



**SCHOOL OF GRADUATE STUDIES COLLEGE OF NATURAL AND
COMPUTATIONAL SCIENCES DEPARTMENT OF CHEMISTRY**

**OBSTACLES IN CHEMISTRY LABORATORY IMPLEMENTATION: A STUDY OF
TWO SCHOOLS IN KAMBATA ZONE, ETHIOPIA**

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HAWASSA, ETHIOPIA

**OBSTACLES IN CHEMISTRY LABORATORY IMPLEMENTATION: A STUDY OF
ANGACHA AND FUNAMURA SECONDARY SCHOOLS IN KAMBATA ZONE
CETRAL REGIONAL STATE, ETHIOPIA**

BY: - TADESSE SHOMORO

**A MASTER THESIS SUBMITTED TO THE DEPARTMENT OF CHEMISTRY,
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FOR THE DEGREE OF MASTERS OF SCIENCE IN CHEMISTRY**

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HAWASSA, ETHIOPIA**

DECLARATION

The research work embodied in this thesis entitled” **OBSTACLES IN CHEMISTRY LABORATORY IMPLEMENTATION: A STUDY OF ANGACHA AND FUNAMURA SECONDARY SCHOOLS IN KABATA ZONE, CETRAL REGIONAL STATE, ETHIOPIA** “was carried out by me in the Department of chemistry, college of Natural and Computational sciences, Hawassa University. The extent and source of information derived from the existing literature have been indicated throughout the thesis at appropriate places. The work is original and has not been submitted partly or fully for any diploma or degree of any other university/institute.

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ADVISORS' APPROVAL SHEET

(Submission Sheet-1)

This is to certify that the thesis entitled “**obstacles in chemistry laboratory implementation: A study of Angacha and funamura secondary schools in kambata zone, central regional state, Ethiopia**” Submitted in partial fulfillment of the requirement for the Degree of Master of Science in chemistry. The graduate program of the Department/School of Graduate studies, and has been carried out by:

Tadesse Shomoro. ID. No GpChemk/012/10 under my supervision.

Therefore I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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We undersigned, members of the board of examiners of the final open defense by Tadesse Shomoro have read and evaluated his thesis entitled **“obstacles in chemistry laboratory implementation: A study of Angacha and funamura secondary schools, kabata zone central regional state, Ethiopia”** and examined the candidate. This is, therefore, to certify that the thesis has been accepted in partial fulfillments for the degree of Master of Science in chemistry in our guide lines.

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ABBREVIATIONS AND ACCRONYMS

KNEC Kenya National Examination Council

MoEVT Ministry of Education and Vocational Training

NESTA National Endowment for Science Technology and the Arts

SEDP Secondary Education Development Plan

SPSS Statistical Packages for the Social Sciences

UK United Kingdom

UNESCO United Nations Educational Scientific and Cultural Organization

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ABSTRACT

The effective implementation of chemistry practical work faces numerous challenges globally, particularly in developing nations. Common obstacles include insufficient laboratory facilities, insufficient funding for practical science instruction, equipment, and supplies, as well as a shortage of qualified teachers. This study investigated the factors obstacle laboratory implementation in chemistry instruction at Angacha and Funamura Secondary Schools in Kabata Zone, Central Regional State, Ethiopia. A total of 213 individuals participated in the study, comprising 192 students, 14 teachers, 2 laboratory technicians, and 5 school principals from public secondary schools within the zone. Employing a descriptive survey research design and a quantitative approach, data collected from the target population were analyzed using SPSS version 26. The findings revealed that the availability of laboratory technicians, along with the attitudes of students, laboratory technicians, and teachers, significantly influenced the use of chemistry experiments in teaching and learning. Furthermore, while laboratories existed in the schools, they were underutilized due to a lack of adequate apparatus.

Keyword: Availability, Challenges, Chemistry, implementation.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Chemistry is the branch of science that deals with the study of the composition and properties of matter, changes in matter, and the laws and principles that govern these changes (Brown et al., 2021). Along with biology and physics, chemistry is taught at the secondary level. The Kenya National Examinations Council (KNEC) syllabus presents it as a practical subject where experimental investigations are anticipated to build scientific concepts, principles, and abilities. KNEC (2005) In contrast to the virtual world, laboratory practicals are teaching and learning activities for any science that require students to work alone or in small groups while manipulating and/or observing actual and virtual items and materials. Additionally, practical activity can help students develop good attitudes and give them the chance to learn teamwork and communication skills (Hofstein, 2015a).

The effective implementation of practical work in science education is a widespread challenge, particularly in developing nations. Many countries, especially in Africa, face significant obstacles such as inadequate laboratory facilities, equipment, and supplies; insufficient funding for practical science instruction; under-trained educators; inconsistent protocol implementation; overloaded curricula; and a lack of qualified teachers (Mathewos A. et al., 2016). Addressing these challenges in chemistry teaching requires a global perspective combined with locally tailored solutions. Successfully resolving laboratory implementation issues is a complex and ongoing process that necessitates prioritized interventions. While Ethiopia has made strides in improving the learning environment (World Bank, 2013), challenges persist, particularly in disadvantaged areas. A significant proportion of secondary schools lack internet connectivity and sufficient classrooms, and many laboratories suffer from a lack of basic equipment and supplies. The quality of education remains a key concern. Developing nations face the dual challenge of expanding access to secondary education while simultaneously ensuring equity, quality, and relevance (World Bank, 2005). Addressing the quality question requires concerted effort from

teachers, students, school leaders, educational officials, and the wider community.

A fundamental issue facing high school chemistry laboratories is the lack of standardized laboratory buildings and facilities, an area requiring thorough investigation. It is widely accepted that meaningful science learning requires valuable practical experiences in the laboratory (Hofstein & Naaman, 2007). Chemistry, as an experimental science, cannot be effectively taught without laboratory work and active student engagement. Therefore, improving the environment for experimental science teaching, particularly in chemistry, is crucial. According to Anza et al. (2016), there is broad agreement regarding the value of practical work in science and that high-quality practical work fosters student interest and engagement while also fostering the development of a variety of skills, scientific knowledge, and conceptual understanding.

Chemistry students need to develop skills through the appropriate use of laboratory resources. Adequate laboratory utilization has a positive impact on student achievement in chemistry (Wanjiku, 2013); suggesting that both theoretical knowledge and practical skills are essential, and that laboratory practice and demonstrations are vital components of chemistry education.

1.2 Statement of the Problem

Experimental activities are essential for effective science teaching. Real learning occurs when students actively observe experiments. The lack of laboratory equipment significantly hinders chemistry instruction (Umar K. et al., 2013). Chalkboard explanations and textbook descriptions are insufficient substitutes for hands-on experimentation. The chemistry laboratory should be a space where students learn to research, organize, analyze, and interpret scientific data. Practical work is considered a vital activity in school science. Nationally, Ethiopian students' achievement in chemistry is low; failing to meet expected learning outcomes. Research has identified several factors contributing to this, including poor teaching methodologies (Hastings & Bham, 2003), lack of laboratory resources and their inadequate use (Otieno, 2012), poor school administration and leadership, low teacher commitment, insufficient school supervision (Otieno & Deya, 2018), and poor performance in practical activities (Onderi & Malala, 2012).

Laboratory/practical classes and workshops are essential for training experimental scientists

(Boud, 2006; Exley, 2000). Laboratory sessions cater to student needs and offer diverse learning objectives, including developing practical skills, planning testing programs, connecting theory and practice, collecting and analyzing data, making observations, formulating and testing hypotheses, applying judgment, cultivating problem-solving abilities, communicating concepts and data, developing personal skills, conducting risk assessments, and establishing safe working practices (Fry H. et al., 2009).

Some schools in Kambata Zone lack standardized laboratories with the necessary equipment for safety and experiential learning, hindering the development of students' natural curiosity. This study aims to identify the factors obstacles laboratory implementation in chemistry instruction at Angacha and Funamura Secondary Schools in Angacha town, addressing issues that require attention.

1.3 OBJECTIVES OF THE STUDY

1.3.1 General Objective

The general objective of this study is to identify the obstacles in chemistry laboratory implementation: A study of Angacha and Funamura secondary schools in Kabata zone, central regional state, Ethiopia

1.3.2 Specific Objectives

- ✓ To identify the extent of factors obstacles practicability of experimental activities in chemistry laboratories in study Area
- ✓ To assess students, teachers and lab technicians attitude towards chemistry experimental work in study area
- ✓ To analyze the level of participation of students in practical activities of chemistry lessons in study area
- ✓ To establish availability of chemistry facilities and their use in the chemistry practical work in public secondary schools in Kambata Zone, Central State, and Ethiopian.

1.4 Research Questions

1. To What extents does factors' obstacle practicability of experimental activities in chemistry laboratories?
2. How is the attitude and attention of the students, teachers and lab technicians to conduct the experiments in school laboratories?
3. What is the extent of care and support of school administrators to laboratory facilities and related follow ups?

1.5 Significance of the Study

This study's findings are intended to benefit various stakeholders in the education sector, particularly in science education. The findings can inform improvements to the educational system. The study also aims to contribute to existing research by providing valuable data and literature for future studies. The target beneficiaries include chemistry teachers, chemistry students, school principals, school laboratory technicians, curriculum developers, and future researchers. The findings may also provide laboratory technicians with insights into better ways of organizing chemistry laboratories.

The study, limited to two public secondary schools in Kambata Zone, can inform teachers, as curriculum implementers, about better ways of organizing and using chemistry laboratories, both for utilizing existing facilities and establishing new ones. The study can also serve as a starting point for professionals to address challenges in implementing experimental activities in chemistry laboratories. The findings may allow professionals to assess the current state of their chemistry laboratories and make necessary adjustments. Furthermore, the research can provide insights for chemistry curriculum developers regarding practical activities that enhance student understanding of scientific concepts and principles. Finally, the study can stimulate future research in this area.

