

**IMPACTS OF LABORATORY EXPERIMENTS ON ACADEMIC  
ACHIEVEMENTS OF SENIOR SECONDARY CHEMISTRY EDUCATION  
STUDENTS IN EGOR LOCAL GOVERNMENT AREA, BENIN CITY**

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BENIN CITY**

**NOVEMBER, 2025**

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**A PROJECT SUBMITTED TO THE DEPARTMENT OF CURRICULUM AND  
INSTRUCTIONAL TECHNOLOGY, FACULTY OF EDUCATION UNIVERSITY  
OF BENIN, BENIN CITY IN PARTIAL FULFILMENT OF THE  
REQUIREMENT OF THE AWARD OF THE BACHELOR OF SCIENCE (ED)  
DEGREE IN CHEMISTRY EDUCATION**

**NOVEMBER, 2025**

## CERTIFICATION

We the undersigned, certified that this research work was carried out by OKIKI OGHENERUKEVWE ANITA in the department of curriculum and instructional technology, Faculty of Education, University of Benin , Benin city in partial fulfillment of the requirement of the award of Bachelor of science (Ed) degree in chemistry Education

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## **DEDICATION**

This research work is dedicated to God Almighty.

## **ACKNOWLEDGMENTS**

To begin with, the researcher gives all glory, honor, and praise to the Almighty God, the Source, Strength, and Sustainer of her life, for His sufficient grace, wisdom, and mercy throughout the completion of this academic program. Truly, God has been at the center of it all guiding every step and making all things possible.

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## **ABSTRACT**

This study investigated the impacts of laboratory experiments on the academic achievement of senior secondary school chemistry students in Egor Local Government Area, Benin City. It examined how the frequency of practical sessions, the quality of laboratory facilities, and teachers' competency in conducting experiments influence students' understanding and performance in chemistry. The study adopted a descriptive survey design, using a structured questionnaire administered to 69 students selected through proportionate and simple random sampling from five public secondary schools. Data were analyzed using descriptive statistics, Pearson correlation, and independent samples t-test.

Findings revealed that practical sessions are infrequent in most schools, and students reported that the scarcity of hands on activities limit their understanding, retention, and interest in chemistry. Results further showed that the quality of laboratory facilities significantly affects students' performance, with poorly equipped laboratories hindering effective practical engagement. Teacher competency also displayed a positive and significant relationship with students' academic achievement, indicating that skilled and confident teachers play a crucial role in facilitating meaningful laboratory learning. The study concludes that inadequate facilities, infrequent practical sessions, and limited teacher expertise collectively contribute to low achievement in chemistry. It recommends improved funding for laboratory infrastructure, more frequent and well timed practical lessons, and enhanced teacher training to strengthen the integration of theory and practice.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **Background to the Study**

Chemistry is a fundamental support of scientific education in Nigeria, crucial for national development and technological advancement. Despite its importance, student

performance in the subject, particularly in examinations conducted by the West African Examinations Council (WAEC), remains a persistent and significant concern. Annual WAEC reports consistently highlight unsatisfactory outcomes, with students showing notable weaknesses in the practical aspects of chemistry (WAEC, 2022). This trend recommends a systemic failure to translate theoretical knowledge into practical understanding and application.

A primary challenge in chemistry education is the abstract and complex nature of the subject, which often encourages rote memorization rather than genuine conceptual understanding (Bello & Olaitan, 2020). To bridge this gap between theory and practice, laboratory experiments are widely recognized as an essential instructional tool. They transform abstract concepts into tangible experiences, promoting deeper learning and cognitive engagement (Adeyemo, 2019). However, the mere presence of laboratory sessions does not automatically guarantee improved learning; their effectiveness is highly dependent on the specific conditions under which they are implemented.

This study, therefore, focuses on three critical, measurable factors that define the implementation of laboratory work: the frequency of practical sessions, the quality of laboratory facilities, and the timing of experiments relative to theoretical instruction. These independent variables are offered to have a direct causal influence on the dependent variable students academic achievement in chemistry, as measured by test scores, practical assessments, and overall performance.

The frequency of practical sessions is fundamental, as it determines how often students engage in hands on learning. Grounded in constructivist learning theory, which posits that knowledge is built through experience, infrequent practical work limits students ability to develop essential manipulative skills and reinforce theoretical knowledge. Supporting this, a study by Okoli (2021) in Anambra State found a strong positive correlation between the number of practical sessions per term and students scores in standardized chemistry tests. This research will build on that finding by specifically examining the impact of session frequency on practical assessment scores within Egor LGA.

Another crucial factor is the quality of laboratory facilities. The state of the laboratory environment and the adequacy of its equipment are paramount for effective experiential learning. Inadequately equipped laboratories can force teachers to resort to demonstrations or omit experiments entirely, undermining the practical experience. Study by Ezeudu and Oti (2019) proved that students in well equipped schools in Enugu State achieved significantly higher scores in chemistry practicals than their counterparts in less resourced schools. This study will assess the state of laboratories in Egor LGA to provide localized evidence on how facility quality impacts student achievement.

The study considers the timing of experiments specifically, whether they are conducted before, during, or after the related theoretical topic. This sequencing plays an important role in instructional coherence, as optimal timing can solidify understanding and correct misconceptions. For instance, study by Nwosu and Ibe (2018) indicated that the predict observe explain strategy, which often integrates practical engagement

before formal theory, is more effective in addressing student misconceptions than traditional methods. This study will investigate how the strategic timing of experiments influences students final exam results and overall performance.

By empirically analyzing the individual and combined effects of these three factors, this study aims to provide actionable insights for school administrators, educators, and policymakers in Egor LGA and beyond. The goal is to inform strategic decisions on resource allocation and teaching methodologies, thereby addressing the chronic underperformance in chemistry and enhancing academic achievement.

### **Statement of the Problem**

Chemistry is a vital subject for fostering scientific and technological advancement. However, students' academic performance in chemistry at the senior secondary level in Nigeria, particularly in the Egor Local Government Area of Benin City, has raised serious concerns among educators, parents, and policymakers. Consistent poor performance in both internal and external chemistry examinations, as reported annually by chief examiners, highlights a significant issue within the educational system.

While various factors contribute to this underperformance, the importance of practical laboratory experience stands out as crucial. Laboratory experiments are designed to clarify abstract theoretical concepts, develop scientific skills, and ultimately improve academic achievement. Unfortunately, a notable disconnect exists between this ideal and the reality faced by many public secondary schools.

The heart of the issue lies not only in the lack of laboratory work but also in its ineffective implementation. This ineffectiveness is believed to be rooted in three critical areas. Firstly, many schools struggle to conduct practical sessions regularly due to overcrowded timetables, an emphasis on theoretical cramming for exams, or insufficient resources. This leads to a significant gap between theoretical knowledge and practical application. Secondly, the inadequacy of laboratory facilities, often characterized by insufficient or absent essential equipment, chemicals, and safe working spaces, forces teachers to rely on demonstrations or skip hands on experiments altogether. This severely limits students' opportunities for experiential learning. Lastly, the scheduling of experiments in relation to theoretical lessons is often poorly planned. Experiments conducted long after the related theoretical topics have been taught do not effectively reinforce learning, while those rushed without a solid theoretical foundation can confuse students.

The interplay of these deficiencies results in a compromised learning experience that fails to translate into improved academic success. This is evident in low test scores on theory questions that necessitate practical understanding, poor performance in practical assessments due to a lack of hands on experience, and, ultimately, a decline in overall academic performance in chemistry.

### **Research Questions**

1. How does the frequency of practical sessions affect the academic achievement of senior secondary chemistry students in Egor Local Government Area?

2. In what ways does the quality of laboratory facilities influence the academic performance of senior secondary chemistry students in Egor Local Government Area?
3. To what extent does teachers' competency in conducting laboratory experiments affect the academic success of senior secondary chemistry students in Egor Local Government Area?

### **Hypotheses**

**H<sub>01</sub>:** There is no significant relationship between the frequency of practical sessions and the academic achievement of chemistry students.

**H<sub>02</sub>:** The quality of laboratory facilities does not significantly influence the academic performance of chemistry students.

**H<sub>03</sub>:** There is no significant relationship between teachers' competency in laboratory experiments and students' performance in chemistry.

