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Research Article

School Factors as Correlates of Students' Chemistry Achievement in Senior Secondary Schools in North-West Sierra Leone

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Abstract
Even though there is proof that learning in favorable conditions yields positive outcomes, the performance of students in chemistry in North-West Sierra Leone remains on a downward trajectory. This research explored school factors as correlates of students' chemistry achievement in senior secondary schools in North-West Sierra Leone using an ex-post facto research design. Specifically, the study examined the influence of school location and laboratory adequacy on students' academic achievement in chemistry. Data from 198 senior secondary school two (SSS II) students from both urban and rural schools were obtained using the Chemistry Achievement Test (CAT) and the School Factors Questionnaire (SFQ), with a reliability coefficient of 0.78 and 0.82, respectively. Independent samples *t*-test and Pearson correlation were utilized for data analyses using SPSS version 27. It was found that there was a statistically significant difference in chemistry achievement with respect to school location, where urban students outperformed their rural counterparts [t (196) = 6.12, p < .05] with a large effect size (d = 0.91). Additionally, laboratory adequacy and students' achievements in chemistry showed a positive correlation (r = .46), explaining 21% of the variance in achievement. The findings further suggest that inadequate laboratory facilities and disparities in educational resources between urban and rural schools may contribute significantly to poor chemistry performance among students. This research paper concludes that school locations and adequate laboratories are some of the key determinants of students' academic achievement in chemistry. It should therefore be a priority for policymakers to ensure that there is equal resource allocation in urban and rural schools, including laboratory facilities, to strengthen chemistry education and improve students' academic outcomes in North-West Sierra Leone.

Keywords: Chemistry Achievement, School Location, Laboratory Adequacy, Secondary Education, Sierra Leone

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1. INTRODUCTION

Science and technology have often been considered a toolkit in nation-building. Sierra Leone, like other nations across the globe, depends on the capabilities of Science, Technology, and Mathematics in developing the nation. The science subject called Chemistry has been identified as a central subject in the successful acquisition of any aspiring science, such as Medicine, Engineering, and Environmental Science. Though this subject enjoys prestigious positions among other sciences, it is evident that obtaining good grades in Chemistry continues to be challenging in many parts of Sierra Leone, notably North-West Sierra Leone. As is seen from the results of the West African Senior School Certificate Examination (WASSCE), students usually encounter difficulty in handling complex knowledge in Chemistry, especially in practical work (Sesay et al., 2025). There are many factors behind the above-mentioned problem, and the school-related ones are considered vital correlates of academic achievement (Oladejo et al., 2023). The selected factors include school location (urban vs. rural schools) and laboratory adequacy.

1.1. Laboratory Adequacy and Chemistry Achievement

Chemistry, by its nature, is a subject whose learning process cannot be divorced from practicality; it needs to be experimented on to reconcile theory and observation (Sesay et al., 2025). Laboratory adequacy is about having the apparatus, reagents, and equipment necessary for teaching science lessons (Khamali et al., 2017). Studies show that laboratories play an important role as instructional centers in developing attitudes and critical thinking among students (Akani, 2015).

In many secondary schools in West Africa, there is a strong relationship between laboratory resources and students' academic performance (Khamali et al., 2017). For example, it has been found that the provision of functioning laboratories and teaching materials explains over 67 percent of variations in students' practical results (Khamali et al., 2017). In cases where laboratories are lacking, teachers may be forced to use the traditional "teacher-centered instructional method" teaching approach with limited demonstrations, thus resulting in little participation from students and poor retention of information (Sesay et al., 2025). Also, laboratory equipment and the practical abilities of students have been found to be strong predictors of success in chemistry practical examinations (Ogundiji, 2025). Nevertheless, despite its relevance, many schools in Sierra Leone encounter several barriers that prevent them from implementing practical-based approaches, including inadequate funding and dysfunctional laboratory equipment, thus necessitating the use of unconventional strategies while teaching science subjects (Sesay et al., 2025).

1.2. School Location: Urban and Rural Schools

The location of a school, whether in an urban or rural setting, is yet another powerful factor that determines how well students perform in scientific subjects, including chemistry (Oladejo et al., 2023). In Africa, there exists a persistent "rural-urban gap" in the educational sector, whereby urban schools tend to have access to greater capital and manpower relative to rural schools (Oladejo et al., 2023).