1.6 Delimitation of the Study

This study does not cover all content areas of chemistry. Any technical discussions are solely for enriching and clarifying the analysis. The study focuses on the implementation of chemistry laboratory facilities for teaching and learning in two public secondary schools in Kambata Zone.

All chemistry teachers, laboratory technicians, principals, and vice-directors in these schools were included using purposive sampling. A statistically determined number of 11th and 12th-grade natural science stream students from each school were selected using systematic sampling.

1.7 Limitation of the Study

Internet connectivity issues, data costs, and work commitments presented significant challenges. Time constraints, combining academic and research work, and financial limitations also posed barriers. The small sample size limits the generalizability of the results to other regions. Data collection from respondents, especially teachers preoccupied with their official duties, was challenging.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

A nation's ability to produce well-qualified scientists with a strong science background depends on a science curriculum that fosters scientific inquiry and engages students in practical experiences, meeting societal needs at all educational levels (Wrightson et al., 2008). Chemistry laboratory courses exemplify such curricular requirements. However, laboratory work, particularly in chemistry, often involves potential exposure to hazardous materials and the risk of accidents (Young, 2003; Ong, McLean & Greco, 2012). Creating a safe and healthy learning environment in school laboratories and preparing students who are responsible, respectful, and easily supervised, and who avoid dangerous activities, has become a major concern for many schools (Bradley, 2011).

In countries with a tradition of practical chemistry teaching (e.g., the UK), such activities are often considered central to the appeal and effectiveness of chemistry teaching (Abraham & Millar, 2008). While many science teachers believe that practical work leads to better learning and performance, some educators have expressed concerns about its effectiveness (Millar, 2009). For example, Abimbola's (1994) research suggests that continuing to prioritize laboratory work in science teaching may no longer be reasonable or feasible in developing countries. School leaders and stakeholders must address the challenges of experimental subjects to achieve curriculum goals and maximize outcomes, recognizing education as a nation-building tool.

Many high schools and preparatory schools struggle to provide properly functioning laboratories with necessary facilities and qualified personnel. Substandard chemistry laboratories negatively impact the attitudes, interests, and mindsets of future stakeholders.

This chapter reviews the literature related to factors influencing laboratory implementation in high school chemistry teaching. It examines the rationale for teaching chemistry, community secondary schools, approaches to science teaching and learning, practical work, its role in science education, and the status of practical science in schools.

2.2 The Rationale for Teaching Chemistry

Chemistry, a branch of natural science, focuses on the composition, properties, and changes of matter (Osborne & Dillon, 2010). It often combines theoretical knowledge with hands-on laboratory experiments (Wahyudiati, 2022). Practical activity has been significant in science education since its inclusion in many countries' curricula in the late nineteenth century (Oliveira & Bonito, 2023). The incorporation of laboratory activities reflects a pedagogical shift towards active learning, moving beyond rote memorization to more experiential learning. Practical work bridges theoretical understanding and practical applications, providing tangible experiences that enhance student engagement and retention (Holstein & Lunetta, 2004).

Practical work develops problem-solving skills and enhances conceptual understanding (Alkan, 2016). By simulating scientific practices, it aims to improve students' knowledge, problem-solving abilities, and understanding of chemistry (Sotiriou et al., 2017). Practical experiments strengthen comprehension of theoretical ideas and develop scientific thinking skills through problem-solving, evidence evaluation, and judgment. Studies have shown that practical work enhances communication skills, enables effective problem-solving, and boosts motivation in science (Holstein & Lunetta, 2004). For example, titration experiments demonstrate chemistry as an applied science, where students directly observe accurate measurements and chemical reactions.

2.3 Effective Strategies for Teaching Chemistry

Chemistry teachers should prioritize conceptual learning goals, focusing on broad concepts within the major ideas of chemistry. Connecting new information to prior knowledge increases student engagement and understanding. Formulating essential or guiding questions at the beginning of each lesson allows teachers and students to focus on key learning objectives (ACS, 2012). Employing diverse teaching methods is essential for effective teaching and learning. For science subjects, strategies such as inquiry-based learning, project-based learning, lecture-demonstrations, experiments, cooperative learning and problem-solving are recommended. Inquiry-based instruction enhances reasoning skills and provides experiences that support cognitive development. Small group work promotes participatory and cooperative learning (URT, 2010a). Utilizing multiple teaching methods is crucial for learners' holistic development.

Experimental learning, connecting theoretical knowledge with laboratory observations, is a key teaching modality in high schools.

2.4 Chemistry Practical as a Teaching Mode

Practical work in chemistry has evolved. Gott & Duggan (2007) note a trend from illustrative demonstrations to more open-ended, laboratory-based inquiries, where students plan research, collect data, and analyze it.

Practical activities make learning more concrete, engaging, and facilitate the acquisition and application of skills, ideas, knowledge, and attitudes. Watson (2000) argues that while the type of practical work has changed, the goals remain: promoting logical reasoning, arousing and maintaining interest, encouraging accurate observation and recording, and making phenomena real. Practical chemistry instruction fosters curiosity and encourages further exploration.

2.5 Experiential Teaching and Learning Chemistry

Chemistry involves observation, classification, measurement, prediction, problem identification, data collection, analysis, interpretation, conclusion drawing, and experimentation. Practical work is essential in chemistry education, enhancing understanding of scientific concepts, developing scientific skills (cognitive and manipulative), and increasing motivation. However, achieving these goals depends on how practical work is organized (Mafumiko, 2006). Chemistry instruction requires careful planning, focusing on desired student outcomes.

Experiential learning involves:

- Active and direct interaction with the environment using multiple senses.
- Moving beyond textbooks as the sole source of knowledge.
- Ongoing dialogue between experience and reflection (Dewey, 2018).
- Transforming experience into new information (Kolb, 2004; Natural Curiosity Manual, 2011).

Hands-on activities facilitate knowledge dissemination and provide opportunities for developing understanding and scientific inquiry (Abrahams & Millar, 2008). Practical work helps students connect the domains of observable objects and events with the domain of ideas (Millar, 2004). The success of practical exercises depends on aligning laboratory work with learning objectives. Practical work allows learners to use scientific equipment, develop manipulative skills, practice

investigative activities, and develop problem-solving attitudes (Mustapha, 2002). Laboratory exercises that promote active engagement and critical thinking lead to deeper comprehension (Omosewo, 2006) and provide concrete experiences to support theoretical learning. Connecting theory with experimental research sparks student interest.

Students with more practical experience tend to perform better than those with limited practical skills (Usmani, 2011), suggesting a close relationship between theory and practice. Students view practical work as beneficial to their learning and enjoyment of science. Chemistry without experimental work is unimaginable (Petty, 2009).

2.6 The Laboratory Experience in High School Chemistry

The chemistry laboratory offers a valuable opportunity to connect the microscopic and macroscopic worlds. It facilitates inquiry-based learning, team building, practical exercises, and exposure to laboratory tools and technologies (ACS, 2012).

Laboratory-based teaching and learning is more learner-centered (Motswiri, 2004). Chemistry teaching objectives should include providing tangible experiences to address misconceptions, opportunities to manipulate data, and practice logical thinking related to science, technology, and society, and building values related to chemistry.

Laboratory exercises should involve pre-lab, lab procedure, and post-lab stages (ACS, 2012). The pre-lab stage allows students to review relevant material and formulate predictions. The lab procedure stage involves planning, identifying and controlling variables, observation, measurement, classification, and recording. The post-lab stage requires data analysis, evaluating the procedure, creating models, and presenting findings. Practical teaching promotes cognitive abilities such as problem-solving, analysis, generalization, evaluation, decision-making, and creativity (Tilya, 2003; Mafumiko, 2006). It also develops manipulative, inquisitive, investigative, organizational, and communicative skills. Practical work helps students understand scientific inquiry processes. Effective chemistry teaching requires well-trained teachers (Kitta & Mafumiko, 2009). Laboratory applications make complex concepts easier to understand. Video displays can supplement hands-on experiments for risky or impractical activities (ACS, 2012). Teachers must stay current with educational technology.

2.7 Chemistry Laboratory Teaching Status in Developing Countries

Studies in Sub-Saharan Africa indicate that rote memorization and textbook-based teaching are prevalent, with practical work comprising less than 20% of science instruction due to lack of equipment and facilities (AHDD, 2007). In Kenya, student-centered teaching strategies that engage multiple senses are more effective than teacher-centered approaches (Wachanga & Mwangwi, 2004). Teacher motivation for activity-based learning is waning due to various challenges.

In Nigeria, many secondary school students are unfamiliar with basic chemistry lab equipment (Ogunbiyi, 1986). Malawi faces severe shortages of laboratory space and equipment, with much practical work done theoretically (Zeymelman, 1990). In Ethiopia, while practical laboratory instruction is recognized as enhancing learning, shortages of qualified personnel, chemicals, and supplies hinder its implementation (Nigussie et al., 2018). Studies in Ethiopia's Bale Zone revealed that teachers do not integrate laboratory activities into lesson plans or assess student performance through practical exercises (Chala et al., 2019). In Afar, schools lack separate, well-equipped laboratories, laboratory technicians, manuals, chemicals, and apparatuses. Laboratories may contain dangerous and expired substances, and overcrowding is an issue.

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Study Area

Angacha is a *woreda* (district) in the Southern Nations, Nationalities, and Peoples' Region of Ethiopia, within the Kambata Zone. It is bordered by Kacha Bira to the south, Doyogena to the west, Hadiya Zone to the north, Damboya to the east, and Kedida Gamela to the southeast. The administrative center of Angacha is the town of Angacha. **Funemura**, a rapidly developing town, is in the northern part of the *woreda*. The western portion of Angacha, including the town of Amecho Wato, was separated to form the Doyogena *woreda*. Angacha has 77 kilometers of all-weather roads and 45 kilometers of dry-weather roads, resulting in a road density of 381 kilometers per 1000 square kilometers.