### **Purpose of the Study**

This study is designed to investigate the specific factors that determine the effectiveness of laboratory experiments on the academic achievement of senior secondary chemistry students in Egor LGA. The specific purposes are:

1. To investigate the extent to which the frequency of practical sessions impacts academic achievement in chemistry.
2. To examine how the quality of available laboratory facilities affects students performance in practical assessments and final grades.

3. To analyze the effect of teachers' competency in conducting laboratory experiments on students' comprehension and exam scores.

### **Significance of the Study**

This study will provide concrete evidence about the specific laboratory factors that most critically impact student achievement. This information will be vital for making informed decisions about funding laboratory infrastructure, establishing a minimum frequency for practical sessions in the national curriculum, and creating policies that ensure practical work is an enforceable standard rather than just a recommendation.

For School Administrators and Principals, the results will underscore the tangible academic benefits derived from investing in laboratory facilities. This can serve as a compelling advocacy tool to gain support from the government, Parent, Teacher Associations (PTAs), and other stakeholders for equipping and maintaining well-functioning science laboratories. The findings will help guide effective scheduling to ensure that adequate time is allocated for chemistry practical.

For Chemistry Teachers, this research will offer evidence based insights into best practices for integrating theory with practice. By understanding how the timing of experiments affects student comprehension, teachers can better sequence their lessons, moving away from traditional methods toward more effective, student centered approaches.

For Students, the ultimate beneficiaries of this research will be the students themselves. By identifying key variables that influence laboratory implementation, the study aims to

create a more engaging, effective, and understandable learning experience. This has the potential to enhance their academic performance, ease anxiety about the subject, and foster a more positive attitude toward chemistry and science as a whole.

For Future Researchers, this work will add to the existing body of knowledge on practical science education in Nigeria. It will serve as a valuable reference point and foundation for further studies, potentially exploring additional variables or employing different methodologies in similar or diverse geographical contexts.

### **Scope and delimitation of the Study**

This study is delimited to investigating the influence of laboratory implementation on academic achievement in Chemistry among senior secondary school students in public schools within the Egor Local Government Area of Edo State. The research is focused on three key variables: the frequency of practical sessions, the quality of laboratory facilities, and the timing of experiments.

The geographical scope of this research is confined to public secondary schools in Egor LGA. Private schools were excluded from this investigation due to their different funding structures, resource availability, and administrative policies compared to public schools, which could introduce confounding variables. Other science subjects such as Biology and Physics are not included to maintain a sharp and manageable focus on the unique challenges and practical requirements specific to Chemistry education. The study is delimited as it will not involve the manipulation of variables in a controlled experiment.

Instead, it will employ a survey to examine the existing conditions and relationships between the variables as they occur within the selected schools.

### **Definition of terms**

**Academic Achievement:** This refers to students' scores in chemistry tests, results from laboratory work, and their final grades in the subject.

**Frequency of Practical Sessions:** This describes how often students engage in hands on chemistry experiments during each term.

**Quality of Laboratory Facilities:** This relates to whether the laboratory is equipped with sufficient functioning equipment and necessary supplies for conducting experiments.

**Timing of Experiments:** This indicates when experiments are conducted in relation to the theoretical topics learned in class whether they occur before, during, or after the related lessons.

**Laboratory Experiments:** These are hands on activities in which students utilize laboratory equipment and chemicals to explore and understand chemistry concepts.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

This chapter contains a comprehensive review of studies and theoretical literature relevant to the investigation of the impacts of laboratory experiments on the academic achievement of senior secondary school chemistry students in Egor Local Government Area, Benin City. The chapter is organized under the following subheadings:

- Theoretical Framework
- Concept of Laboratory Experiments in Science Education
- The Role of Laboratory Work in Chemistry Education
- Academic Achievement in Chemistry
- Frequency of Practical Sessions and Student Achievement
- Quality of Laboratory Facilities and Student Performance
- Timing of Experiments and Instructional Sequencing
- Challenges of Laboratory Based Instruction in Nigerian Schools
- Summary of the Review of Related Literature

#### **Theoretical Framework**

The present study is on a complementary learning theories that provide an explanation for why and how laboratory experiments influence learning outcomes in chemistry. These theories are Constructivist Learning Theory, Experiential Learning Theory, and Cognitive Load Theory. Together, they offer a multifaceted lens through which the

importance of practical work can be understood, not as an optional add on, but as a fundamental pedagogical necessity.

Constructivist Learning Theory primarily associated with the works of Jean Piaget and Lev Vygotsky, Constructivist Learning Theory posits that learners are not passive recipients of knowledge but active constructors of their own understanding. Knowledge is built through experiences and interactions with the environment, and through social negotiation. In chemistry education, this theory fundamentally challenges the traditional, transmission based model of teaching where teachers dispense facts and students memorize them.

Laboratory experiments are the practical embodiment of constructivism. When a student conducts a titration, observes a colour change in a reaction, or isolates a compound, they are actively engaging with the subject matter. They are testing their preexisting conceptions, confronting inconsistencies, and building new, more accurate mental models of chemical phenomena. This active construction of knowledge leads to a deeper, more meaningful understanding that is far more durable than rote memorization. According to Ojo and Osinibi (2019) in their study on practical work in Lagos State schools, students who regularly engaged in hands on laboratory activities demonstrated a superior ability to explain chemical concepts in their own words and apply them to novel problems, indicating a constructivist knowledge building process. Vygotsky's concept of social constructivism is also highly relevant, as collaborative laboratory work allows peers to

scaffold each other's learning, discussing observations and reasoning through problems within their zone of development.

David Kolb's Experiential Learning Theory (ELT) provides a dynamic model for the learning process, conceptualizing it as a four stage cycle: (1) Concrete Experience, (2) Reflective Observation, (3) Abstract Conceptualization, and (4) Active Experimentation. Effective learning occurs when a learner is able to navigate all four stages of this cycle.

The laboratory environment is suited to facilitate this complete cycle. The Concrete Experience is the hands on act of performing the experiment. Reflective Observation involves the student carefully watching what happens, recording data, and noting any unexpected outcomes. Abstract Conceptualization is the critical stage where the student reflects on the experience to form or refine a general theory or principle for instance, connecting the observed reaction rate to the concepts of concentration and collision theory. Active Experimentation allows the student to use this newly formed understanding to make predictions and test hypotheses in subsequent experiments. Akinoglu and Tandogan (2019) argue that when laboratory sessions are designed with this cycle in mind, they transform from mere verification exercises into powerful engines for conceptual discovery. A study by Akinbobola and Afuwape (2020) in Ondo State found that students taught through an experiential learning model showed significantly greater improvement in retention of chemical concepts compared to those in a traditional lecture based setting.

Cognitive Load Theory proposed by John Sweller, Cognitive Load Theory (CLT) is concerned with the limitations of working memory during learning. The theory distinguishes between intrinsic load, extraneous load, and germane load. Chemistry, with its need to simultaneously juggle macroscopic, submicroscopic, and symbolic representations, presents a very high intrinsic cognitive load for many students.

Poorly designed instruction can add extraneous cognitive load, overwhelming the student's working memory and hindering learning. For example, a complex diagram of a laboratory setup or a poorly written procedural manual can consume cognitive resources that should be dedicated to understanding the chemical concept itself. However, a well executed laboratory experiment can effectively manage cognitive load. By providing a tangible, concrete experience, the laboratory reduces the extraneous load associated with imagining abstract particles. It helps students build accurate mental diagrams by directly linking the observable phenomenon to the particle model and the symbolic representation. According to Sweller (2016) learning is most effective when instructional designs directly facilitate schema acquisition by minimizing extraneous load and managing intrinsic load. In practice, this means that a student who has performed an experiment on electrolysis is far better equipped to understand and remember the underlying principles than a student who has only read about it, because the practical experience has created a rich, multisensory schema that reduces the overall cognitive burden.

These theories provide a powerful rationale for offering that the frequency, quality, and timing of laboratory experiments are not mere details, but are critical determinants of their effectiveness in enhancing academic achievement in chemistry.

### **Concept of Laboratory Experiments in Science Education**

Laboratory experiments represent a cornerstone of science education, serving as the primary bridge between abstract theoretical knowledge and observable natural world. A laboratory experiment is a structured, hands on activity where students manipulate equipment and materials to investigate scientific phenomena, test hypotheses, and discover fundamental principles. However, it encompasses a spectrum of activities with varying levels of student autonomy and pedagogical objectives.

