of that, Busingye and Najjuma (2015) described the relationship between the availability of resources for teaching and learning and the learning gains to be a direct one. Acknowledging this fact, Ndihokubwayo et al. (2019) emphasized the need to enhance the quality of science education by making available adequate supplies of teaching and learning materials because of its immeasurable benefits on secondary and higher-level education. Teaching and learning science by innovative methods direct learners on how to apply a science idea to a variety of phenomena, and students' academic achievement in science related subjects is more enhanced with flexible teachers who are able to adapt the content to learners with different background and abilities in a conducive classroom environment (Gomendio & OECD Staff, 2017).

3.3 Attitudes of learners and teachers towards chemistry

The Attitudes of student towards have measured through structured survey curried out to both teachers and students, then the results shown that the average of 25 % of the student agreed with the statements "I like chemistry more than any other school subjects" These results revealed that 75 % student the lesson of chemistry without motivation, and the consequences' were the failure of the course in the recent academic year. In addition, the obtained results are confirmed by the results from teaching staff which revealed that only 60% are only liked chemistry.

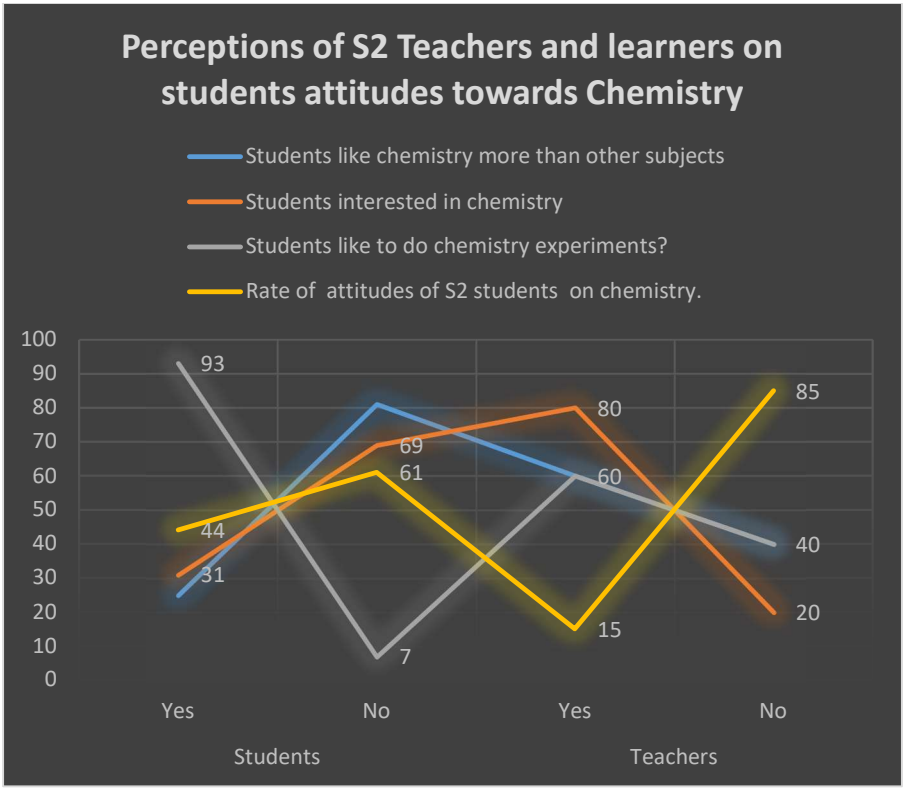

Figure 1. Perception of S2 teachers and students on attitudes towards chemistry subject.

Source: Primary data (March, 2023)

For the statement "Chemistry lessons are interesting", the following results were revealed that 69% of the students are interested to study the lesson as if the teachers have confirmed the statement at 60%. This statement shown that the students have the zeal to persue the subjects but the other factors which can inhibit the smooth learning.

The students like to do chemistry experiment are at the rate of 93% and teachers confirmed the statement at 60% that the students liked experiments both in classroom.

Source: Primary data (March, 2023

The rate at which s2students attitudes towards chemistry demonstrated by the student is on 44% for teaching staffs and 15% at rate of teachers' perception.