1. Urban Schools: Urban schools situated within cities or district capitals are usually characterized by better physical facilities, stronger monitoring mechanisms, and more skilled science educators than their rural counterparts. The students from urban areas tend to perform better in examinations because of the improved educational facilities (Owan, 2020; Oladejo et al., 2023).
2. Rural Schools: Schools located in isolated places are often plagued by poor infrastructural development, which inevitably results in poorer academic achievements (Owan, 2020). Besides, rural students may experience other external factors, such as walking great distances to reach school on time for classes (Owan, 2020).

Nonetheless, the effect of school location on academic performance continues to be a controversial issue in academia. Even though research conducted in Nigeria and Western Australia indicates that urban students have been shown to perform better than their rural counterparts (Bizimana et al., 2021), other research indicates that when there is an equalization of resources, such as the deployment of special instructional technology, there is no statistically significant variation between the average performances of urban and rural students (Bizimana et al., 2021; Obikezie et al., 2025).

1.3. Problem Statement

The persistent gap in the performance of students in chemistry within various education systems in North-West Sierra Leone has posed a serious challenge to educational stakeholders. It is important to note that despite the significance of chemistry as a basic science subject for medical and engineering courses, among others, the performance of the students continues to fall even in the external and internal examinations. The problem appears to be substantial in practical areas where students lack conceptual knowledge and understanding (Sesay et al., 2025).

Despite the universal acceptance that practical learning plays a vital role in facilitating students' comprehension of complex chemistry subjects, most high schools in the country fail to provide adequately furnished laboratories needed for such learning. In most instances, the lack of suitable laboratory facilities forces the teachers to adopt only theoretical or "chalk and talk" methods of instruction, reducing students'

chances to conduct practical experiments (Akani, 2015; Sesay et al., 2025). In essence, this practice negates the key tenets of experiential and constructivist learning theories.

In addition to this, inequalities in school placement have also contributed significantly towards creating educational disparities. In most cases, urban schools tend to enjoy adequate infrastructural development, availability of learning materials, and a sufficient number of skilled teachers, while rural schools may suffer from poor facilities, scarcity of resources, and unfavorable conditions for learning (Oladejo et al., 2023; Owan, 2020). This inequality results in a consistent disparity in academic performance between rural and urban students.

Previous research has been carried out on various factors affecting performance in science among secondary school students. However, there is very little research carried out that focuses explicitly on the role played by both the geographical location of the school and laboratory availability concerning chemistry performance in secondary schools within North-West Sierra Leone.

In light of all the above, the current study endeavors to establish the association between certain factors in schools, especially the adequacy of laboratories and the location of schools, on the chemistry performance of students. This knowledge will be instrumental in formulating strategies to enhance chemistry instruction and mitigate any disparities in its delivery.

1.4. Theoretical Framework

This study is based on three interrelated theories, which include the Educational Production Function theory, School Effectiveness theory, and Constructivist Learning theory. Through the application of these theories, the study aims to explore the relationship between school inputs, such as laboratory facilities and school location, and learning outputs in Chemistry.

1.4.1. Educational Production Function Theory

As per the Educational Production Function Theory, student success is considered to be the output resulting from several inputs, which include school resources, teacher ability, and the type of learning environment (Khamali et al., 2017). The Educational Production Function Theory posits that there is a way through which the effect of different school-based inputs on student success can be measured. With respect to Chemistry, the input factors include lab resources that play a vital role in affecting student success (Khamali et al., 2017).

Several studies have demonstrated the importance of such input factors as they act as predictors of student success; for example, the presence of lab materials can be attributed to 67.1% variance in academic performance in sciences (Khamali et al., 2017). Absence of such inputs causes the processing of scientific knowledge to be adversely affected and equally affects student performance (Oginni et al., 2013). For example, in North West Sierra Leone, such a theory explains how differences in the allocation of resources lead to achievement gaps among schools.

1.4.2. School Effectiveness Theory

The School Effectiveness Theory emphasizes that internal and external environmental factors play an important role in determining students' success (Oladejo et al., 2023). It can be said that schools with good internal and external environments are likely to have better performance since they possess proper physical infrastructure and are well located geographically (Owan, 2020; Oladejo et al., 2023).