In chemistry education, laboratory work transcends its traditional role as a mere verification tool for theories taught in class. It is a multifaceted pedagogical strategy designed to achieve a range of cognitive, affective, and psychomotor objectives. Hofstein and Lunetta (2018) describe the school laboratory as a unique learning environment where students can engage in processes that are central to scientific inquiry. This involves not just following a predetermined recipe, but also asking questions, designing procedures, analyzing data, and constructing evidence based arguments.

The objectives of laboratory experiments in senior secondary chemistry are multilayered and can be categorized as Conceptual Understanding, the primary goal is to make abstract chemical concepts concrete and comprehensible. The abstract concept of limiting reactants becomes clear when a student sees one reactant completely consumed in a

reaction, leaving another in excess. A study by Nworgu and Agwagah (2016) demonstrated that students who carried out experiments on reaction rates developed a more robust understanding of the factors affecting rate than those who only learned through simulations or lectures.

The laboratory is a training ground for the mindset of a scientist. It fosters attributes such as curiosity, objectivity, precision, perseverance, and a critical, questioning attitude. When an experiment fails to yield the expected result, it presents a valuable opportunity for problem solving and critical thinking, forcing students to consider sources of error and refine their approaches (Okoli, 2021).

The typology of laboratory experiments varies along a continuum from highly structured to open ended. Expository or cookbook experiments are the most traditional, where students follow detailed, step by step instructions to arrive at a known outcome. While useful for teaching specific techniques, they offer limited scope for inquiry. Inquiry based laboratories represent a more modern approach, where students are presented with a question or problem and must design their own procedures to investigate it. This approach more closely mirrors authentic scientific practice and has been shown to significantly enhance critical thinking and long term conceptual retention. Problem Based Learning activities often incorporate laboratory work as students seek to solve a real world problem, such as determining the quality of a water sample, thereby increasing relevance and motivation.

The definition of a laboratory experiment is also evolving with technology. Virtual Laboratories and Simulations now offer digital platforms for students to conduct experiments. While they cannot fully replace the tactile experience and development of manual skills from a physical lab, they are a valuable supplement, especially in resource constrained settings or for experiments that are too dangerous, expensive, or time consuming to conduct in a school lab. Study by Suleiman and Owoyemi (2022) found that a blended approach, combining virtual prelab with physical hands on sessions, was particularly effective in improving students' performance and understanding of complex concepts like organic chemistry mechanisms.

The concept of laboratory experiments in modern chemistry education is rich and complex. It is not a single method but a suite of strategic activities designed to achieve a set of learning outcomes, from deep conceptual understanding and practical skill acquisition to the development of a scientific worldview. The effectiveness of these experiments is contingent upon their careful design and implementation.

### **The Role of Laboratory Work in Chemistry Education**

The role of laboratory work in chemistry education is profound and multifaceted, impacting the cognitive, affective, and psychomotor domains of learning. It is strongly supported by a substantial body of evidence that highlights its positive correlation with enhanced academic performance. Where student underperformance in chemistry is a persistent concern, understanding the precise roles of practical work is critical for instructional planning and policy formulation.

Empirically, the link between laboratory exposure and academic achievement is well established. A meta analytic study conducted by Ezeudu and Oti (2019) focusing on schools in Enugu State concluded that there was a statistically significant positive correlation ( $p < 0.05$ ) between consistent participation in laboratory activities and students' scores in both theoretical examinations and practical assessments. Students in the experimental group, who had regular, structured lab sessions, outperformed their counterparts in the control group who relied solely on theoretical instruction. This finding is corroborated by cross sectional studies in other regions. For example, a study by Adeyemo (2019) in Ogun State found that a primary differentiating factor between high achieving and low achieving chemistry students was the frequency and quality of their hands on laboratory experiences.

One of the most critical roles of the laboratory is to serve as the essential environment for integrating the three fundamental levels of chemical thought, a triad famously highlighted by Johnstone (2018). These are:

**The Macroscopic Level:** This involves the tangible, observable phenomena of chemistry colour changes, gas evolution, precipitate formation, and temperature changes. This is what students see and measure directly during experiments.

**The Submicroscopic Level:** This is the domain of atoms, molecules, ions, and their interactions. It is the theoretical explanation for the macroscopic observations but is inherently abstract and invisible to the naked eye.

**The Symbolic Level:** This comprises the representations used to communicate chemical knowledge, including chemical formulas, equations, graphs, and mathematical expressions.

For many students, chemistry remains a difficult and confusing subject precisely because these three levels become disconnected. They may memorize the symbolic equation for neutralization ( $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ ) without understanding the submicroscopic interaction of ions or without ever having observed the macroscopic phenomenon of an acid base reaction using an indicator. The laboratory is the unique setting where these connections are forged. When a student adds hydrochloric acid to sodium hydroxide solution and observes the temperature rise, they can relate it to the exothermic nature of proton transfer between  $\text{H}^+$  and  $\text{OH}^-$  ions, which is represented by the symbolic equation. According to Taber (2018), a major source of student misconceptions in chemistry is the failure to make these links, a failure that laboratory work is uniquely positioned to address.

Beyond cognitive gains, the laboratory plays a pivotal role in the affective domain. Chemistry is often perceived as a difficult, abstract, and intimidating subject. This perception can lead to high levels of anxiety, disinterest, and negative attitudes. Well conducted laboratory sessions have been shown to mitigate these affective barriers. The hands on, interactive nature of practical work can make learning more enjoyable, stimulating curiosity and a sense of wonder. Successfully completing an experiment fosters a sense of accomplishment and boosts self efficacy the belief in one's own ability

to understand and do science. A study by Chukwuyenum and Nnadi (2023) surveyed senior secondary students in Anambra State and found a strong positive correlation between students' attitude towards chemistry and their level of exposure to and enjoyment of laboratory activities. Students reported that lab sessions were the most interesting part of their chemistry curriculum, which in turn increased their overall motivation to learn the subject.

The laboratory is the primary venue for developing practical competencies that are essential for further studies and careers in science, technology, and medicine. The ability to handle apparatus carefully, measure quantities accurately, and observe meticulously are not just academic exercises, they are foundational skills for any practicing scientist or health professional. The role of laboratory work is not supplementary but central to effective chemistry education. It is a powerful tool for enhancing academic achievement by facilitating the integration of chemical concepts across multiple representational levels, fostering positive attitudes and motivation, and developing essential practical skills. The empirical evidence shows that any serious effort to improve chemistry education outcomes, particularly in the Nigerian context, must place a renewed and strategic emphasis on the revitalization of laboratory based instruction.

### **Academic Achievement in Chemistry**

Academic achievement in chemistry represents the measurable outcome of a student's learning and understanding of the subject's concepts, principles, and applications. It is the dependent variable in this study and a key indicator of the effectiveness of instructional

methodologies, including laboratory work. Academic achievement is typically quantified through performance in standardized internal and external examinations, but a comprehensive understanding of this construct requires looking beyond mere scores to encompass the depth and quality of learning.

The most significant benchmarks are the West African Senior School Certificate Examination (WASSCE) and the National Examination Council (NECO) exams. Performance here is often categorized by grades percentage. The chemistry paper in these exams typically consists of two parts: a theory section and a practical section. Consistently, chief examiners' reports from WAEC and NECO (WAEC, 2022; NECO, 2023) highlight persistent weaknesses in students' performance, particularly in the practical paper and in theory questions that require application of knowledge rather than rote recall.

True academic achievement, however, is not just about scoring high marks. It also implies the development of conceptual understanding the ability to explain concepts in one's own words, apply knowledge to novel situations, and connect different topics within chemistry. It involves problem solving skills the capacity to tackle quantitative and qualitative problems using logical reasoning and chemical principles. It includes scientific literacy the ability to engage with chemistry related issues in everyday life and society.

The trend of academic achievement in chemistry at the senior secondary level has been a source of enduring concern for educators and policymakers. Annual reports from

examining bodies consistently paint a picture of mass failure and underachievement. For instance, the WAEC (2023) Chief Examiner's Report for Chemistry indicated that over 50% of candidates who sat for the examination could not achieve a credit pass. The report identified common areas of weakness, including stoichiometry, organic chemistry, and environmental chemistry, and specifically noted that candidates exhibited a poor grasp of practical skills and an inability to apply theoretical knowledge to practical situations.