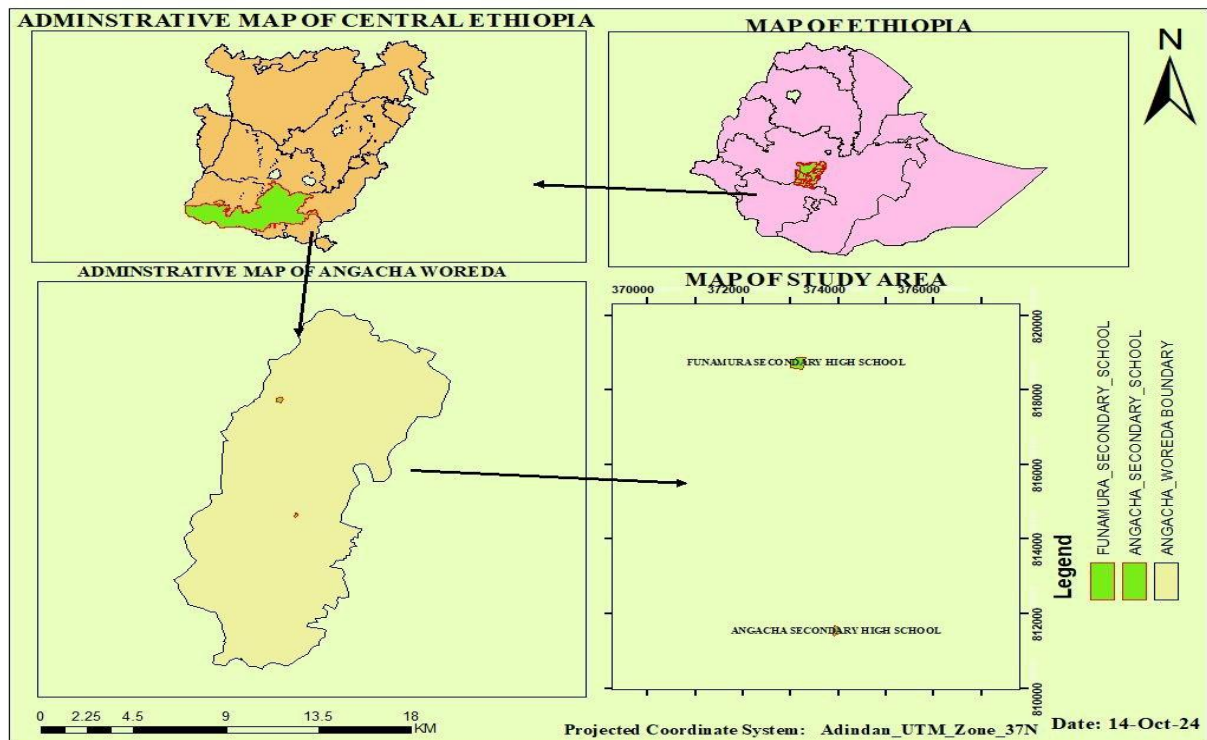


Figure 3.1 map of Angacha and funamura secondary schools

3.2 Research Approach

In the study, A mixed research approach specifically, descriptive survey technique was employed. A mixed research approach was employed as the advantage arose in using both quantitative and qualitative designs. Although there are many different reasons to use mixed designs, (Creswell & Zhang 2009), it pointed out that they can be broadly characterized as strategies to increase the breadth or scope of research to offset the shortcomings of either strategy alone. Furthermore, a survey design is used to gather information from members of a population to ascertain the current status of that group with regard to one or more variables, as noted by (Mugenda & Mugenda 2003). The study used survey design was adopted since it involved collecting data to answer questions regarding the current status of focus of the study. The use of a variety of tools, such as questionnaires, interview schedules, and observation schedules, is also made possible by survey design.

The study used questionnaires, an interview schedule and an observation schedule to obtain both qualitative and quantitative data from students, teachers, school principals and laboratory technicians regarding the laboratory implementation in teaching chemistry in Angacha and Funamura higher secondary schools in Kambata zone, central state, Ethiopian.

3.3 Research Design

A research design, according to Jaakkola (2020), is a set of rules and directives that are adhered to when performing research. Gaining more control over the study is the aim of the research design (Hennink, Hutter, & Bailey, 2020).It structures the study and demonstrates how all elements work together to answer the research question. Frankel & Wallen (2000) describe a descriptive research design as one that allows for the use of both qualitative and quantitative methods while providing a description of the current situation.

Data was collected using questionnaires and observation checklists focused on chemistry laboratories, teachers, and lab technicians, exploring their opinions and the extent of their and their students' participation in experimental work. School principals also completed a questionnaire designed to investigate their involvement in chemistry laboratory application,

support for lab facilities, and follow-up activities. The condition of the chemistry laboratories was observed and documented. Data sources included recorded documents (student lab attendance, lab reports, and other previous documents) and observations during the initial months of the new academic year.

3.4 Target Population

A target population is a group of individuals, items, or entities from which samples are drawn for measurement (Kombo & Tromp, 2006). Omari (2011) defines a population as the entirety of any set of units sharing one or more characteristics of interest to the researcher. The population for this study included school directors, vice directors, chemistry teachers, laboratory technicians, and 11th and 12th-grade natural science stream chemistry students in the target schools.

3.4.1 The Sample of the Study

A sample is a smaller, representative portion of a population selected for observation and analysis (Omari, 2011). Samples are subsets of a larger population (Kombo & Tromp, 2006). The sample for this study included all vice directors and principals, all chemistry teachers and laboratory technicians, and 11th and 12th-grade natural science stream chemistry students selected using systematic random sampling.

Because the study investigates factors obstacles the implementation of experimental chemistry learning, 11th and 12th-grade students were chosen as the population. These students, having spent at least one academic year in the schools, were considered the best sources of information regarding the schools' current and past chemistry experimental practices. A sample size of 213 students was determined by calculating 10% of the total student population (460) in the target schools and grade levels. Mugenda & Mugenda (2003) suggest that a 10% sample is sufficient for descriptive studies.

3.4.2 Sampling Procedures

Sampling is the process of selecting individuals, locations, or items for study. It involves choosing a subset of a population that represents the characteristics of the entire group (Kombo & Tromp, 2006). This study used purposive sampling for school leaders, chemistry teachers, and

lab technicians, and systematic random sampling for students. Purposive sampling, according to Kombo & Tromp (2006), involves targeting specific groups believed to be informative for the study. School leaders (directors), chemistry teachers, and lab technicians were purposively selected because they are directly responsible for the success or failure of laboratory implementation.

Systematic sampling introduces randomness by using random numbers to select the starting unit (Cothari, 2004). After a random starting point is chosen, every n^{th} item is included in the sample. Student lists were collected from the schools, and only 11th and 12th-grade natural science stream students were included in the selection process. After arranging the lists systematically, 10% of the total population was calculated to determine the number of sample students. Systematic sampling was then used to select the students, resulting in a sample of 213 students. The study focused on Angacha and Funamura High Schools in Kambata Zone, Central Regional State, Ethiopia, targeting 11th and 12th-grade chemistry students.

Table 3. 1 Population and Sample Size of Respondents

Selected secondary school	Chemistry teacher			School principal			Lab technical			Students			Tot.
	M	F	Tot.	M	F	Tot.	M	F	Tot.	M	F	Tot.	
Angacha	6	2	8	3	0	3	1	0	1	65	50	115	127
Funamura	6	0	6	2	0	2	1	0	1	50	48	98	107
Tot.	12	2	14	5	0	5	2	0	2	115	98	213	234

*Note: M = male, F = Female, Tot. = total

In this study, all chemistry teachers, school principals, and laboratory technicians from both schools were included in the sample. Representative student samples were selected for the study.

3.5 Data Collection Procedures

Before data collection, the researcher contacted Woreda education officers to obtain cooperation letters for the target schools. Data collection tools (questionnaires and observation checklists) were developed based on research objectives and questions. School leaders were contacted, and data collection assistants were selected and trained on effective strategies and ethical considerations. These assistants played a key role in supporting and coordinating the orientation and data collection process. Training was provided to two assistants, one from each school. The sample subjects were informed about the investigation and were positive towards the study. Questionnaires were reviewed by individuals from the various sample groups for feedback and modifications before being printed, reproduced, and distributed. Data collection involved structured observations of the chemistry laboratories and documentation review.

3.6 Data Collection Techniques and Instrumentations

This mixed-methods research collected both qualitative and quantitative data. Qualitative data was gathered using sequential interviews and observation checklists. Quantitative data was collected using survey questionnaires and rating scales. A five-point rating scale was used (Strongly Agree = 5, Agree = 4, Neither Agree nor Disagree = 3, Disagree = 2, Strongly Disagree = 1). The instrument was validated by chemistry teaching and measurement/evaluation experts. The questionnaire, distributed to chemistry teachers with a 100% return rate, was analyzed using frequency percentages. The instrument included both structured and unstructured questions, divided into two sections: personal data and questions based on the research questions, using an adapted five-point Likert scale. The research instruments were validated by two chemistry teachers and experts, and their suggestions were incorporated. Data was analyzed using frequency distribution. The research employed various instruments, including questionnaires, observation schedules, rating scales, and interview schedules.

3.7 Instruments for Data Collection

This study used multiple data collection methods, including observation of physical conditions and review of written laboratory documents to support and verify questionnaire data.