The location of schools is one of the key elements within the theory. It has been proven that urban schools generally have more resources available to them, as well as more effective academic supervision and infrastructure compared to rural schools (Owan, 2020; Oladejo et al., 2023). According to the theory, there are quite a few developing countries where rural schools do not have enough "infrastructural provisions." Additionally, the lack of qualified teachers in distant areas makes it hard for rural schools to function properly due to a phenomenon known as "scientific disconnect." Hence, students studying at rural schools are underprivileged due to the location of the schools they attend (Oladejo et al., 2023; Sesay et al.,

2025). As a result, the efficiency of schools can no longer be regarded as a reflection of the students' natural talents.

1.4.3. Constructivist Learning Theory

According to Constructivist Learning Theory, students gain knowledge best when they take an active part in their own learning process and do not merely sit back and listen (Sesay et al., 2025). According to Vygotsky and Dewey, who support the theory, learning is a "construction" process that takes place with the help of practical experience and interactions in a stimulating learning environment (Sesay et al., 2025).

Constructivism is achieved by providing an environment where the students can conduct hands-on experiments. The laboratory setting in chemistry is vital for allowing the students to explore "the practicality of chemistry and how it works in the real world" (Akani, 2015; Sesay et al., 2025). The failure by learning institutions to provide sufficient laboratory settings forces the teachers to resort to teaching "theoretical and chalkboard explanations," thus making it difficult for students to develop an understanding of the subject (Sesay et al., 2025). The result is poor performance because students lack relevant attitudes and skills.

In conclusion, these theories offer a solid rationale as to why school location and laboratory conditions can be independently studied as predictors of Chemistry performance among the students. According to the theory of educational production function, these two variables are vital ingredients in the learning process, and the theory of school effectiveness explains the differences in outcomes due to the uneven distribution of the two variables (rural versus urban).

1.5. Research Questions

Based on the problem statement as aligned to the purpose of this study, the following research questions and null hypotheses are formulated to conduct this investigation. The null hypotheses were tested at the 0.05 level of significance.

1. Is there a statistically significant difference in students' chemistry achievement based on school location (urban and rural) in senior secondary schools in North-West Sierra Leone?
2. What is the relationship between laboratory adequacy and students' chemistry achievement in senior secondary schools in North-West Sierra Leone?

1.6. Null Hypotheses

H_{01}: There is no statistically significant difference in students' chemistry achievement based on school location (urban and rural) in senior secondary schools in North-West Sierra Leone

H_{02}: There is no significant relationship between laboratory adequacy and students' chemistry achievement in senior secondary schools in North-West Sierra Leone.

2. METHODOLOGY

2.1. Research Design

This study used an ex-post facto (causal-comparative) research design to determine the effects of some school factors on the academic achievement of students in chemistry. It was suitable for this study since the independent variables, school location (urban or rural) and laboratory adequacy, are natural occurrences and can neither be created nor changed by the researcher.

The design allowed for: Comparing achievement among schools based on school location (Research Question 1). Investigating the effect of laboratory adequacy on achievement (Research Question 2). Since it is not experimental in nature, the results are only indicative of associations and not causes.

2.2. Population and Sample

The study population consisted of all Senior Secondary School Two (SSS II) students studying chemistry at public senior secondary schools in the North-West Region of Sierra Leone. Out of the population, 198 students volunteered to be part of the study sample, comprising 105 students from urban schools and 93 students from rural schools. Out of 198 respondents, 108 were male students, whereas 90 were female students. The age of respondents was between 15 and 19 years, with the average age being 16.8 years. SSS II students were suitable for the research due to their sufficient exposure to chemistry fundamentals and preparations for external exams.

2.3. Instrumentation

Instruments used in collecting data in this study included the Chemistry Achievement Test (CAT) and the School Factors Questionnaire (SFQ). The two instruments were carefully constructed and extensively tested to fit the research variables and questions raised, thus making the data collected more reliable and valid.

2.3.1. Chemistry Achievement Test (CAT)

The Chemistry Achievement Test (CAT) was designed such that the items on the test could be used to determine how well the participants had mastered the basic concepts of chemistry according to the curriculum. 50 multiple-choice questions were contained in the CAT, where four options, with only one correct option, were provided in each item. These items were designed in accordance with Bloom's taxonomy to cover all the major cognitive domains, ranging from simple recall to complex problem-solving skills. A table of specifications was prepared in order to guarantee that the content of the test was represented well enough in terms of important chemistry concepts. The preparation of this table made it possible to ensure higher content validity of the test.

Considering the research questions, the CAT could be regarded as the dependent variable in the following ways: In Research Question 1, it was used as a criterion of comparison of students' achievement in different school environments; In Research Question 2, it helped analyze the correlation between lab adequacy and students' achievement.