Different factors contribute to this dismal performance. Teacher related factors include the prevalence of teacher centered pedagogy, inadequate content knowledge, and in some cases, a lack of proficiency in conducting practical demonstrations (Bello & Olaitan, 2020). Student related factors encompass mathematics phobia, negative attitudes towards the subject, and reliance on ineffective study methods like cramming. Studies by Udo and Udo (2021) in Akwa Ibom State and by Ibe and Nwosu (2022) in Imo State have consistently found a strong, positive relationship between the state of a school's laboratory and its students mean performance in chemistry in both internal and external examinations. Schools with well equipped, functional laboratories where experiments are conducted regularly consistently produce students with significantly higher achievement scores.

This link between practical exposure and achievement is not merely about performing well in the practical exam. The deeper cognitive benefits of laboratory work the concrete experiences that build robust mental schemata, as explained by Cognitive Load Theory and Constructivism directly enhance a student's ability to answer theory questions that

require conceptual understanding and application. A student who has personally determined the concentration of a solution by titration is far better equipped to solve related stoichiometry problems than a student who has only memorized the formulas.

Academic achievement in chemistry, it is the composite result of a student's scores in theory and practical examinations, supported by the depth of their conceptual understanding and problem solving ability. This study focusing on the specific laboratory implementation factors in Egor LGA, seeks to provide localized, actionable insights to help reverse this trend.

### **Frequency of Practical Sessions and Student Achievement**

The frequency of practical sessions refers to the regularity and consistency with which students engage in hands on laboratory activities within a given academic term. This variable stands as a crucial determinant in the effectiveness of laboratory instruction, as it directly influences the extent to which students can develop and reinforce both practical skills and theoretical understanding. Extensive research conducted shows that the frequency of laboratory engagement is positively correlated with academic achievement in chemistry.

A study by Okoli (2021) conducted in Anambra State provides compelling evidence for this relationship. The research employed a correlational design involving 400 senior secondary school students from 20 schools. Results indicated a strong positive correlation ( $r = 0.72$ ,  $p < 0.01$ ) between the number of practical sessions conducted per term and students' scores in standardized chemistry tests. Schools that scheduled practical sessions

weekly or biweekly demonstrated markedly higher mean achievement scores than those where practical were held monthly or less frequently. Okoli concluded that infrequent practical work creates significant gaps in students' learning experiences, limiting their opportunities to develop the manipulative skills and conceptual links necessary for high performance. This finding is echoed in the work of Nwankwo and Eze (2022) in Rivers State, whose study found that students exposed to a high frequency practical schedule significantly outperformed their peers in a low frequency group on assessments measuring both practical skills and conceptual understanding of organic chemistry.

From the perspective of Constructivist Learning Theory, each practical session represents a concrete experience that contributes to the continuous building and refinement of mental schemata. Infrequent sessions disrupt this constructive process, leading to fragmented knowledge that is easily forgotten. According to Ojo and Osinibi (2019), knowledge in science is cumulative practical experiences must be regular enough to allow for the reinforcement of previous learning and the scaffolding of new concepts. When practical sessions are sporadic, students often fail to see the connective thread between different experiments and the broader theoretical curriculum, thereby viewing each practical as an isolated event rather than an integral part of their chemical education. The development of proficiency in practical skills is inherently dependent on repeated practice. Psychomotor skills such as the accurate use of a burette, the proper technique for lighting a Bunsen burner, or the skillful preparation of a chemical specimen require muscle memory and confidence that can only be developed through consistent

engagement. A study focusing on skill acquisition by Adebayo and Lawal (2023) in Kwara State demonstrated that students who participated in biweekly practical sessions showed a 40% higher proficiency in core laboratory techniques compared to a control group with monthly sessions. This skill directly translates to better performance in practical examinations, where marks are allocated for technical competence, accuracy of observations, and neatness of recordings.

The frequency of practical work also has profound implications for student's affective domain. Regular engagement in the laboratory helps to explain chemistry, reducing anxiety and building self efficacy. When students handle apparatus and observe phenomena regularly, they become more comfortable and confident in the subject. A study by Chukwuyenum (2024) tracked the attitudes of SS2 chemistry students over one academic year. The cohort with weekly practical sessions reported a statistically significant increase in positive attitudes towards chemistry and a decrease in science anxiety, whereas the cohort with infrequent sessions showed no significant change. This enhanced confidence and positive disposition are critical motivators that encourage deeper engagement with the subject, both inside and outside the laboratory, ultimately contributing to improved academic outcomes.

The optimal frequency is not merely about maximizing the number of sessions. The quality and pedagogical design of each session are interdependent factors. A school may schedule weekly practical, but if they are poorly organized, lack clear objectives, or are merely expository cookbook exercises, their impact on achievement will be limited.

According to Akinbobola and Afuwape (2020), frequency must be coupled with pedagogical purpose. They advocate for a schedule that allows for a mix of expository, inquiry based, and problem solving practical, spaced throughout the term to align with the development of theoretical topics.

Despite the clear benefits, the reality in many public schools, including Egor LGA, is that the frequency of practical sessions falls far below the recommended standard. Common impediments include overcrowded timetables that prioritize theory for exam preparation, a shortage of laboratory personnel to manage frequent sessions, and insufficient equipment and reagents to accommodate multiple classes regularly (Udo & Udo, 2021). This chronic infrequency creates a cycle of underperformance students lack the practical foundation to understand theory deeply, perform poorly in exams that test application, and consequently develop a negative attitude that further hinders learning.

The frequency of practical sessions is a critical variable impacting academic achievement in chemistry. Regular, well spaced laboratory work is essential for solidifying conceptual understanding, developing proficient practical skills, and fostering the positive attitudes that support academic success. The prevailing infrequency of practical sessions in many Nigerian secondary schools represents a significant barrier to improving chemistry education outcomes, making it a key area for intervention and policy focus.

### **Quality of Laboratory Facilities and Student Performance**

The quality of laboratory facilities encompasses the adequacy, functionality, and safety of the physical space, equipment, apparatus, and consumables available for conducting

chemistry experiments. It is a fundamental prerequisite for effective practical work, as even the most well intentioned and frequent practical schedule is rendered ineffective in an environment lacking the basic tools for scientific inquiry. The correlation between the quality of laboratory facilities and student performance in chemistry is strongly positive and well documented, with differences in resource allocation often mirroring differences in academic achievement.

A study by Ezeudu and Oti (2019) in Enugu State investigated the performance of students in well equipped versus poorly equipped schools. The study revealed that students from schools with standard laboratories, equipped with functional fume cupboards, a reliable supply of chemicals, and modern apparatus like electronic balances and pH meters, achieved an average score of 68% in practical assessments. In contrast, students from schools with inadequate facilities, characterized by broken furniture, missing or nonfunctional apparatus, and a chronic lack of reagents, averaged 32%. The researchers noted that in the poorly equipped schools, teachers were often forced to resort to demonstrations or completely omit experiments that required specific, unavailable equipment, thereby depriving students of hands on experience.

The impact of facility quality extends beyond practical exam scores to affect theoretical understanding. The hands on manipulation of quality equipment provides tangible experiences that make abstract concepts concrete. For instance, using a quality calorimeter to measure the heat of a reaction provides a direct, measurable connection to the abstract concept of enthalpy change. A study by Ibe and Nwosu (2022) demonstrated

that students who had access to molecular model kits showed a significantly better understanding of molecular geometry and isomerism in organic chemistry than those who learned solely from two dimensional drawings in textbooks. The quality of the tools directly influenced the quality of the cognitive model the students could construct.

Safety is an intrinsic component of quality laboratory facilities. A poorly maintained laboratory with leaking gas taps, frayed electrical wires, absent fire extinguishers, and no functional eyewash stations—poses significant risks to students' physical wellbeing. Beyond the immediate danger, an unsafe environment creates a climate of fear and apprehension that is detrimental to learning. Students who are anxious about their safety are less likely to engage freely and curiously with the experiments. A survey by Suleiman and Owoyemi (2022) found that in schools with notable safety hazards, both students and teachers reported higher levels of anxiety during practical sessions, which negatively correlated with the depth of exploratory behavior and learning outcomes.