3.8 Validity of Instruments

Validity, according to Vakili & Jahangiri (2018), establishes if the study tools accurately measure what they were designed to measure. To check the questionnaire's Validity, the extent to which a test measures what it intends to measure, is crucial. In this study, questionnaire item validity was assessed by experts (chemistry teachers and experienced language teachers) who reviewed the questionnaires for the four sample groups.

3.9 Reliability of the Instruments

Reliability, the consistency of a test's measurements, was ensured through a pilot test at Angacha Comprehensive High School (not a target school). Ten teachers, fifteen randomly selected 11th and 12th-grade students, one laboratory technician, and one school principal participated. The pilot test data was analyzed using Cronbach's alpha to assess instrument reliability. The alpha coefficient for the items ranged from 0.71 to 0.91, indicating homogeneity and demonstrating that each item contributed to measuring a single construct (Cohen et al., 2007).

3.10 Data Analysis and Interpretation

This chapter presents the analyzed and interpreted data collected through questionnaires, document analysis, and observation checklists from 213 students, 14 chemistry teachers, 2 lab technicians, and 5 principals from the sampled schools. Questionnaires from the smaller sample groups (principals, teachers, and technicians) were also processed. Descriptive statistics (percentages, frequency distribution, means, and standard deviations) were used for interpretation, conclusions, and recommendations. Qualitative data from observation checklists provided crucial support for interpreting the quantitative data. According to Yıldırım & Şimşek (2016), similar data are grouped together around specific concepts and themes, which are then structured and analyzed in a way that makes sense.

3.11 Ethical Considerations

Earl-Babbie (2013) defined ethics as a conforming to the standards of conducts of a given profession or group. He goes on to say that everyone working in research must be aware of the broad consensus among scientists regarding what constitutes appropriate and inappropriate behavior in scientific investigations. For harmonious research process, Ethical standards were

maintained through confidentiality, anonymity, and informed consent. Permission was obtained from school administrations before data collection. School principals, technicians, and teachers were included after proper communication and ethical interactions. The study's purpose and methods were explained. Ethical issues were emphasized in the training for data collection assistants. Respondent confidentiality and privacy were protected.

CHAPTER FOUR

RESULT AND DISCUSSION

4. Introduction

This chapter focuses on the analysis of the findings that emerged from the data gathered. The study investigated obstacles laboratory implementation in teaching chemistry in comprehensive high schools: A Study of Angacha and funamura secondary school, kabata zone central regional state, Ethiopia. The data analysis is presented and analyzed using frequency tables, figures, and texts. The chapter begins with an analysis of the questionnaire return rate for the respondents followed by the demographic data analysis. Thereafter, the findings are presented in line with the research objectives.

4.1 Questionnaire Return Rate

The analysis of the questionnaires' return rate for the number of respondents who participated in the study is presented in table 4.1.

Table 4. 1 Instruments return rate

Respondents	Distributed Questionnaire	Returned Questionnaire	Return rate (%)
Students	216	213	98.61
Chemistry teachers	14	14	100
Lab technical	2	2	100
Schools principal	5	5	100
Total	237	234	98.73

Of the 237 individuals targeted for participation in this study, 234 completed the questionnaires, representing a response rate of 98.73%. Participants included 115 students from Angacha

School and 98 students from Funamura School, along with 14 teachers, 2 lab technicians, and 5 school principals from each school. This high response rate comfortably exceeds the 75% threshold considered "very good" by Teresia (2021), indicating a satisfactory level of participation.

4.2 Demographic Information

This study collected demographic information from respondents, including gender, age, and teaching experience. The purpose of gathering this data was to understand the characteristics of the students and teacher participants.

4.2.1 Gender

Table 4. 2 Gender distribution of students

Gender	F	%
Male	115	54
Female	98	46
Total	213	100

*Note: f =frequency, % = percentage

The gender breakdown of student respondents was 46% female and 54% male, indicating a slightly higher male representation. This difference may be related to the distribution of single-sex and co-educational secondary schools in the area, with three schools for boys, two for girls, and one mixed-gender school.

The study also collected gender data from the participating teachers, summarized in Table 4.3.

Table 4. 3 Gender distribution of teachers

Gender	Teacher	
	F	%
Male	12	85.7
Female	2	14.3
Total	14	100

*Note: f =frequency, % = percentage

Table 4.3 indicates that 14.3% of teacher respondents were female, while 85.7% were male, demonstrating a significantly higher proportion of male teachers. In the case of female chemistry teachers, this suggests that the teaching force was dominated by men. This contradicts Gatana's (2011) finding that the majority of chemistry teachers in Nairobi were female, with a minority of 15.4% being male. However, because it presents chemistry as a masculine science, the male-dominated teaching staff needs to be deconstructed. However, as long as the instructor is competent and informed in the subject, Adedayo & Owolaye (2012) assert that a teacher's gender has no bearing on their capacity to impart knowledge to students.

4.2.2 Age of the Students

The researcher collected data on the age distribution of the student participants. These results are presented in Table 4.4.

Table 4. 4 Analysis of students' age

Age (years)	F	%
17-25	180	84.5
26-35	20	9.4
Above 35	13	6.1
Total	213	100

*Note: f =frequency, % = percentage

The study revealed that the majority of student respondents (84.5%) were between 17 and 25 years old followed by 9.4% in the 26-35 age range and 6.1% over 35 years old. The average age of respondents was 21. Santrock (2008) notes that individuals in this age group typically begin to think abstractly, reason logically, and draw conclusions beyond concrete experiences. Therefore, the respondents were considered mature enough to understand the questions and provide meaningful responses.

4.2.3 Residence level of participants of high school students

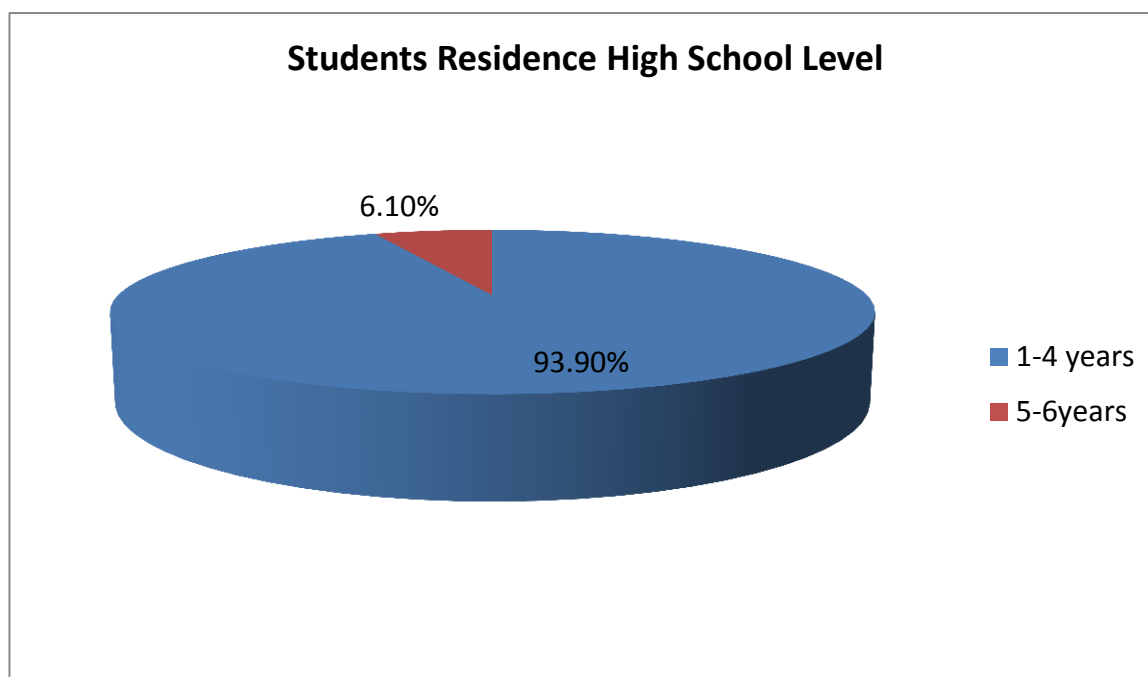


Figure 4. 1 Analysis of the Students' Residence High School Level

According to this study, knowing the students' class level was crucial for evaluating their educational experience. It is also useful for determining how well pupils understand chemistry fundamentals. Those in years 1-4 and 5-6 were the focus of the study in order to get the necessary data. **Figure 4.1** above shows that out of the 213 students who participated in the study (200) representing 93.9% were 1- 4 years students and (13) representing 6.1% were 5-6 years students. This suggests that 1-4 years students outnumbered their counterparts.