3.4 Families' social -economic profile

It was found that most of the parents' earnings are not sufficient to afford the provision of basic materials, electricity, food and other necessary components to support the teaching and learning process as it is presented in figure below.

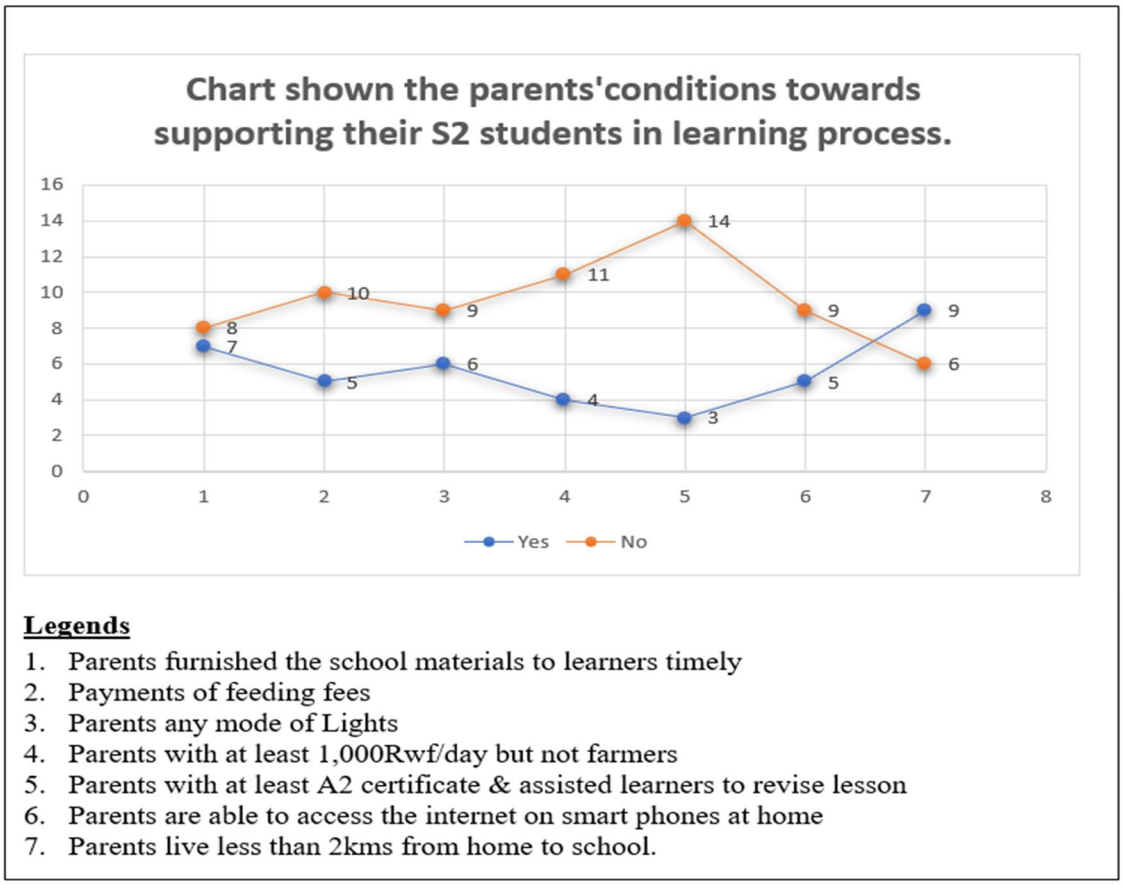

Figure 2.Parents' social-economics profile and its effects to education S2 students.

Source: Primary data (March, 2023)

The 46.5% of parents are able to furnish the school materials to learners timely while 53.8% are not able to do so, 30.8% of the parents have not paid the school fees to their learners to facilitate them to take the food at school, instead only 23.1% of the parents are able to get 1,000 Rwfs not based on Agro-business based activity.

According to Bora and Ahmed (2018), the levels of the parents socio-economic standing dictates to a large extent the type of school children attend, even those who are in rural areas where teaching and learning facilities are not adequately provided; the parents' status can change the trend that a child can cope with the academic challenges.