In order to establish the validity of the test, CAT went through face and content validation processes conducted by four experts in chemistry education from credible tertiary institutions in Sierra Leone. Its validity was established by analyzing: relevance to the objectives of the curriculum, clarity and appropriateness of the items used, adequacy of coverage of the content, and cognitive level of the questions. This led to the modification of certain ambiguous questions, among others. Reliability was evaluated in terms of conducting a pilot study, carried out on 204 respondents selected randomly from non-participating schools. Internal consistency was determined using the Kuder-Richardson Formula 20 (KR-20), and the obtained coefficient was 0.78. This means that the reliability coefficient is satisfactory enough.

2.3.2. School Factors Questionnaire (SFQ)

The development of the instrument known as the School Factors Questionnaire (SFQ) was done by the researcher in light of the identified constructs from past studies on science teaching, school effectiveness, and adequacy of laboratories (Akani, 2015; Khamali et al., 2017; Oginni et al., 2013). The instrument was created in such a way that it captures the realities of senior secondary schools in Sierra Leone's chemistry teaching.

The instrument is made up of two parts. Section A comprised demographic information such as gender, age, and school location (rural or urban), serving as independent variables for the first research question. Section B contained 30 Likert-scale items that captured the constructs of laboratory adequacy in three main areas: (i) availability of laboratory apparatus and reagents, (ii) frequency and quality of practical laboratory activities, and (iii) functionality and adequacy of laboratory facilities. The SFQ used a four-point Likert Scale that included categories of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree

(1) for positively worded items. Five negatively worded items on the SFQ took reversed scoring to eliminate any form of response bias. The instrument was administered for 45 minutes. The lowest score was 30, while the highest score was 120.

Face and content validity of the instrument were established through an expert review by the same four specialists who helped validate the Chemistry Achievement Test (CAT). The validity testing ensured that the items on the instrument are clear, relevant to the variables under investigation, and reflect the construct. The recommended revisions included clarifying some ambiguous items and eliminating redundancies. Cronbach's alpha coefficient was used to establish the reliability of the SFQ after the administration of the instrument to respondents from non-participating schools. The resulting coefficient was 0.82, thus establishing the reliability of the instrument.

2.4. Data Collection Procedure

Approval for the collection of data was obtained formally from the relevant education authorities and school administrators. The instruments were administered during regular school hours. First was the SFQ, then came the CAT, to discourage any form of bias. In total, all 198 respondents answered the two instruments, CAT and SFQ. The administration of the two instruments was done in the presence of the researcher and classroom teachers during regular school hours. This procedure entailed answering the questionnaire without any distractions to the pupils. Ethical considerations were observed throughout the entire research.

2.5. Method of Data Analysis and Assumption Checks

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27. Independent samples t-test and Pearson correlation were the inferential statistics utilized for data analyses. All hypotheses were tested at the 0.05 level of significance. The assumptions of the statistical tests employed in the study were verified before conducting the inferential analyses. The distribution of students' achievement scores in chemistry was checked for normality by the Shapiro-Wilk test. No violation of the normality assumption was noticed since the p-value was greater than 0.05, $W = .98$, $p = .21$. The independent samples t-test is premised on the homogeneity of variances assumption, which was tested using Levene's Test. There was no violation of the assumption of equal variances since the p-value was greater than 0.05, $F(1, 196) = 0.84$, $p = .36$. Linearity and homoscedasticity assumptions were examined through scatterplots, and it was observed that there was a linear association between laboratory adequacy and students' achievement without heteroscedasticity for Pearson Product–Moment Correlation (PPMC).

3. RESULTS

3.1. Research Question 1

Is there a statistically significant difference in students' chemistry achievement based on school location (urban and rural)?

An independent samples *t*-test was conducted to compare students' chemistry achievement scores between urban and rural schools.

Table 1. Difference in Chemistry Achievement by School Location (Scores out of 50)

Location	N	Mean	SD	t	df	p(sig level)
Urban	105	29.35	4.90	6.12	196	0.02
Rural	93	24.80	5.10			

The findings revealed in Table 1 show a significant difference in the chemistry achievement scores of the students depending on the location of the schools, $t(196) = 6.12$, $p < .05$. The students from urban schools had higher achievement scores, $M = 29.35$, $SD = 4.90$, compared to their rural counterparts, $M = 24.80$, $SD = 5.10$. The effect size was quite large, as indicated by the value of Cohen's $d = 0.91$. It implies

that there is an educationally significant difference between the two groups of students due to school location.