4.2.4. Teacher's Experience

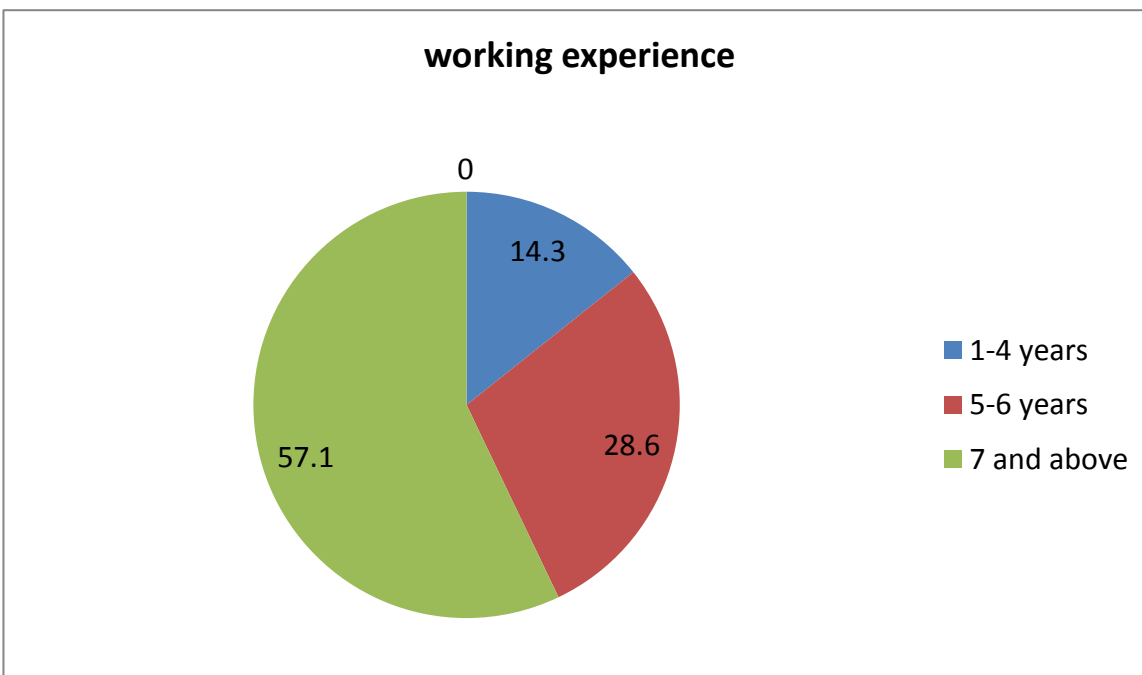


Figure 4. 2Teaching experiences of the teachers

To understand if teachers' experience influenced their views on the importance of supervision, leadership, student performance, and attitude in chemistry practical work, the researcher investigated their teaching experience. **Figure 4.2 Shows above** the distribution of teacher experience, While 14.3% of teachers had 1-4 years of experience and 28.6% had 5-6 years, the largest group (57.1%) had taught for 7 or more years. Although a substantial portion of the teachers are relatively new to the profession, their combined experience positions them well to address student challenges related to instructional strategies and practical work. This suggests having qualified chemistry teachers have a thorough command of the subject, claims Orado (2009), this is necessary to give the students a clear and compelling explanation of chemical facts, concepts, principles, and theories.

4.2.5. Average Class Size

To understand the typical class sizes handled by teachers and lab technicians, the researcher investigated the average number of students they taught. Table 4.5 presents these findings.

Table 4.5 Average Class Size they teach

Size of the class		F	%
More than 35 Students	Chemistry teacher	14	100
	Lab technical	2	100

*Note: f =frequency, % = percentage

Table 4.5 shows that all responding teachers and lab technicians (100%) reported teaching classes larger than 35 students. This suggests that most instructors lack the smaller class sizes that would facilitate more effective hands-on learning in chemistry labs. The finding from this study is consistent with the study conducted by Shafie *S et al*, (2014) in Malaysia who concluded that the teachers are unable to develop materials for teaching because of large class and as a result lack innovation in teaching and learning. Research suggests that optimizing class size and implementing small-group activities can enhance student engagement and participation (Van Dijk *et al.*, 2014).

4.3. Extent factors Obstacle practicability of experimental activities in chemistry laboratories

According to this study, a number of factors were considered as extent obstacle for chemistry laboratory in selected schools in study area. The Key among them were resources and facilities for teaching practical work in chemistry, skills emphasized in teaching and assessment of practical work and attitudes of teachers and students towards practical work in chemistry. The major findings were presented in **Table 4.6** for details extent of these influencing factors in study area.

Table 4. 6 Extent factors obstacles practicability of experimental activities in chemistry laboratory

No	Statement	Options	Students		Lab technician		Chemistry teachers	
			Freq	%	Freq	%	Freq	%
6	Our school has Chemistry Laboratory	Yes	203	95.3	2	100	14	100
		No	10	4.7	0	0	0	0
		Total	213	100	2	100	14	100
7	Our chemistry laboratory adequate laboratory equipment	Yes	150	70.4	1	50	7	50
		No	63	29.6	1	50	7	50
		Total	213	100	2	100	14	100
8	There is enough time allocated for practical lessons to complete practical tasks	Yes	136	63.8	1	50	7	50
		No	77	36.2	1	50	7	50
		Total	213	100	2	100	14	100
9	Our school has adequate laboratory technicians	Yes	163	76.5	1	50	7	50
		No	50	23.5	1	50	7	50
		Total	213	100	2	100	14	100
10	We always make use of the available laboratories for our practical lessons	Yes	189	88.7	2	100	14	100
		No	24	11.3	0	0	0	0
		Total	213	100	2	100	14	100

11	Negative Attitude of Students to Chemistry Practical Work	Yes	159	74.6	1	50	7	50
		No	54	25.4	1	50	7	50
		Total	213	100	2	100	14	100
12	Constant use of practical work improves students' interest in learning chemistry	Yes	197	92.5	2	100	14	100
		No	16	7.5	-	-	-	-
		Total	213	100	2	100	14	100

4.3.1 Chemistry Laboratory

A large majority of student respondents (95.3%, or 203 students) confirmed the presence of a chemistry lab in their school, with only a small fraction (4.7%, or 10 students) reporting the absence of such a lab. This suggests that most schools in the study area have at least one chemistry lab. This finding was further supported by all lab technician and chemistry teacher respondents, who universally confirmed the presence of a chemistry lab in their respective schools. According to the finding of Asefa Belete *et al.*, (2023), assessment of status and practices of chemistry laboratory organization and utilization in 'adet' and 'debremewii' secondary schools, Amhara region, Ethiopia, still today that do not have chemistry laboratories in secondary schools. Hence, it can be deduced that teaching chemistry with inadequate laboratory or in the absence of laboratory supported teaching is one of the key causes of students' poor achievement in chemistry in Amhara Region, Ethiopia. The findings of this study have agreement with several other research findings. Among these, Millar (2004), described that schools with no laboratories were poor with human and material resources and are likely to affect student's achievement in Chemistry. Furthermore, as stated by, engaging Lewis, K. (2003) students in practical activity boosts learning by allowing learners to share ideas and experiences within their groups.

4.3.2 Adequate laboratory equipment

Table 4.6 provides an example of 150 (70.4) % of student respondents affirmed that their school had adequate chemistry laboratory equipment and 63 (29.6%) of the student respondents confirmed that their school did not have adequate chemistry equipment. This implies that some schools in their have chemistry laboratories but did not have adequate laboratory equipment while other schools did have adequate laboratory equipment. This was affirmed by the teacher respondents with 7(50%) confirming that the school had adequate laboratory equipment, and 7(50%) affirming they had not. This shows that not all the schools have adequate equipment in the chemistry laboratories. From the qualitative findings, it was noted that schools should put in place enough apparatus in the laboratory to facilitate the practical lesson and the participation of students. This finding is comparable to that of Mohammad & Fayyaz (2011), who found that Pakistani schools lacked adequate supplies of chemicals and equipment. According to Hofstein & Lunett (2004), laboratory tools, facilities, and activities are essential and unique to science education. They also stated that using laboratory equipment has several educational advantages.

4.3.3 Time allocated for practical lessons

Table 4.6 reveals mixed opinions regarding the adequacy of time allotted for practical assignments. A majority of students (63.8%, or 136 respondents), half of the chemistry teachers (7 respondents), and half of the lab technicians (1 respondent) felt the time was sufficient compared to study taken by (TSC 2005) in Nairobi Kenya, a teacher is considered fully utilized if she/he teaches not less than 27 lessons per week. However, a significant portion of students (36.2%, or 77 respondents), the other half of chemistry teachers (7 respondents), and the other half of lab technicians (1 respondent) believed more time was needed, citing instances where practical work had to be interrupted for the next session.

4.3.4 Laboratory technicians

Table 4.6 summarizes responses to the question of whether schools have lab technicians who assist chemistry teachers with experiment setup. A majority of students (163, or 76.5%) answered "yes," as did half of the lab technicians (1) and half of the chemistry teachers (7).

These results suggest a collaborative environment where chemistry teachers and lab technicians work together to promote students' interest in hands-on chemistry. The data also implies that schools recognize the value of lab technicians in improving practical activities and experiments in chemistry and other science subjects. This supported the idea put forth by Bayessa (2014) also reported that absence of laboratory chemicals, rooms, apparatuses, technicians and well organized laboratory manuals negatively affected the effective implementation of science education and students' academic achievement

4.3.5 Utilization of Laboratories

The majority of respondents to the survey about public secondary schools said they thought the school used its available labs to perform chemical experiments, according to Table 4.6's findings. These findings are consistent with those of Orado (2009), who reported that all schools in Nairobi had laboratories. According to Neji et al. (2014), school laboratories offer the best setting for conducting practical activities, so their availability and sufficiency have an impact on how chemistry experiments are carried out.

4.3.6 Negative Attitude of Students to Chemistry Practical Work

The majority of students are afraid of chemistry practical work, according to 159 (74.6%) of the student respondents, 1 (50%) of the lab technical, and 7 (50%) of the chemistry teacher respondents. Similarly, 7 (50%) of chemistry teachers, 1 (50%) of lab technicians, and 54 (25.4%) of students who responded replied no. This would suggest that most students are terrified of chemistry and so have a negative attitude toward practical practice. These findings run counter to (Majani's 1989) findings on the factors that lead to poor performance in O-level chemistry, which indicated that students' attitudes toward chemistry were a major influence in their bad performance. (Orado's 2009) findings also support this finding.

4.3.7 Practical Work improves Students' Interest in Learning Chemistry

Table 4.6 shows that the greatest number of student's respondents 92.5% of them confirmed that their practical work improves students' interest in learning chemistry. On the other hand, 100%

of the lab technical responses and 100% of the chemistry teachers verified. This supported (Gastel 2007) that students' interest in chemistry should be sparked and maintained through practical activity. A smaller percentage of respondents disagreed with the majority's assertion that consistent use of hands-on activities in chemistry instruction boosts students' interest in the topic.