Only 15.4% of the parents have graduated with A2 certificates and they are able to facilitate their learners to revise the lesson even if at home, while 30.8% of the parents are only access the internet at home with their smartphones

The 38.5% of Parents live far from home to school in more than 2kms which inhibiting the good performance of their learners, for talented students who do not need their parents to assist them in revising lesson and control their learning process, the level of academic grades of the parents didn't mean a lot on their children's academic abilities, but the school location can be a prognosticator factor to their academic achievement in basic science while in secondary schools.

3.5 Academic performance results analysis in Chemisty

3.5.1 Academic performance for S2 chemistry students in Rutsiro District of Rwanda

For the data collected at school levels, the mark ranges of senior two students for term 1 of the year 2022/

2023 are highlighted in the table 2.

3.5.2 Research question 1: How is the performance of S2 chemistry students in Rutsiro District?

As shown by the table 2, the performance rate of senior two students in sampled schools is at 35%, the percentage of students who obtained at least 50% in term one of year 2022/ 2023. There was a big number of students who have poor performance in term 1 of the year 2022/ 2023, for senior 2 chemistry students, as the average good performance is at 35%. Indeed, 2/100 obtained above 80 to 100 marks, 8/100 students had 70 to 79 marks, 13/100 students had 60 to 69 marks, and 12/100 students obtained 50 to 59%.

Table 5. Academic performance records for S2 chemistry students in 5 schools of Rutsiro.

	Categories & Average marks of 100 S2 students in 2022/2023									
	(100-80) Excellent		**(79-60) Very Good**		**(59-50) Good**		**(49-30) Fair**		**(29-0) Failed**	
Schools	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
School1	0	1	1	1	1	1	2	5	2	5
School2	0	0	0	2	2	1	3	5	3	3
School3	1	0	1	2	1	2	3	4	3	3
School4	0	0	1	1	1	4	3	4	5	4
School5	0	1	1	0	1	2	1	3	4	6
Total	**1**	**2**	**4**	**6**	**6**	**10**	**12**	**21**	**17**	**21**

Source: Primary data (March, 2023

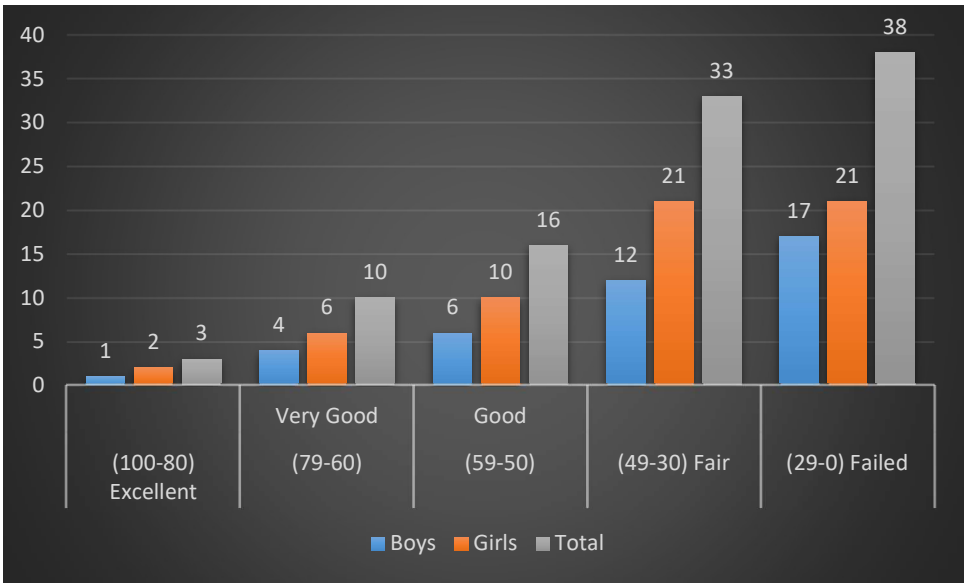

Figure 3. Charts demonstrates the summary average of Academic performance records for S2 chemistry students of Rutsiro.

Source: Primary data (March, 2023

The school performance is poor when the number of students who succeeded the assessment is below 50% (Lamas, 2014). Firstly, the level of performance was endorsed by the findings from the primary data collected in five schools of Mukura Sector and Mushubati sector in Rutsiro district. Considering the results drawn for term one, of the year 2022/ 2023, the data showed that the

average score of the performance of senior two students in chemistry is low, at a level of 36.7%. The majority of senior two students fail in chemistry as shown by the fail rate of 71.0% because there are below 50% in marking records of first term.