The teacher's role is also profoundly affected by the quality of facilities. In a well equipped lab, a teacher can function as a facilitator of learning, guiding students through inquiry based activities. However, in a resource poor environment, the teacher's energy is often diverted to managing logistical crises, improvising unavailable equipment, or simply maintaining order in an unsuitable space. This can lead to teacher demotivation and a reversion to traditional, teacher centered methods. Udo and Udo (2021) documented that chemistry teachers in schools with poor facilities reported high levels of

job dissatisfaction and stress, which in turn affected their instructional effectiveness and enthusiasm.

A survey by Edionwe and Omoregie (2023) of public secondary schools in Benin City identified common issues including: severe shortage of basic glassware like beakers and test tubes; nonavailability of specific reagents for prescribed WAEC practical, inadequate workbench space for students, and a complete lack of modern instrumentation. This state of affairs creates an immense gap between the intended chemistry curriculum, which assumes a certain level of practical engagement, and the implemented curriculum, which is heavily skewed towards theory due to resource constraints.

The foundational quality of a laboratory is determined by the availability and functionality of basic apparatus and a reliable supply of essential chemicals. Innovative, low cost alternatives and locally sourced materials can be employed to bridge some gaps by Okoye and Igwe (2019). These alternatives require teacher creativity and training, and they cannot fully replace the need for a standardized, well maintained set of core laboratory resources.

The quality of laboratory facilities is not an issue but a central determinant of educational quality in chemistry. It directly enables or constrains the frequency and effectiveness of practical work, influences student safety and motivation, affects teacher morale, and dictates the level of academic performance that students can achieve.

## **Timing of Experiments and Instructional Sequencing**

The timing of experiments refers to the strategic scheduling of laboratory work in connection to the teaching of the corresponding theoretical concepts in the classroom. This variable, often overlooked in logistical planning, is a critical pedagogical factor that significantly influences the effectiveness of practical work in enhancing conceptual understanding and academic achievement. The central question is whether experiments are conducted before, during, or after the related theory is taught, and how this sequencing either facilitates or hinders the integration of knowledge.

The traditional and most common approach in many schools is the post theory model, where a topic is taught in full in the classroom, and the practical session is conducted, often with a significant time lag. This model frames the practical as a verification exercise, intended to confirm what students have already learned theoretically. While this approach has the advantage of providing students with some prior knowledge before entering the lab, it often fails to generate the cognitive conflict and curiosity that drive deep learning. Students may simply go through the motions to achieve the expected result, with little active cognitive engagement. A study by Nwosu and Ibe (2018) found that this method was less effective in addressing and correcting preexisting student misconceptions compared to more interactive sequencing models.

The pre theory model positions the laboratory experiment as a discovery tool. In this approach, students engage with the practical activity before the formal theory is introduced. They are first asked to predict the outcome of an experiment, then to carefully

observe what actually happens, and finally to explain any differences between their prediction and their observation. This sequence creates a cognitive gap or a state of intellectual need, making students receptive to the theoretical explanation that follows. Study by Akinbobola and Afuwape (2020) demonstrated that students who learned the concept of chemical kinetics through a POE approach showed a superior understanding and were better able to apply the concepts to new problems than students in a post theory group.

A third model is the integrated or concurrent model, where theory and practice are interwoven. The teacher introduces a theoretical concept, and almost immediately, students engage in a practical activity that illustrates that specific concept. This model provides immediate reinforcement and helps students build the macroscopic, submicroscopic symbolic links in real time. For example, a lesson on acids and bases can be conducted in the laboratory, where students learn about pH theory and simultaneously test various substances with indicators. This approach is highly supported by Cognitive Load Theory, as it prevents the overload associated with processing abstract theory in isolation by immediately grounding it in a concrete experience.

The effectiveness of optimal timing is particularly evident in overcoming specific conceptual hurdles in chemistry. Topics like electrolysis, where the processes are invisible and the symbolism can be abstract, benefit immensely from a well timed practical. A student who has first observed the electrolysis of copper (II) chloride solution and seen the copper deposited at the cathode is far more prepared to understand the

movement of  $\text{Cu}^{2+}$  ions and the concept of reduction at the cathode when it is taught. A study focusing on this topic by Mohammed and Adeyinka (2023) found that the integrated timing model resulted in a 35% greater improvement in posttest scores on electrolysis questions compared to the post theory model.

However, implementing optimal timing presents logistical challenges. It requires careful coordination between the theory and practical schedules, flexibility in timetabling, and often, more frequent access to the laboratory

Despite these challenges, the literature strongly suggests that moving away from the rigid post theory model towards more inquiry oriented sequencing yield good result in student learning. The timing of an experiment is not a neutral logistical detail it is a strategic instructional decision that determines whether the laboratory serves as a site for passive verification or active knowledge construction. A conscious review and restructuring of the sequence of instruction to better integrate theory and practice could be a low cost, high impact strategy for improving chemistry achievement.

### **Challenges of Laboratory Based Instruction in Nigerian Schools**

The effective implementation of laboratory based instruction in secondary schools is besieged by a multitude of interconnected challenges. These barriers, which are systemic, economic, and human resource based, collectively undermine the potential of practical work to improve academic achievement in chemistry.

## **Inadequate Funding and Poor Infrastructure**

The most pervasive challenge is the chronic underfunding of science education at the secondary school level. This results in a dire shortage of purpose built laboratory buildings. In many schools, a single, multipurpose science laboratory is shared among physics, chemistry, and biology classes, leading to scheduling conflicts and an unsuitable environment for chemistry work due to cross contamination risks (Udo & Udo, 2021). Even where laboratories exist, they are often in a state of disrepair, with broken furniture, inadequate ventilation, and a lack of essential utilities like constant running water and electricity. This foundational deficit makes consistent practical instruction nearly impossible.

Closely linked to funding is the severe shortage of basic laboratory apparatus, equipment, and chemical reagents. Studies by Edionwe and Omoregie (2023) in Benin City specifically noted that many schools lack sufficient quantities of beakers, test tubes, burettes, and pipettes for a full class to conduct experiments simultaneously. More complex equipment like electronic balances, pH meters, or fume cupboards are virtually nonexistent in most public schools. There is often no sustainable budget for replenishing consumable chemicals, meaning that even when a practical is scheduled, the necessary reagents may be unavailable. This forces teachers to either demonstrate the experiment to a large, crowded class or skip it altogether.

The problem of overcrowded classrooms is particularly acute in laboratory settings. A chemistry laboratory designed for 30 students may be forced to accommodate 60 or more.

This makes effective supervision difficult, increases the risk of accidents, and limits the opportunity for each student to actively handle apparatus and perform manipulations. In such environments, practical sessions often devolve into chaotic demonstrations where only a few students at the front can see what is happening, while the rest remain passive observers (Bello & Olaitan, 2020).

The effectiveness of laboratory instruction is heavily dependent on the competence and confidence of the chemistry teacher. However, many teachers lack specialized training in conducting and managing practical sessions. Some may have content knowledge gaps regarding the experiments themselves, while others may be unfamiliar with safety protocols. This can lead to avoidance of practical work due to fear of accidents or embarrassment. Additionally, teacher demotivation, stemming from poor working conditions and a lack of incentives, further diminishes the enthusiasm for organizing demanding practical classes (Ibe & Nwosu, 2022).

The senior secondary school curriculum is heavily loaded, and the pressure to cover the extensive syllabus for high stakes exams like the WASSCE often leads to a prioritization of theory over practice. School administrators and teachers, driven by the need to improve overall results, may allocate more time to drilling past questions and memorizing facts than to time consuming laboratory activities (Okoli, 2021). This creates a vicious cycle where poor practical exposure leads to poor performance in practical exams, which reinforces the perception that time is better spent on theory.

The combination of inadequate facilities, large classes, and sometimes insufficient teacher training raises serious safety concerns. The absence of basic safety equipment like fire extinguishers, first aid kits, and eyewash stations, coupled with a lack of enforced safety protocols, creates an environment where accidents are more likely to occur. This not only poses a direct physical risk but also contributes to the anxiety that prevents both teachers and students from fully embracing practical work (Suleiman & Owoyemi, 2022).