4.4. Students' attitude towards chemistry laboratory

According to the Studies undergoes in different countries including our country Ethiopia shown that a positive attitude was a requirement if learning must be accomplished (Chala *et al.*, 2019). The results of this study revealed that students generally had positive attitudes towards practical work in chemistry. One of the reasons that could be given for lack of reflection of positive attitudes in performance of students for practical work in chemistry would be that students failed to make links between the practical activities they carry out in chemistry and the theory behind them. This was likely to be the case based on the view held by students that practical work in chemistry was something to fall back to whenever they did not understand content taught during theory lessons. According to this study there were futures that have been identified during the study time in the selected schools in study area were listed in **table4.7 below**.

Table 4. 7 student's attitude towards chemistry experimental work in school laboratories

Statement	Respondent	SA		A		U		D		SD	
		F	%	f	%	F	%	F	%	F	%
Labs in chemistry helps students acquire skills in doing experiment	Student	113	53.1	92	43.2	4	1.9	4	1.9	-	-
	Teacher	7	50	7	50	-	-	-	-	-	-
	lab techi.	1	50	1	50	-	-	-	-	-	-
Lab makes learning Chemistry	Student	106	49.8	73	34.3	12	5.6	8	3.8	14	6.6
	Teacher	7	50	7	50	-	-	-	-	-	-

possible with using all their senses	lab techi.	1	50	1	50	-	-	-	-	-	-
Lab makes the learning of chemistry more difficult	Student	20	9.4	14	6.6	8	3.8	117	54.9	54	25.4
	Teacher	-	-	-	-	-	-	-	-	14	100
	lab techi.	-	-	-	-	-	-	-	-	2	100
Lab in chemistry is too demanding for the students	Student	57	26.8	23	10.8	40	18.8	35	16.4	58	27.2
	Teacher	-	-	-	-	-	-	1	7.1	13	92.9
	lab techi.	-	-	-	-	-	-	-	-	2	100
I prefer doing experiments by myself to watching the teacher perform	Student	100	46.2	82	38.5	9	4.2	12	5.6	10	4.7
	Teacher	-	-	-	-	-	-	-	-	-	-
	lab techi.	-	-	-	-	-	-	-	-	-	-
Lab increases students interest in learning chemistry	Student	117	54.9	70	32.9	10	4.7	10	4.7	6	2.8
	Teacher	14	100	-	-	-	-	-	-	-	-
	lab techi.	2	100	-	-	-	-	-	-	-	-
Students' Preference of Reading chemistry Books to Doing Experiments	Student	50	23.5	36	16.9	24	11.3	59	27.7	44	20.7
	Teacher	3	21.4	4	28.6	3	21.4	4	28.6	-	-
	lab techi.	-	-	1	50	-	-	1	50	-	-

*Note: lab techi. = lab technician and (SA =Strongly Agree = 5, A =Agree = 4, U= Undiced = 3, D =Disagree = 2, SD =Strongly Disagree = 1).

4.4.1. Acquire skills

According to Weld (2004), scientific skills may be categorized into two main forms; **basic process skills** and **integrated process skills**. Basic process skills include observing, classifying, measuring, communicating, inferring and predicting while integrated process skills include experimenting, formulating hypothesis, collecting and representing data, interpreting and analyzing data and making conclusions. Just like Weld (2004), the results of this study revealed that opportunities were offered to students that enabled them to engage in a variety of practical work activities in chemistry. However the extent of emphasis of skills in teaching and assessment of practical work lay mainly in the basic process skills category. The skills emphasized included observation and manipulation of apparatus and materials. Emphasis of skills in the integrated category such as hypothesis formulation and experimenting were found to be lacking during practical work sessions in chemistry. Lack of emphasis of process skills in the integrated category during practical work in chemistry denied students vital opportunities to take control of their own learning which could result in enhanced understanding.

Emphasis of basic process skills encourages students to follow instructions work sheets without thinking about what they were doing. For those who would be able to carry out the procedures, they would probably not be able to attach meaning to the results obtained. According to (KNEC, 2005), some students were unable to make correct inferences even after making correct observations. From **Table 4.7** it is evident that the majority of the respondents feel that practical work in secondary schools is aimed at helping students to acquire skills in doing experiment. This supported the idea put forth by Weld (2004), Grace (2009) that practical activity is intended to educate fundamental abilities.

4.4.2. Use their Senses

Table 4.7 exemplifies that practical work makes it possible for students to use all their senses while learning chemistry. The majority of student responders support the idea that when learning chemistry through practical activity, students employ all of their senses. This is shown in **above Table 4.8**, which illustrates that 84.1% of student respondents agreed, 5.6% were unsure while (10.4 %) were in disagreement. 100% of the teacher and lab technician

respondents agreed with the statement. This suggests that by encouraging students to engage their senses of smell, touch, vision, and sensation, practical activity is crucial to their chemistry education. If the student is to understand the ideas and concepts that are offered throughout the session, he must actively participate in the learning process, according to Millar (2004). For any practical lesson to have any real meaning, this is a given.

4.4.3. Makes learning more Difficult

Table 4.7 explains how students and teachers felt about the assertion that practical work makes the learning of chemistry more difficult. As Table 4.4 shows 80.3% (80%) of the students disagreed that practical work makes the learning of chemistry difficult, 3.8% were undecided and 16% agreed that practical work makes the learning of chemistry more difficult. In addition, secondary schools have a number of physical facility-related difficulties, such as congested labs, problems with power and water supplies, and a lack of space for pupils to participate in laboratory activities. Berket, A. & Ashebir, G. (2016). Since all of the lab technicians and teachers disagreed with the statement, the researcher agrees with Toplis (2012) that in order to effectively teach and study chemistry, both teachers and students need to have a more positive attitude about practical work.

4.4.4 Practical Work Is Too Demanding For Students

Table 4.7 provides an explanation of how teachers and students feel about the idea that students find practical work to be excessively demanding. It shows that while 43.6% of students disagreed with the assertion or thought that practical work was not too demanding, 18.8% were unsure, and 37.6% of students thought that practical exercises were too demanding for them. 100% of the lab technicians and most of the teachers disagreed with the statement. This suggests that secondary school students, instructors, and lab technicians—particularly those schools lacking lab technicians—have not yet accepted practical work. As a result, many people avoid practical chemistry work because they find it difficult.

4.4.5 Practical Work and Interest in Learning Chemistry

Table 4.7 points to the one hand that 87.8% (88%) of the students agreed that practical work

increases their interest in learning chemistry. 4.7% (5%) were undecided while 7.5% (8%) disagreed with the motion. On the other hand, 100% of the teacher and lab technician respondents agreed that practical work increases the interest of students in learning chemistry. This supported Gastel's (2007) assertion that students' interest in learning chemistry is genuinely increased by practical activity.

4.4.6 Preference of Reading Books to Doing Experiments

Table 4.7 explains students' choice of reading chemistry books over doing experiments. A good number of students 48.4% (48%) disagreed that they would rather read their books to do experiments. 11.3% (11%) were undecided while 40.4% (40%) felt they would prefer reading their books to doing practical work. Of the teachers, 50.0% (50%) agreed, 21.4 (21%) were undecided and 28.6 % (29%) disagreed with the statement that students would prefer to read their books rather than do practical work. This suggests that while some students would rather read their books, a sizable portion would rather complete practical chemistry assignments. This demonstrates that for some students, reviewing their notes is more valuable than conducting experiments.

4.5. Care and support of school administration

This objective was intended to extent of care and support of school administration to laboratory facilities and related follow up in the school laboratory on the teaching of chemistry practical instruction and they are good quality

4.5.1 Number of laboratories the school have

Table 4. 8 laboratories possessed by the school

STATEMENTS	Students		Teachers		Lab technician	
	F	%	F	%	F	%
3 laboratories	122	57.3	14	100	2	100
2 laboratories	39	18.3	-	-	-	-
1 laboratories	49	23	-	-	-	-
None	3	1.4	-	-	-	-
TOTAL	213	100	14	100	2	100

*Note: f = frequency, % = percentage

According to 122 (57.3%) of the student respondents, 2 (100%) of the lab technician respondents, and 14 (100%) of the instructor respondents, most schools had three laboratories that served the three science topics (physics, chemistry, and biology), as shown in Table 4.8. Of the students who responded, 39 (18.3%) said that some schools had two laboratories, while 49 (23%), on the other hand, said that the school had one laboratory for each of the three science topics. This suggests that every school has a lab where pupils could conduct experiments, which is encouraging.

4.5.2 Laboratory Materials in the School Laboratory

4.5.2.1 Benches are in Good Condition

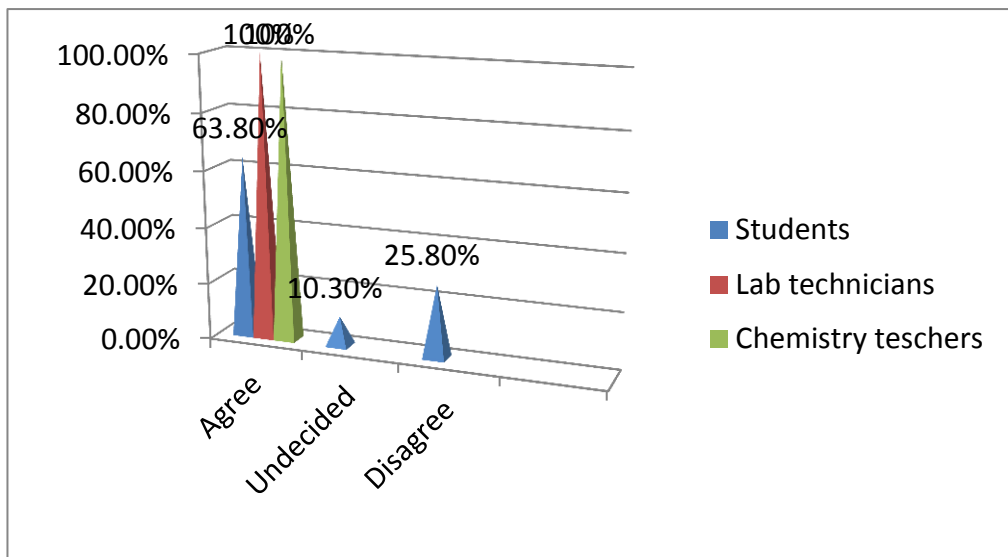


Figure 4. 3. *Benches are in Good Condition*

According to the above figure, the greater part of the respondents as of 63.9% of students, 100% lab technician and 100% of teachers, agreed that they have good benches in their laboratories. This suggests that benches that allow students to feel comfortable while in the lab were present in the majority of the laboratories from the respondents' schools.