In Rutsiro District, the girls have failed than the boys in Chemistry subject because among 71.0% of the students under average scores, the 42% are female gender. These results shown that in rural areas the girls are left behinds but they make large number of selected students during the survey of the research.

3.5.3 The p and t-values of students' responses

The p and t-values of students' responses are summarized in the table 4.

Table 6. p and t-values of students' responses.

One-sample test						
Statement	**Test value = 2**					
	T	**Df**	**Sig. (2-tailed)**	**Mean difference**	**95% Confidence interval of the difference**	
					Lower	**Upper**
Activity- based learning and performance						
1. In a classroom, a chemistry teacher gives task to perform in groups (like exercises, problems, experiment?)	17.000	99	.000	1.000	1.00	1.00
2. We have given opportunity to go in laboratory for experiment?	1.000	99	.000	.000	-.05	.00
3. I can do one experiment for each of the unit that we covered in Chemistry for term one	4.000	99	.000	.000	.00	.00
4. I can manipulate chemicals and perform the reaction	2.000	99	.004	.000	.06	.00
Attitudes/ Liking chemistry						
5. I like chemistry more than any other school subjects	6.000	99	.000	.000	.00	.00
6. Chemistry lessons are interesting	5.000	99	.000	.000	.00	.00
7. Chemistry is one of my favorite subjects.	1.000	99	.000	.000	-.04	.00
8. I like to do chemistry experiments.	3.000	99	.001	.000	.00	.00
9. When I am working in the chemistry lab, I feel I am doing something important	4.000	99	.000	.000	.00	.00
10. Doing chemistry experiments in school is fun	8.000	99	.000	1.020	.00	1.00
11. Chemistry is useful for my everyday life	2.000	99	.005	.000	.09	.00
12. Chemistry is one of the most important subjects for people to study	5.000	99	.000	.000	.00	.00

13. I am willing to spend more time reading chemistry books	2.000	99	.026	.000	.02	.00
14. I like trying to solve new problems in chemistry	2.000	99	.005	.000	.07	.00
Students' resources availability						
15. My school has enough books for Senior 2 chemistry	5.000	99	.000	.000	.00	.00
16. My school has equipped laboratory for experiment	.000	99	.000	.040	.00	.00
17. I regularly read chemistry books to complete what teacher taught me	3.000	99	.000	.000	.00	.00
18. We use laboratory in studying chemistry	2.000	99	.005	.000	.00	.00

Source: Primary data (March, 2023

The table 6 of p and t-values shows that students' responses have a significant relationship between activity-based technique, attitudes of students and resources availability, because p value is < 0.05, and when we say that t value is 2 (disagree), the response of students on activity-based technique tend to 2, to mean that in classroom they do not use activity-based technique in teaching and learning.

For the attitudes of students to chemistry, they disagree to have positive attitudes to it, the answers provided were around 2, to mean that their attitudes toward chemistry is negative and do not like chemistry. The resource availability, students showed that the school does not have equipped laboratory (0.000 while t value is 2), and they disagree on the statement "we use laboratory in studying chemistry" as t value is equal to their answers.

3.5.4 Teachers' perception frequency

Table 7. Teachers' perception p- and t-values

One-Sample Test						
Statement	**Test Value = 2c**					
	t	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**95% confidence interval of the difference**	
					Lower	**Upper**
Activity based technique and performance						
1. In a classroom, a S2 chemistry teacher gives task to perform in groups (like exercises, problems, experiment?)	9.000	4	.001	2.000	1.00	3.08
2. My S2 students can manipulate chemicals and perform chemical reactions	.000	4	.040	.000	.00	.00
Students' attitudes and liking chemistry						

3. Do you find S2 students interested in learning chemistry?	1.000	4	.000	.000	.00	.00
4. Do S2 students like chemistry more than any other school subjects?	.000	4	.040	.000	.00	.00
5. Do you find your students are being interested in chemistry subject?	1.000	4	.000	.000	.00	.00
6. Do students like to perform chemistry experiments?	1.000	4	.000	.000	.00	1.08
7. Do you think the attitudes of S2 student on chemistry my affect his/ her performance in chemistry?	11.000	4	.000	2.000	1.00	2.00
Students' resource availability and performance						
8. My school has equipped laboratory for experiments	-1.000	4	.000	.000	.00	.00