The null hypothesis (H_{01}) that suggests there is no significant difference between the chemistry achievements of the students concerning school location was rejected at $p < .05$. It means that school location affects students' chemistry achievement.

3.2. Research Question 2

What is the relationship between laboratory adequacy and students' chemistry achievement?

Pearson Product–Moment Correlation was used to examine the relationship between laboratory adequacy and students' achievement.

Table 2. Correlation between Laboratory Adequacy and Chemistry Achievement

Variable	N	Mean	SD	r	p (sig level)
Laboratory Adequacy	198	2.85	0.62	0.46	.01
Chemistry Achievement	198	27.20	5.23		

The correlation between laboratory adequacy and students' chemistry performance was moderately positive, with $r(196) = .46$, $p < .05$, as seen in Table 2. It can be interpreted that better laboratory facilities correlate with better academic performance of the students. The coefficient of determination ($r^2 = .21$) means that the laboratory adequacy accounts for 21% of the variance in students' chemistry performance.

The null hypothesis (H_{02}), which posits that there is no significant association between laboratory adequacy and students' chemistry performance, was rejected at $p < .05$. This means that laboratory adequacy significantly correlates with students' chemistry performance.

4. DISCUSSION

The results of this study offer empirical support for the importance of school-related variables in influencing students' performance in Chemistry in North-West Sierra Leone. The analyses centered on two key variables: location of the school and the adequacy of its laboratory facilities.

4.1. School Location and Chemistry Achievement

The findings indicate that there was a statistically significant difference in the Chemistry performance scores between students enrolled in urban and rural schools ($t=6.12$, $p<.05$). Students from urban schools performed much better than those from rural schools, with a mean score of 29.35 ($SD=4.90$) as opposed to 24.80 ($SD=5.10$) for those from rural schools.

These findings are in line with earlier studies showing that urban-based schools are characterized by better facilities, improved administration, and an abundance of competent science teachers (Oladejo et al., 2023). The findings are in line with what is predicted by the School Effectiveness Theory, where the environmental factors associated with the institution are seen as key predictors of academic achievement (Oladejo et al., 2023). The phenomenon of the "rural-urban gap" in Africa persists since rural schools have less capital and personnel support when compared to urban-based schools (Oladejo et al., 2023). Moreover, rural students have to overcome additional challenges in the form of greater commuting time, thus limiting their learning hours and achievements (Owan, 2020).

4.2. Laboratory Adequacy and Chemistry Achievement

According to the research findings, there is a moderate positive relationship between laboratory adequacy and Chemistry achievement among students ($r=0.46$, $p<.05$). This implies that when laboratory adequacy increases, student performance in the subject improves. This is in line with the theory of the

Educational Production Function, where schools use inputs such as laboratory and instructional aides to produce educational outcomes (Khamali et al., 2017).

Similar investigations conducted elsewhere have also found the same correlation. For example, a study by Paul (2017 revealed a high correlation between laboratory materials and academic achievement in Kenya, where the researchers concluded that laboratory materials made up over 67% of the variance in practical marks (Khamali et al., 2017). On the other hand, some studies from Nigeria have identified laboratory facilities as poor predictors of students' grades because the schools were noted for having low academic achievements in general (Ogundiji, 2025). The current findings highlight that chemistry is fundamentally a practical subject, and a lack of proper laboratories means that students will not have the opportunity to explore the relationship between theory and practice. The results have made us believe that investment in science laboratory facilities is important in helping improve the state of STEM education and making the students more prepared for science-related careers in underdeveloped education systems like Sierra Leone.

4.3. Relationship to Theoretical Framework

The findings serve to reinforce the theoretical foundations of the study. The Constructivist Learning Theory has been reinforced by the positive relationship between lab adequacy and academic performance since it underscores the need for a dynamic learning environment that enables students to construct their own knowledge in science through practical sessions (Akani, 2015). In cases where the labs are inadequate, there will be no option but to teach "chalkboard science," which does not enhance problem-solving abilities and scientific attitudes among students (Akani, 2015; Sesay et al., 2025). Secondly, the wide gap between urban and rural settings reinforces the principles of School Effectiveness Theory.

4.4. Implications

In light of the results of this research, the following recommendations are hereby proposed.