4.5.2.2 Good Tap Water

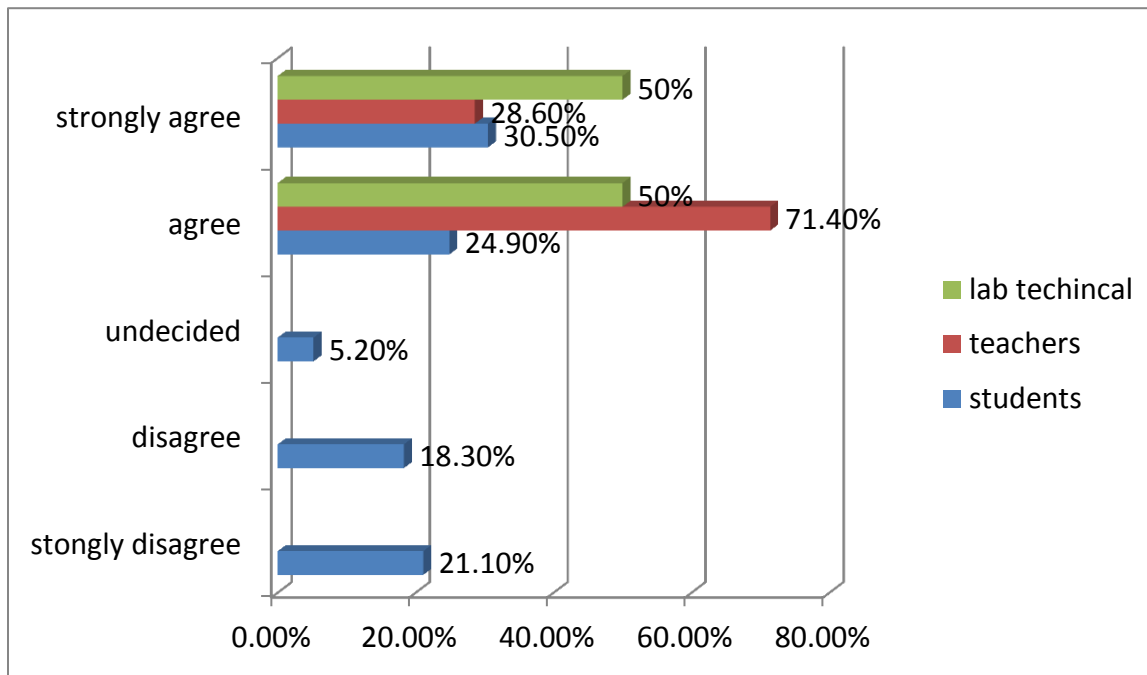


Figure 4. 4. Good quality of tap water

Figure 4.4 shows that a good number of the respondents as 55.4% (30.5% strongly agreed and 24.9% agreed) of student, 100% (50% strongly agree and 50% agree) of lab technicians and 100% (28.6% strongly agree and 71.4% agree) of teachers felt that the tap water provided in the laboratories were in good condition and 39.4% (18.3% disagreed and 21.1% strongly disagreed) of the student respondents disagreed, while 5.2% of the student respondents remained undecided. Some respondents recommended that there be good taps in the laboratories for teachers, lab technicians and students to use for hand and equipment washing, even though a substantial percentage of schools had tap water in good quality. This suggests that using high-quality tap water in the lab is crucial.

4.5.2.3 Good Quality of Stools

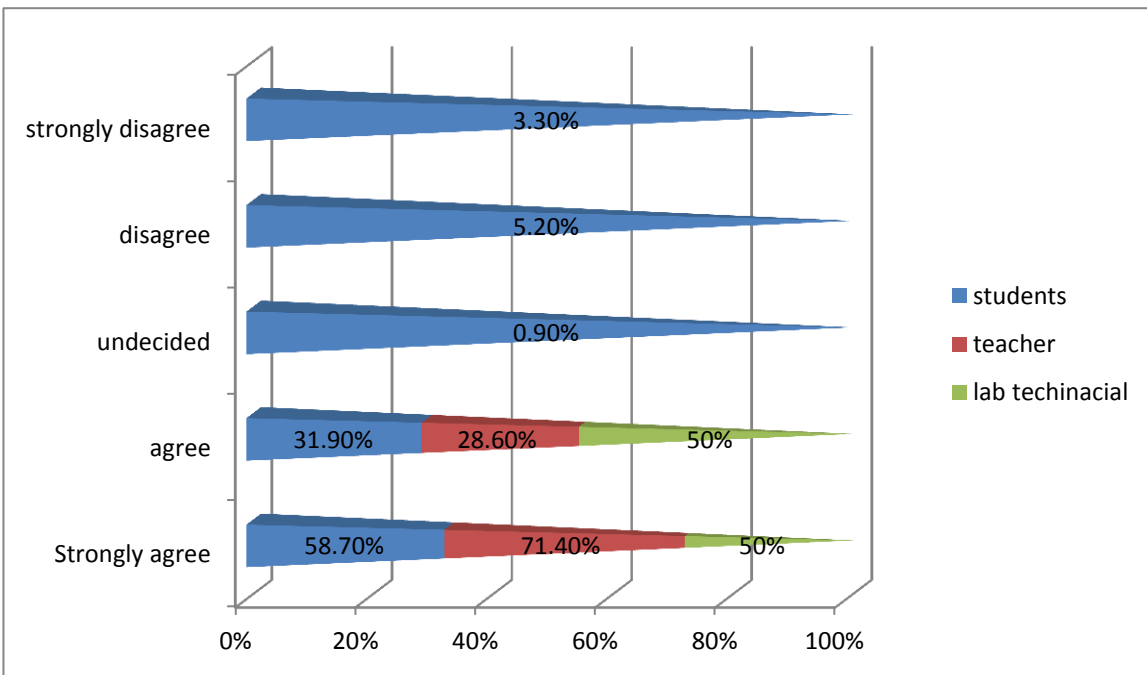


Figure 4. 5 Good Qualities of the Stool

According to Figure 4.5, the majority of respondents 90.6% of students (58.7% strongly agree and 31.9% agree), 100% of lab technicians (50% strongly agree and 50% agree), and 100% of teachers (71.4% strongly agree and 28.6% agree) felt that their labs had good facilities of the students, 5.2% disagreed and 0.9% was undecided. This suggests that they make good laboratory stools in the majority of schools.

4.5.2.4 Suitable Equipment

Table 4. 9 Suitable equipment

Statements	Teacher		Students		Lab technical	
	F	%	F	%	F	%
Strongly agree	7	50	125	58.7	1	50
Agree	7	50	70	32.9	1	50
Undecided	-	-	8	3.8	-	-
Disagree	-	-	2	0.9	-	-
Strongly disagree	-	-	8	3.8	-	-
Total	14	100	213	100	2	100

*Note: f = frequency, % = percentage

According to Table 4.9, 91.6% of respondents who were students and 100% of respondents who were teachers and lab technicians believed that the equipment in their labs was adequate for practical work. However, 4.7% of students who responded disagreed that the equipment was inadequate. Therefore, according to several responders, "the school must add some apparatus in the laboratories." This suggests that the majority of schools must have adequate equipment to support kids' learning, According to Hofstein & Lunett (2004) play a central and distinctive role in science education. They also reported that rich benefits in learning accrue from using laboratory equipment. Also, Kallat (2001) noted that practical work in the laboratory offers learners the opportunities to use scientific equipment to develop basic manipulative skills as well as practicing investigative activities which develop problem-solving attitudes needed for future work in chemistry.