Source: Primary data (March, 2023

3.5.4 HT and DOS' perception

For teachers' responses, p and t- value are summarized in the table 6. The table 6 of p and t- value gives details on teachers' responses have a significant relationship between activity-based technique, attitudes of students and resources availability, because p value is < 0.05, and when we say that t value is 2 (disagree), the response of teachers on activity based technique tend to 2, to mean that in classroom they do not use activity based technique in teaching and learning. For the attitudes of students to chemistry, they disagree to have positive attitudes to it, as the responses provided were below 2, to mean that students' attitudes toward chemistry are negative and do not like chemistry. The resource availability, teachers showed that the school does not have equipped laboratory (0.000 while t value is 2).

Table 8. HTs and DoS' responses frequency

Statement	**Responses**	**SD**	**D**	**U**	**A**	**SA**
Activity based technique and performance						
In a classroom, a chemistry teacher gives task to perform in groups (like exercises, problems, experiment?)	10	0 0%	0 0%	0 0%	6 60%	4 40%
Does the teacher give opportunity to students to go to laboratory for experiments?	10	1 10%	7 70%	2 20%	0 0%	0 0%
Do you think that the activity-based teaching method is important for teaching chemistry and performance for S2 students?	10	0 0%	0 0%	0 0%	3 30%	7 70%

Activity based technique and performance						
Do S2 students like chemistry more than any other school subjects?	10	2 20%	7 70%	1 10%	0 0%	0 0%
Are chemistry lessons interesting for S2 students?	10	1 10%	7 70%	2 20%	0 0%	0 0%
Activity based technique and performance						
My school has enough books for Senior two chemistry	10	2 20%	8 80%	0 0%	0 0%	0 0%
My school has equipped laboratory for experiment	10	3 30%	6 60%	1 10%	0 0%	0 0%
Do you think that the lack of enough teaching resources may affect negatively the performance of senior 2 students in chemistry?	10	0 0%	0 0%	0 0%	5 50%	5 50%

Source: Primary data (March, 2023

Where SD: Strongly disagree, D: Disagree, U: Undecided (Not sure), A: Agree, SA: Strongly agree.

For the perception for HTs and DOS on activity-based technique and performance, “in a classroom, a chemistry teacher gives task to perform in groups (like exercises, problems, experiment?)” A: 6 (60%), SA: 4 (40%). For “Does the teacher give opportunity to students to go to laboratory for experiments?” SD: 1 (10%), D: 7 (70%), U: 2 (20%). For “Do you think that the activity-based teaching method is important for teaching chemistry and performance for S2 students?” A: 3 (30%), SA: 7 (70%).

About the responses of HTs and DOS to attitudes of students towards chemistry lesson. For the perception for HTs and DOS on liking for chemistry lesson, the following were noticed for the two statements. “do S2 students have positive attitudes to chemistry more than other subjects?” SD: 2 (20%), D: 7 (70%), U: 1 (10%). “are chemistry lessons interesting for S2 students?” SD: 1 (10%), D: 7 (70%), U: 2 (20%).

For the pperception for HTs and DOS on students’ resource availability and performance, “my school has enough books for Senior 2 chemistry”: SD: 2 (20%), D: 8 (80%). For “my school has equipped laboratory for experiment” SD: 3 (30%), D: 6 (60%), U: 1 (10%). For “do you think that the lack of enough teaching resources may affect negatively the performance of senior 2 students in chemistry?” A: 5 (50%), SA: 5 (50%).