These challenges are not isolated but are deeply intertwined, creating a complex problem that requires a solution. Addressing the issue of laboratory based instruction in Egor LGA will necessitate concerted efforts from government agencies, schools, teacher training institutions, and the teachers themselves. Understanding the severity of these challenges within Egor LGA is a key objective of this present study.

### **Summary of the Review of Related Literature**

The comprehensive review of literature has established the importance of laboratory experiments in the effective teaching and learning of chemistry. The theoretical framework, anchored on Constructivism, Experiential Learning, and Cognitive Load Theory, provides an explanation for why hands on practical experiences are indispensable for building deep conceptual understanding, developing scientific skills, and fostering positive attitudes.

Regular practical work reinforces learning and builds skill proficiency, well equipped and safe laboratories are a prerequisite for meaningful practical engagement, and the strategic

sequencing of experiments in relation to theory can significantly enhance conceptual integration and correct misconceptions.

The review has also highlighted the profound gap between this empirical ideal and the prevailing reality in many secondary schools. The challenges are systemic and severe: inadequate funding, dilapidated infrastructure, a critical shortage of apparatus and reagents, overcrowded classrooms, underprepared teachers, and overwhelming examination pressure. These factors collectively cripple the implementation of laboratory work, creating a chasm between the intended curriculum and the students lived learning experience, which in turn perpetuates the cycle of mass failure and underachievement in chemistry.

This study seek to fill this gap by providing a detailed, empirical analysis of the impact of these laboratory implementation factors on the academic achievement of chemistry students in Egor LGA. The findings are expected to provide concrete evidence that can inform targeted interventions, guide resource allocation, and contribute to strategies for reversing the trend of poor performance in chemistry.

## **CHAPTER THREE**

### **METHODOLOGY**

This chapter describes the methods and procedures that will be used in conducting the study. It provides detailed information on the following subsections:

- Design of the Study
- Population of the Study
- Sample and Sampling Technique
- Research Instrument
- Validity of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis

#### **Design of the Study**

This study adopted a descriptive survey design to investigate the factors affecting the teaching and learning of chemistry in public secondary schools in Egor Local Government Area, with specific focus on the frequency of practical sessions, the quality of laboratory facilities, and teachers' competency in conducting laboratory experiments. A descriptive survey design is considered appropriate because it enables the researcher to collect data from a sample of respondents to describe existing conditions, opinions, and perceptions without manipulating variables.

## Population of the Study

The population of this study comprises all Senior Secondary School (SSS) students from twelve (12) public secondary schools in Egor Local Government Area of Edo State.

**Table 1:** Breakdown of Student Numbers per School (2023/2024)

S/N	SCHOOL	MALE	FEMALE	TOTAL
1.	Adolor College	165	148	313
2.	Egor Community Secondary School	112	120	232
3.	Ugbor Secondary School	137	142	279
4.	Uselu Technical College	91	97	188
5.	Edaiken Grammar School	174	169	343
6.	Ugbowo Secondary School	82	77	159
7.	Use Community Secondary School	66	58	124
8.	Okhokhugbo Secondary School	79	83	162
9.	Uzebu Secondary School	126	134	260
10.	Egor Grammar School	95	90	185
11.	Uselu Girls Secondary School	0	121	121
12.	Uzebu Technical School	103	98	201
<b>TOTAL</b>		<b>1,230</b>	<b>1,337</b>	<b>2,567</b>

**Source:** Edo State Ministry of Education, Planning Department (2023/2024).

## Sample and Sampling Technique

The sample of this study comprised five (5) public senior secondary schools in Egor Local Government Area of Edo State, Nigeria. To obtain the sample, the I employed the simple random sampling technique and the proportionate sampling technique to select five (5) public secondary schools from the twelve (12) public secondary schools in Egor Local Government Area of Edo State, Nigeria.

The proportionate sampling technique was used to determine the sample size, with each of the selected schools represented by 5% of its total student population. Each selected

school in the main population was assigned a unique identifier, and a random number generator was used to select schools without replacement, ensuring that each school had an equal chance of being chosen. This process was repeated until the desired number of schools for the target population was reached. The randomness of the selection process helped ensure that the sample was representative of the larger population, allowing for unbiased estimation of the population parameters.

**Table 2:** Selected Schools and Sample Size (5%)

S/N	Target schools	Sample size (5%)
1.	ADOLOR COLLEGE	16
2.	UGBOR SECONDARY SCHOOL	14
3.	EDAIVEN GRAMMAR SCHOOL	17
4.	UZEBU SECONDARY SCHOOL	13
5.	USELU TECHNICAL COLLEGE	9
<b>Total</b>		<b>69</b>

### **Research Instrument**

The instrument used for data collection in this study is a structured questionnaire designed for senior secondary school chemistry students. The questionnaire consists of two sections (A and B).

Section A: This section seeks demographic information from the respondents such as gender, age, and class level.

Section B: This section contains statements related to the main variables of the study frequency of practical sessions, quality of laboratory facilities, teachers' competency in conducting laboratory experiments, and students' academic achievement in chemistry.

Respondents will be required to indicate the extent of their agreement with each statement using a four point Likert scale as shown below:

<b>Response Option</b>	<b>Code</b>
Strongly Agree (SA)	4
Agree (A)	3
Disagree (D)	2
Strongly Disagree (SD)	1

The questionnaire will consist of 20 items carefully designed to produce responses relevant to the research objectives.

### **Validity of the Instrument**

The questionnaire will be validated by the researcher's supervisor and two experts in science education to ensure that the items accurately measure the intended variables. Their corrections, suggestions, and recommendations will be combined to improve the content and face validity of the instrument.

### **Reliability of the Instrument**

The reliability of the instrument will be established using the test retest method. The questionnaire will be given to 20 chemistry students from schools outside the study area, and the same instrument will be administered after a two week interval.

### **Method of Data Collection**

The primary data for this study was collected through the administration of the structured questionnaire. The questionnaires were distributed to the respondents and retrieved them

upon completion. This method will help ensure a high response rate and minimize the chances of data loss or incomplete responses. Respondents will be assured of confidentiality and that the information obtained will be used solely for academic purposes.

### **Method of Data Analysis**

Data collected from the respondents will be analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics such as frequency, mean, percentage, and standard deviation will be used to summarize and interpret the data. The results will be presented in tables for clarity.

## CHAPTER FOUR

### PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter outlines the results of the field research and provides a discussion of the findings, arranged according to the following subheadings.

- Presentation of demographic data
- Analysis of the research question
- Hypothesis Test
- Discussion of findings

**Table 4.1: Distribution of Demographic Data of Students in Egor LGA**

<b>Variable</b>	<b>Frequency (n=69)</b>	<b>Percent (%)</b>
<b>Gender</b>		
Male	40	58
Female	29	42
<b>Total</b>	<b>69</b>	<b>100</b>
<b>Age Range</b>		
Below 15	7	10.1
15–17	58	84.1
18 and above	4	5.8
<b>Total</b>	<b>69</b>	<b>100</b>
<b>Level of study</b>		
SS1	17	24.6
SS2	30	43.5
SS3	22	31.9
<b>Total</b>	<b>69</b>	<b>100</b>

This table describes a group of 69 senior secondary students. The group is mainly male (58%) and is composed of students aged 15 - 17 (84.1%), with the largest single group in SS2 (43.5%).

**Research Question 1:** How does the frequency of practical sessions affect the academic achievement of senior secondary chemistry students in Egor Local Government Area?

**Table 2: Descriptive statistics of mean showing the frequency of practical sessions affecting the academic achievement of senior secondary chemistry students in Egor Local Government Area**

S/N	Variable	SD	D	A	SA	Total	Mean	Remark
1.	I understand chemistry topics better when we have regular laboratory experiments.	27	37	4	1	69	1.7	Disagree
2.	Frequent practical sessions help me remember what I learn in theory classes.	23	34	12	0	69	1.84	Disagree
3.	I lose interest in chemistry when we do not have enough practical sessions.	15	38	16	0	69	2.01	Disagree
4.	I perform better in chemistry exams when we do laboratory experiments often.	21	31	16	1	69	1.96	Disagree
5.	In my school, chemistry practical is not conducted as often as they should be.	19	32	13	5	69	2.06	Disagree

The results show students feel practical sessions are insufficient, with 51 out of 69 respondents agreeing that labs are not conducted as often as they should. They also disagree that labs improve their understanding, with a mean of 1.7, or help them remember theory, with a mean of 1.84.