4.4.1. Equal Allocation of Educational Resources

The government, together with all other educational institutions, needs to focus on equitable resource allocation between urban and rural schools. According to research studies, it has been found that rural schools receive comparatively less attention in terms of educational resource provision compared to urban schools (Oladejo et al., 2023). Moreover, research on instruction funding suggests that comparatively much less funding is provided for science materials to urban and rural teachers compared to those residing in suburban areas, affecting the learning process of underprivileged children (Muzammal & Hashmi, 2025). Therefore, it is important to take certain measures to provide rural schools with enough resources.

4.4.2. Provision and Upgrading of Chemistry Laboratory Facilities

It is necessary that funding be provided to ensure chemistry laboratories are well-equipped. This would involve the provision of basic laboratory apparatus, reagents, and safety gear. Lack of such facilities tends to pose a great challenge to the practical side of teaching and academic achievement among the students in chemistry (Sobowale et al., 2024). It has been found that there is a strong relationship between the presence of materials in the laboratories and the grades scored by the students in the practical aspects of chemistry (Hashi et al., 2025). Therefore, investing in modern equipment is essential for fostering conceptual knowledge and effective laboratory-based learning.

4.4.3. Advocating for the Use of Activity-Oriented Learning Strategies

Teachers should be urged to adopt a practical approach in the delivery of lessons in accordance with constructivist learning theory. Constructivist teaching approaches, hands-on experiments, and problem-solving activities motivate students to actively create their own understanding and apply knowledge in real-

world contexts (Boateng, 2024). Research has proven that laboratory-based instruction produces better academic performance and higher retention rates than the lecture method (Ogiga & Alu, 2025). Implementing student-supported, open-ended approaches to experimentation helps students explore concepts more deeply (Tsai, 1999).

4.4.4. Teacher Development Programs

Programs must be put in place to train teachers in chemistry, especially those in the rural sector. This will help such teachers develop their capabilities in delivering lessons practically and creatively. Teachers can be equipped on how to utilize whatever local materials, such as ash, lemons, and eggshells, available in a resource-poor environment to narrow the gap between theory and practice (Ngendabanga et al., 2025). Professional development programs can feature the aspect of improvising in science classes due to the adverse situation that such teachers face (Mabasa & Singh, 2020).

4.4.5. Monitoring and Enforcement

There is a need to strengthen the mechanism of supervision of education in terms of assessing adherence to the necessary standards of laboratory equipment and methodology of teaching. The use of systematic evaluation and monitoring procedures is required in order to measure the results of introduced policies and make sure that the educational objectives are reached (Safaryan, 2020). Monitoring the provision of material and technical conditions in science classes allows for the obtaining of objective information that will help in making academic decisions. Policies on science teaching should be continually assessed in order to correlate with standards and curricula.

5. CONCLUSION

The findings of this study are that the location of the schools and the adequacy of laboratories are key variables associated with the academic performance of senior secondary students taking Chemistry. The marked disparity in performance between urban and rural schools implies a systematic imbalance in the allocation of educational resources in favour of urban schools, leaving rural children behind. Moreover, the positive link between laboratory adequacy and academic success underscores the necessity of having such science laboratories in order to promote learning.

To realize the developmental objectives in the areas of Science and Technology in Sierra Leone, deliberate measures should be taken to equip rural schools with up-to-date laboratories and appropriate teaching materials. Addressing the imbalance in the provision of educational facilities in rural areas will make it possible for children in both settings to learn Chemistry and embark on medical and engineering professions, among others.

Conclusions made through this research can greatly inform educational policies to ensure that disparities in science education between urban and rural areas and other national policies on STEM are effectively implemented in Sierra Leone.

6. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The study was conducted among 198 students selected from senior secondary schools located in North-Western Sierra Leone. As a result, the results of this study cannot be extrapolated to other regions of Sierra Leone.

Further research could use either a longitudinal or experimental design approach to find out whether laboratory adequacy causes improved student performance in chemistry. Other factors that need further exploration include teachers' qualifications, teaching methods, the socioeconomic status of students, their attitude towards chemistry, and school management practices in various parts of Sierra Leone.

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Research Ethics. Ethical clearance for this study was obtained from the relevant school authorities and educational stakeholders from Kambia, Port Loko, and Karene districts before the commencement of data collection. Informed consent was also obtained from the participating students and their parents before their involvement in the research process.

Data Availability Statement. All data can be obtained from the corresponding author.

Conflicts of Interest. The author declares no conflicts of interest.

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