Table 9. p and t-values of DOS and HTs’ responses

One-Sample Test						
Statement	**Test Value = 2**					
	T	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					Lower	**Upper**
Activity based technique and performance						

1. In a classroom, a chemistry teacher gives task to perform in groups (like exercises, problems, experiment?)	14.000	9	.000	2.000	2.03	2.00
2. Does the teacher give opportunity to students to go to laboratory for experiments?	.000	9	.000	.000	.00	.00
3. Do you think that the activity-based teaching method is important for teaching chemistry and performance for S2 students?	17.000	9	.000	2.000	2.00	3.05
Students' attitudes and chemistry liking						
4. Do S2 students like chemistry more than any other school subjects?	.000	9	.000	.000	.00	.00
5. Are chemistry lessons interesting for S2 students?	.000	9	.000	.000	.00	.00
Students' resources availability						
6. My school has enough books for Senior 2 chemistry	-1.000	9	.000	.000	.00	.00
7.My school has equipped laboratory for experiment	-1.000	9	.000	.000	.00	.00
8. Do you think that the lack of enough teaching resources may affect negatively the performance of senior 2 students in chemistry?	15.000	9	.000	2.000	2.00	2.00

Source: Primary data (March, 2023

Where DOS: deputy head teacher in charge of studies, HT: head teacher

The table 8 of p and t- value demonstrates that DOS and HTs' responses have a significant relationship between activity-based technique, attitudes of students and resources availability, because p value is < 0.05. When we say that t value is 2 (disagree), the response of DOS and HTs' on activitybased technique are below 2, to mean that in classroom they do not use activitybased technique in teaching and learning. For the attitudes of students to chemistry, DOS and HTs' disagree to have positive attitudes to it, as the responses provided were below 2, to mean that students' attitudes toward chemistry are negative and do not like chemistry. The resource availability, teachers showed that the school does not have equipped laboratory and no enough books (0.000 while t value is 2).

The low rate of performance can be ascribed to various reasons. Indeed, 65% of students show that they are not given opportuninty to perform experiment in laboratory. 58% of students do not perform one experiment for each unit covered, and do not manipulate chemicals. Teachers also mentioned that there are no practical activities in teaching and learning as answered by 5 teachers (100%) disagree. No practical experiment as one of the methods of teaching and learning chemistry is done. DOS and HTs in charge of studies agree that teachers use group work in teaching learning, but no practical laboratory is used in teaching and learning, as 80% disagree with the statement of practical laboratory and the performance of experiment. Indeed, when teaching chemistry using theory, course becomes abstract and consequently students do not perform well in the assessment. Therefore, the activity based techinique is the factor that affect senior 2 students performance in chemistry, as it is shown by the poor performance observed.

These findings are in the same line with REB (2015) report showing that CBC emphasizes that the number of students in classroom has to be manageable to enable teacher controlling all students and accord activities, but the number of students in classrooms was beyond the average in Rutsiro district. This leads to overcrowding and students' engagement decreases, and

consequently the generation of there are so many disruptive behaviors that hinder the integration of chemistry concepts, and it becomes abstract. Further, this constitutes a major challenge to reach the competence-based environment of learning (REB/MINEDUC, 2015) that is the goal of the Government of Rwanda. Consequently, the students do not perform well in chemistry because of the loose of motivation in studying it (Chee & Kim, 2012).

In the present research, girls have poor performance compared to boys' counterparts (33.9 vs 36.8%). Similar observations were also reported (Ojukwu, 2016). Boys like chemistry more than girls' counterpart. Instructional methods especially theoretical chemistry leads to poor performance than practical experiments. Teachers' teaching methods do not favor girls to like chemistry, or to raise their attitudes to chemistry. The teacher's instructional methods could hinder girls' attitudes toward chemistry, mainly when hands-on activities do not stimulate girls to participate actively in the learning process. Girls think that chemistry course is hard to study after physics and the calculations in chemistry are very hard to solve. They tends to be focused on social science like geography, history and languages, and tend to be focus on the lessons that do not imply complicated calculations (Surya, 2021). The girls tend to attribute subjects like chemistry, physics and mathematics as lessons for boys and become demotivated to be focused on them. The complexity of the chemistry curriculum reads them to be afraid of it. The terminal grade is more likely motivated than the middle class (senior two) and the beginning class (senior one) (Musengimana *et al.*, 2022).

For attitudes of senior two students in chemistry, the responses from students show that they do not like chemistry and it is not interesting them to study it. 54% students do not like, only 35% like it, and 67% of students are not interested in studying chemistry, 80% of students, chemistry is not their favorite subject, 74% of students do not read chemistry books to complete what teacher taught them, and 77% do not solve new problem in chemistry lesson. Teachers showed that students do not like chemistry subject as mentioned by them that 80% of students are not interested in studying chemistry. Even administrative staff (HTs and DoS) mentioned that majority of senior two students do not like chemistry, and this become the cause of poor performance in it.