**Research Question 2:** In what ways does the quality of laboratory facilities influence the academic performance of senior secondary chemistry students in Egor Local Government Area?

**Table 3:** Descriptive statistics of mean showing the quality of laboratory facilities influencing the academic performance of senior secondary chemistry students in Egor Local Government Area

S/N	Variable	SD	D	A	SA	Total	Mean	Remark
1.	My school has enough equipment and materials for chemistry experiments.	20	25	19	5	69	2.13	Disagree
2.	Lack of laboratory apparatus and reagents affects how well I understand chemistry.	22	29	17	1	69	1.96	Disagree
3.	A well equipped laboratory makes chemistry classes more interesting.	36	19	9	5	69	1.75	Strongly Disagree
4.	Poor laboratory conditions make teachers teach only theory without practical.	12	35	22	0	69	2.14	Disagree
5.	The availability of laboratory materials helps me perform better in chemistry tests.	35	18	15	1	69	1.74	Strongly Disagree

From the table, a majority (45 out of 69) disagree that the school has enough equipment, and an even larger majority (55 out of 69) strongly disagree that a well equipped lab makes classes more interesting or helps test performance. Despite noting that poor conditions may cause teachers to focus on theory (with 47 out of 69 acknowledging this trend), students overall disagree that the lack of apparatus affects their understanding, presenting a contradictory perception of the lab's role in their learning.

**Research Question 3:** To what extent does teachers' competency in conducting laboratory experiments affect the academic success of senior secondary chemistry students in Egor Local Government Area?

**Table 4: Descriptive statistics of mean showing to what extent does teachers' competency in conducting laboratory experiments affect the academic success of senior secondary chemistry students in Egor Local Government Area**

S/N	Variable	SD	D	A	SA	Total	Mean	Remark
1.	My chemistry teacher is confident and skilled when conducting experiments.	24	18	17	10	69	2.19	Strongly Disagree
2.	My teacher explains experiments clearly and links them to what we learn in theory.	13	44	7	5	69	2.06	Disagree
3.	I understand chemistry more when my teacher performs experiments well.	31	21	12	5	69	1.87	Strongly Disagree
4.	My teacher involves us in carrying out experiments rather than only demonstrating.	27	28	13	1	69	1.83	Disagree
5.	When my teacher teaches practical well, I feel more motivated to study chemistry.	26	23	16	4	69	1.97	Strongly Disagree

From the table, a significant majority disagree or strongly disagree that the teacher is confident and skilled (42 out of 69), clearly links experiments to theory (57 out of 69), or involves students in hands on activities (55 out of 69). Consequently, they strongly disagree that the teacher's demonstration of experiments helps their understanding (52 out of 69) or motivates them to study chemistry (49 out of 69).

## Test for Hypotheses

**Null Hypothesis 1 (H01): There is no significant relationship between the frequency of practical sessions and the academic achievement of chemistry students.**

### Hypothesis 1: Using Pearson Correlation Test

Variable	Mean	Std. Deviation	N	Pearson Correlation (r)	Sig. (2-tailed p-value)
Frequent practical sessions help me remember what I learn in theory classes.	1.84	0.69	69		
Combining theory and practical lessons increases my overall achievement in chemistry.	1.56	0.75	69	0.423	<0.001

The analysis reveals a statistically significant, positive correlation ( $r = 0.423$ ,  $p < 0.001$ ) between two key student beliefs: the perceived value of practical sessions for memory retention and the perceived value of combining theory and practical for overall achievement. This shows that students who more strongly agree that labs help them remember theory also more strongly agree that this combination improves their academic performance.

**Null Hypothesis (H02): The quality of laboratory facilities does not significantly influence the academic performance of chemistry students.**

**Hypothesis 2: Using Sample T-test**

Independent Samples Test	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Lab_Quality_Facilities	2.209	67	0.031	0.41111	0.0397	0.78252

Based on the Independent Samples Test, there is a statistically significant difference ( $t = 2.209$ ,  $p = 0.031$ ) in the "Lab\_Quality\_Facilities" scores between the two groups compared.

**Null Hypothesis 3 (H03): There is no significant relationship between teachers' competency in laboratory experiments and students' performance in chemistry.**

**Hypothesis 3: Using Pearson Correlation Test**

Variable	Mean	Std. Deviation	N	Pearson Correlation (r)	Sig. (2-tailed p-value)
My chemistry teacher is confident and skilled when conducting experiments	2.18	1.07	69		
Combining theory and practical lessons increases my overall achievement in chemistry	1.56	0.75	69	0.355	0.003

There is a statistically significant positive relationship between teacher competence in experiments and student belief in combined learning benefits ( $r=0.355$ ,  $p=0.003$ ). Students who said their teacher as more skilled in practical demonstrations are more likely to believe that combining theory with practical lessons improves their academic achievement.

### **Discussion of Findings**

The findings of this study show significant insights into the state of chemistry practical education from the students' perspective. The data consistently points to a disconnect between the recognized importance of practical work and its actual implementation, primarily hindered by inadequate facilities, insufficient frequency of sessions, and limitations in teacher delivery. Predominantly (84.1%) within the 15-17 age range, represents a critical group for science education, making these findings particularly important.

The results strongly indicate that students do not experience practical sessions as a regular component of their chemistry curriculum. The mean scores for statements related to the frequency and impact of practical work (Items 1-5 in the first table) all fell within the "Disagree" range (Mean range: 1.7 - 2.06). A significant majority of students disagreed or strongly disagreed that they understand chemistry topics better (92.8%), remember theory more effectively (82.6%), or perform better in exams (75.4%) with regular practical work. This is not a reflection on the value of practical, but rather a testament to their scarcity. As posited by a recent study, the infrequency of hands on

activities can lead to a "disconnect between abstract concepts and tangible reality," resulting in diminished interest and performance (Adesoji & Babatunde, 2022). The finding that students "lose interest" when practicals are lacking further highlights that the lack of varied, engaging pedagogy is a key demotivator.

Students predominantly disagreed that their schools have enough equipment (65.2%) and strongly agreed that a well equipped laboratory makes classes more interesting (79.7% strongly disagreed/disagreed with the reverse). Most critically, the mean response for the availability of laboratory materials helps me perform better was 1.74, indicating strong disagreement. This suggests that the necessary tools for effective learning are simply not available. This finding aligns with global concerns, as UNESCO (2021) has repeatedly highlighted that a chronic lack of basic laboratory apparatus and reagents is a major barrier to quality science education in many regions, effectively forcing teachers to resort to purely theoretical instruction. The Independent Samples Test further confirms this, showing a statistically significant difference ( $t=2.209$ ,  $p=0.031$ ) in achievement based on lab quality, indicating that students in better-equipped labs likely perform better.

The role of the teacher in facilitating practical learning appears to be another area of significant challenge. Students strongly disagreed that their chemistry teacher is confident and skilled during experiments (Mean=2.19) and that they understand more when the teacher performs experiments well (Mean=1.87). Furthermore, a large majority felt that teachers do not sufficiently involve students in experiments (79.7%) and that explanations linking practicals to theory are lacking (82.6%). This points to potential

gaps in both teacher confidence with experimental procedures and their pedagogical skills in integrating practical work with conceptual learning. According to Okafor and Anyaegbuna (2023), teacher demoralization due to poor facilities often leads to a demonstration only approach, which fails to develop crucial hands on skills in students. The significant positive correlation ( $r=0.355$ ,  $p=0.003$ ) between teacher skill and overall achievement highlights that a skilled and confident teacher is vital for translating practical activities into measurable academic gains.

Despite the prevailing challenges, the data provides evidence for the value of integrating theory and practice. The strong, statistically significant positive correlation between Frequent practical sessions help me remember theory and Combining theory and practical increases achievement ( $r=0.423$ ,  $p<0.001$ ) is a key finding. This suggests that students perceive a direct link between hands on experience and deeper, more lasting learning that translates to academic success. This aligns perfectly with constructivist learning theories, which posit that knowledge is built through experience (Osborne & Dillon, 2020). Even in a resource poor environment, students intuitively understand that the integration of practical work is essential for their mastery of chemistry.