From the findings, attitudes of students are the factor that hinder or influence performance of senior two chemistry subject. This goes to the same line with Ojukwu (2016) who showed that many students do not like chemistry lesson, which cause them to have poor performance in it. Teachers fail to motivate them, and do not show them the role of chemistry in their everyday life. Negative attitude, lack of attention towards students, hyperactivity disorders, loss of memory, lack of concentration to chemistry, fear of chemistry make students think that chemistry is the complex subjects in all subjects (Anthony, 2019).

Surya (2021) suggested that natural sciences like chemistry and physics are feared by students in secondary schools because the intended objectives are not attained by students due to methods used by teachers in classroom, and students are more focused on other subjects more than these ones. The teachers are obliged to attract attention of their students by involving curiosity among students and connect chemistry lesson with their everyday life. Traditional lecture based teaching method favors students to become more passive because students follow teacher and do not imply in activities hence they fail in in assessment, but when they are taught using activity based technique, they gain more and their performance increases.

For availability of materials as a factor affecting performance, students, teachers, DOS and HTs demonstrate that there is lack of laboratory in their schools, no enough chemistry book, they don't use laboratory in learning chemistry. As 57% of students disagree the availability of enough books, only 28% agree that there are enough books, and 75% disagree the availability of equipped laboratory, only 11% agree on laboratory availability. All teachers (100%) also deny the availability of enough chemistry books and equipped laboratory, and this explains the poor performance among S2 chemistry students. Similarly, all DOS and HTs disagree the availability of enough books and equipped laboratory. This is the reason why students have poor performance in chemistry.

Studies in Nigeria showed that the availability of students' materials has a great impact on the academic performance, the shortage of students' material availability affects students' performance negatively (Agiang, 2022). Availability of chemistry textbook, computers, laboratory materials and total school resources are the factors that imply in students' achievement. The schools with shortage of resources does not favorite students' performance (Ndlovu, 2017). We observe that p-value found from students, teachers and administrative staff are less than 0.05 ($p < 0.05$) for all statements, this mean that there is a statistical significant difference in mean scores, and we denote that inadequate activity-based technique of teaching learning, negative attitudes of students to chemistry and insufficiency of teaching- learning resources are the factors affect performance negatively in Rutsiro district of Rwanda.

IV. Conclusion

As conclusion, the activity-based technique of teaching learning, attitudes of students towards chemistry lesson and students' materials availability are factors that affect the performance of S2 chemistry students in Rutsiro district of Rwanda. When there is good culture of conducting chemistry experiments and hands on activities, there is an increase in the performance. When there is a lack of those activities, the teaching learning becomes abstract and there is poor performance in chemistry. Teachers have to create an environment where students learn while touching what they are learning. These enable students to construct knowledge and to succeed in the assessments. Attitudes of students towards chemistry is another factor that affect performance of senior two chemistry students. When students like chemistry, the have good performance, when they do not like it they fail. As the middle students, the students have to be motivated in studying chemistry in order to improve their performance. Students resource materials is another factor that affect senior two students' performance, as when there is a shortage of text books, library, laboratory, this favors poor performance in chemistry, and when there are enough materials, the students perform well in chemistry as shown in the present research.

V. Recommendations

a) Teachers should use activity-based techniques of teaching as they motivate learners and improve their performance,

b) Schools and other authorities have to provide enough textbooks, smart classrooms, adequate infrastructures, equipped laboratory in order to improve senior two students' performance.

c) Parents, teachers and school administration have to motivate students and encourage them to have good attitudes towards chemistry to improve their performance.

d) The present study was based on factors affecting performance of senior chemistry students. Other studies are needed to assess the extent to which each factor may be handled using improvisation, how to make locally made materials to overcome the materials' challenges and use of ICT in modern teaching chemistry for improving students' performance.

VI. Acknowledgment

We thank University of Rwanda- College of Education (UR-CE) and the African Center of Excellence for Innovative Teaching and Learning Mathematics and Science (ACEITLMS) for its academic support, the students, teachers and schools' administration who took part in this study.

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