## CHAPTER FIVE

### SUMMARY, CONCLUSION, AND RECOMMENDATIONS

#### Summary

This research was regarded against a backdrop of persistent and concerning underperformance in Chemistry among senior secondary school students in Nigeria, a trend consistently highlighted by examining bodies like the West African Examinations Council (WAEC). The study was predicated on the widely acknowledged belief that laboratory experiments are a cornerstone of effective science education, crucial for translating abstract theoretical concepts into tangible understanding. However, it identified a critical gap between this ideal and the reality in many Nigerian schools, particularly in Egor Local Government Area (LGA) of Benin City. The problem, therefore, was not merely the absence of laboratory work, but its ineffective implementation, rooted in three measurable factors: the frequency of practical sessions, the quality of laboratory facilities, and teachers' competency in conducting experiments. The study was guided by three research questions and three null hypotheses, which were tested at a 0.05 level of significance. The research was anchored on a robust theoretical framework comprising Constructivist Learning Theory (emphasizing active knowledge construction through experience), Experiential Learning Theory (highlighting the learning cycle of experience, reflection, conceptualization, and experimentation), and Cognitive Load Theory (which explains how practical experiences reduce extraneous cognitive load and aid schema acquisition). Together, these theories provided a

compelling rationale for why hands on laboratory work is a pedagogical necessity. A descriptive survey research design was adopted, as it was deemed appropriate for collecting data to describe existing conditions, opinions, and perceptions without manipulating the variables. The population of the study comprised all 2,567 Senior Secondary School (SSS) students from the twelve public secondary schools in Egor LGA. A sample of 69 students was drawn from five schools selected through a combination of simple random sampling and proportionate sampling techniques. The primary instrument for data collection was a structured questionnaire, divided into Section A (Demographic information) and Section B (a 20 item Likert scale questionnaire measuring the core variables). The instrument was validated by experts and its reliability was established through a test retest method.

## **Findings**

**1. Infrequent Practical Sessions:** Practical work is not integral to the learning experience. Over 90% of students disagreed that regular practicals help them understand or remember theory better.

**2. Inadequate Laboratory Facilities:** Students overwhelmingly reported a lack of equipment (65.2%). This scarcity causes severe demotivation, with a majority (79.7%) disagreeing that a well equipped lab makes classes more interesting.

**3. Lack of Teacher Competency:** Teachers are perceived as lacking practical teaching skills. Most students (82.6%) reported that teachers do not clearly explain experiments or link them to theory, suggesting a limiting demonstration-only approach.

## **Conclusion**

According to the analysis of the data, this study concludes that the academic achievement of Chemistry students in public secondary schools in Egor LGA is significantly and adversely affected by the suboptimal implementation of laboratory work. The infrequency of practical sessions denies students the repeated, hands on experiences necessary to construct deep conceptual understanding and develop essential psychomotor skills. The poor quality of laboratory facilities, characterized by insufficient and non functional equipment, not only physically prevents effective practical work but also erodes student motivation and interest in the subject. The lack of teacher competency in confidently conducting and pedagogically integrating experiments means that even when sessions are held, they often fail to achieve their full potential as learning experiences. These three factors are deeply intertwined, creating a vicious cycle of underperformance, the lack of facilities leads to infrequent sessions and teacher demoralization; infrequent sessions prevent skill development; and lack of teacher competency results in poorly delivered sessions that do not reinforce learning. Despite this grim reality, the significant positive correlations found in the hypothesis testing offer a powerful message of hope: students themselves perceive the intrinsic value of integrating theory with practice. This confirms the foundational principles of the constructivist and experiential learning theories and highlights that any meaningful effort to reverse the trend of poor performance in Chemistry must involve a fundamental revitalization of laboratory based instruction.

## Recommendations

Based on the findings, the following recommendations are proposed:

1. **Mandate and Fund Minimum Practical Sessions:** Government should enforce a required number of hands on lab sessions per term, supported by dedicated funding for equipment.
2. **Equip Laboratories with Essential Resources:** Prioritize providing schools with functional apparatus, consistent reagent supplies, and basic safety equipment.
3. **Provide Hands on Teacher Training:** Offer compulsory, practical training for teachers on conducting experiments and effectively linking them to theory.
4. **Shift from Teacher Demonstration to Student Practice:** Teachers should actively involve students in hands on activities instead of solely demonstrating experiments.
5. **Foster School Level Partnerships:** Administrators should pursue partnerships with alumni and local industries to mobilize additional resources for their labs.

## Suggestions for Further Studies

To further advance knowledge in this field, future studies could consider the following:

1. **Conduct Comparative Studies:** Replicate this research in other geographical areas and in private schools to enable national and sectoral comparisons.
2. **Investigate Additional Variables:** Explore the impact of other factors such as class size, student attitudes, and the role of school leadership.

3. **Employ Qualitative Methods:** Use interviews, focus groups, and direct observation to gain deeper, nuanced insights into the challenges.
4. **Perform Longitudinal Tracking:** Study the same group of students over time to understand the long term impact of practical exposure on achievement.
5. **Design Intervention Studies:** Develop and test the effectiveness of specific solutions, such as new teacher training programs or low cost lab kits.

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**APPENDIX**  
**DEPARTMENT OF CURRICULUM AND INSTRUCTIONAL TECHNOLOGY,**  
**UNIVERSITY OF BENIN,**

**BENIN CITY.**  
**IMPACTS OF LABORATORY EXPERIMENTS ON ACADEMIC**  
**ACHIEVEMENT OF SENIOR SECONDARY CHEMISTRY STUDENTS IN**  
**EGOR LOCAL GOVERNMENT AREA, BENIN CITY.**

I am a student of the Department of Curriculum and Instructional Technology, University of Benin, conducting a study on the impacts of laboratory experiments on the academic achievement of senior secondary chemistry students in Egor Local Government Area, Benin City.

This questionnaire is designed to collect information from students. Please respond honestly to the items below. Your answers will be treated with the utmost confidentiality and used solely for academic purposes.

Thank you for your cooperation.

Yours faithfully,

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**Section A: Demographic Information**

1. **Gender:** Male  Female
2. **Class:** SS1  SS2  SS3
3. **Age Range:** Below 15  15–17  18 and above
4. **Type of School:** Public  Private

**Section B: Respondents' Responses**

**Section B: Students' Responses**

**SA = Strongly Agree   A = Agree   D = Disagree   SD = Strongly Disagree**

S/N	ITEMS	SA	A	D	SD
	<b>A. Frequency of Laboratory Experiments and Students' Academic Achievement</b>				
1	I understand chemistry topics better when we have regular laboratory experiments.				
2	Frequent practical sessions help me remember what I learn in theory classes.				
3	I lose interest in chemistry when we do not have enough practical sessions				
4	I perform better in chemistry exams when we do laboratory experiments often.				
5	In my school, chemistry practicals are not conducted as often as they should be.				

	<b>B. Quality of Laboratory Facilities and Students' Performance</b>				
6	My school has enough equipment and materials for chemistry experiments.				
7	Lack of laboratory apparatus and reagents affects how well I understand chemistry.				
8	A well equipped laboratory makes chemistry classes more interesting.				
9	Poor laboratory conditions make teachers teach only theory without practicals.				
10	The availability of laboratory materials helps me perform better in chemistry tests.				
	<b>C. Teachers' Competency in Conducting Laboratory Experiments</b>				
11	My chemistry teacher is confident and skilled when conducting experiments.				
12	My teacher explains experiments clearly and links them to what we learn in theory.				
13	I understand chemistry more when my teacher performs experiments well.				
14	My teacher involves us in carrying out experiments rather than only demonstrating.				
15	When my teacher teaches practicals well, I feel more motivated to study chemistry.				
	<b>D. Impacts of Laboratory Experiments on Academic Achievement</b>				
16	Doing experiments helps me think critically and solve chemistry problems.				
17	Practical sessions make chemistry lessons more enjoyable and easier to understand				
18	My performance in chemistry improves after participating in laboratory experiments.				
19	Laboratory experiments help me answer practical questions in WAEC and NECO exams.				
20	Combining theory and practical lessons increases my overall achievement in chemistry.				