4.5.2.5 Good Heating Apparatus

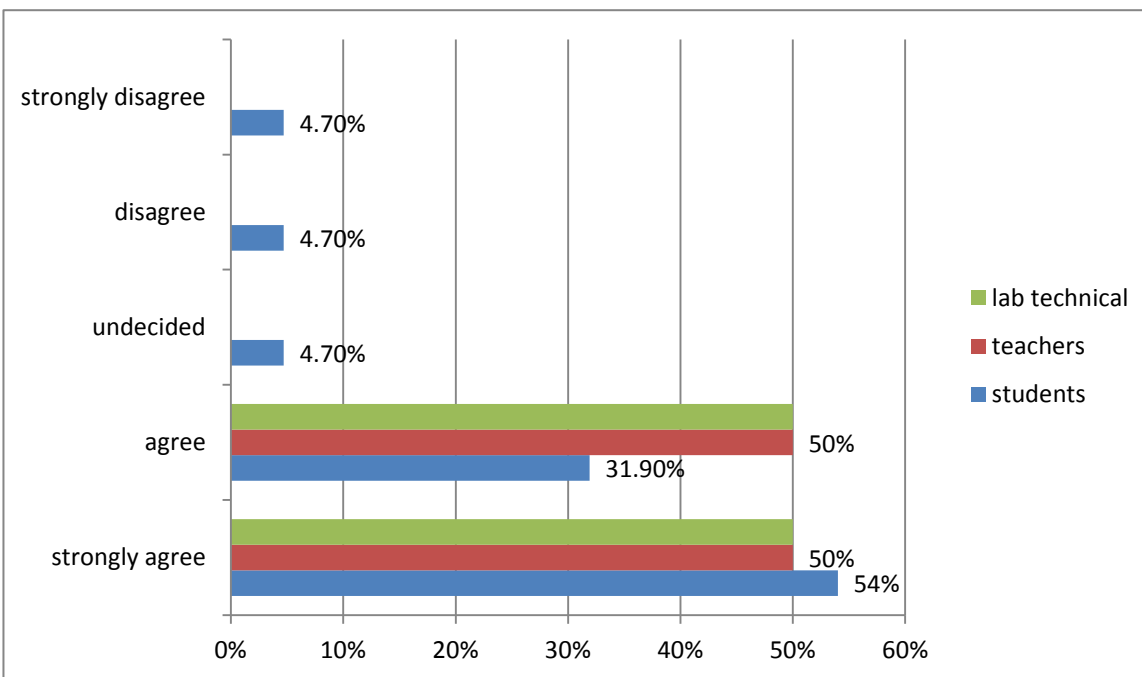


Figure 4. 6 Good Heating Apparatus

According to the teachers-students questionnaire, 85.9% (54% strongly agree and 31.9% agree) of students, 100% (50% strongly agree and 50% agree) of teachers, and 100% (50% strongly agree and 50% agree) of lab technical respondents thought that the schools had heating apparatus. This is followed by 9.4% (4.7% strongly disagree and 4.7% disagree) of students who disagreed. 4.7% of students who responded were still unsure. This suggests that the schools under investigation have well-maintained heating apparatus in their labs, which is a crucial component needed for a number of studies.

4.5.2.6 Functioning fume chamber

Table 4. 10 Functioning Fume Chamber

Statements	Students		Teachers		Lab technical	
	F	%	F	%	F	%
Strongly agree	60	28.3	-	-	-	-
Agree	39	18.3	-	-	-	-
Undecided	28	13.1	-	-	-	-
Disagree	45	21.1	14	100	2	100
Strongly disagree	41	19.2	-	-	-	-
Total	213	100	14	100	2	100

*Note: f = frequency, % = percentage

From the table above, 46.6% (28.3% strongly agree and 18.3% Agree) of student respondents thought that the fume chamber they had was in good condition. 40.3% (19.2% strongly disagree and 21.1% disagree) of Student respondents and 100 % of teacher and lab technical respondents disagreed that the fume chamber in their schools had was in good condition, while 13.1% were still undecided about the issue. This suggests that the fume chamber was not in good shape at every school. Nonetheless, based on the qualitative results, it was noted that schools need to have fume chambers in their labs so that hazardous chemical experiments can be conducted safely. Furthermore, even when laboratories were available and well-equipped, it was discovered that they were missing necessary components such a fume chamber, safety gear, gas taps, and tap water. (Nsanzimana *et al*, 2021) also found that teacher demonstrations were the main activity carried out in these labs.

4.5.2.7 Adequate chemicals

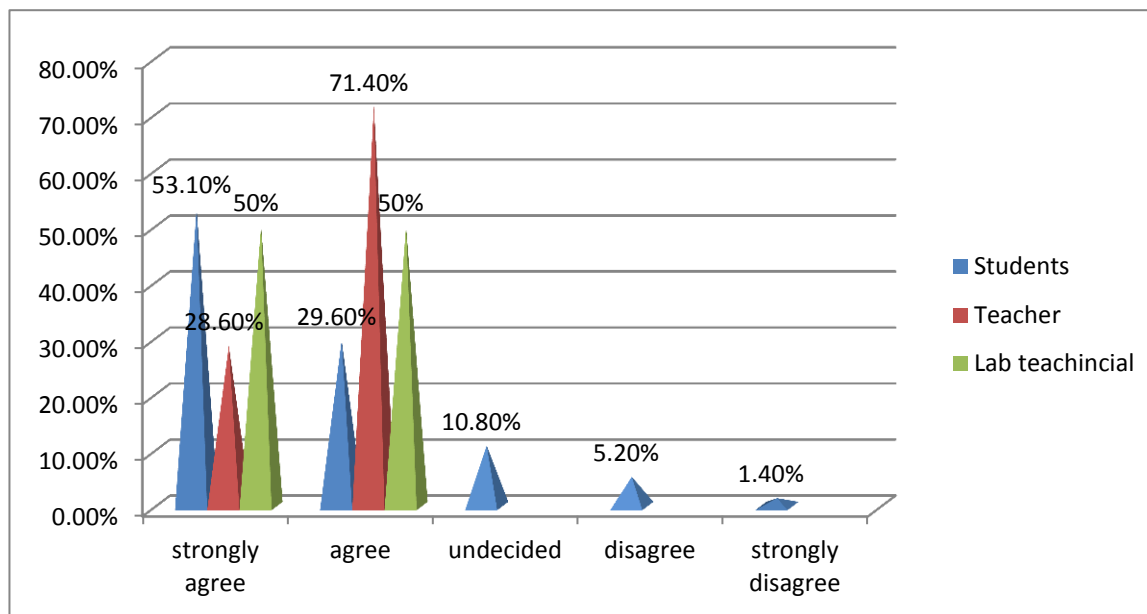


Figure 4. 7 Implementation of Adequate Laboratory chemicals

The researcher came to the conclusion that Figure 4.7 that 82.6% (53% strongly agreed and 29.6% agreed) of the student respondents, 100% (50% strongly agree and 50% agree) of the lab technician respondents and 100% (28.6% strongly agreed and 71.4% agreed) of the teacher respondents agreed that there are adequate chemicals Supplied for the students to carry out practical activities, 10.8% of student respondents remained undecided while 6.6% (5.2% disagreed and 1.4% strongly disagreed) disagreed that there are adequate laboratory chemicals in their schools. This suggests that most schools have enough chemicals for their labs. The researcher wants to highlight, however, that laboratory experiences help students better understand certain scientific facts and concepts as well as how these facts and concepts are arranged in the scientific disciplines. According to Babalola et al. (2020), Laboratory instruction is predicated on the idea that direct observation and manipulation of scientific objects is a better way to foster comprehension and appreciation than other approaches. Laboratory training is also frequently utilized to build abilities necessary for more advanced study or research. Therefore, sufficient laboratory chemicals are essential to achieving the primary goal of science class practicals.

4.5.2.8 First Aid Box

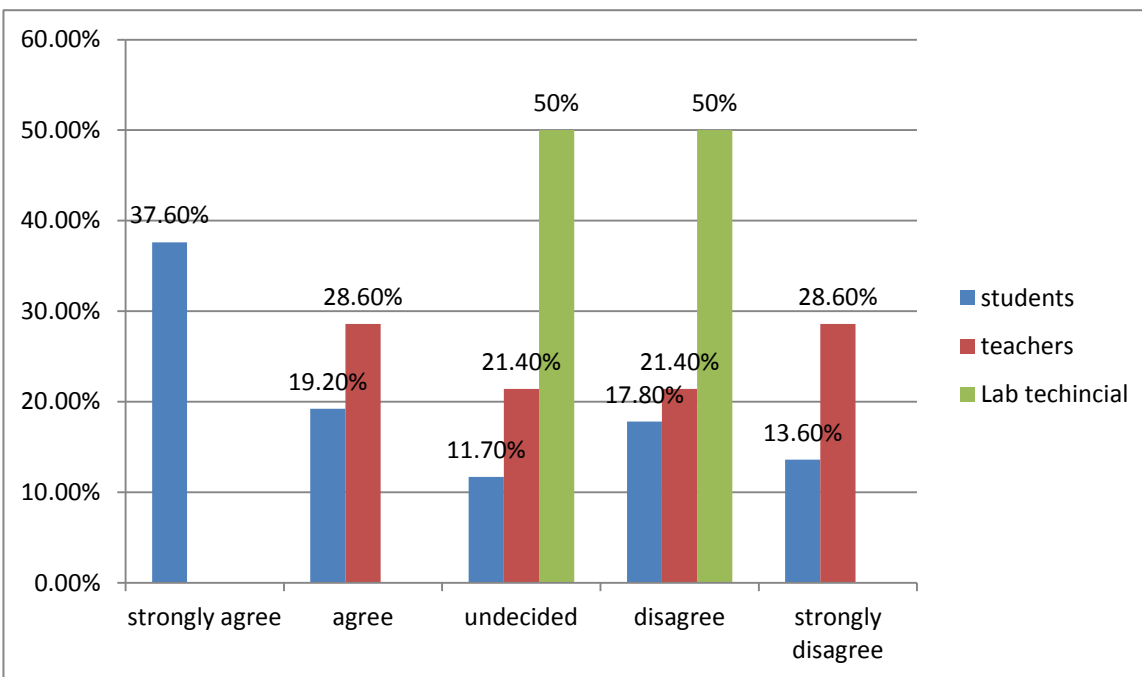


Figure 4. 8 Implementation and Adequacy of First Aid Box

Most of the people who responded agreed, 56.8 % (37.6%strongly agree and 19.2% agree) of students and 28.6% of teachers that they had a first aid box in the laboratory. 31.4 % (13.6% strongly disagree and 17.8% disagree) of students disagree, 50% of lab technicians’ disagree and 50 % (28.6% strongly disagree and 21.4% disagree) of the teachers disagreed while 11.7% of students, 50% of lab technicians undecided and 21.4% of teachers were undecided about the matters. This suggests that there was not a first aid box in every school lab. But because it is so important, the researcher came to the conclusion that schools need to have a sufficient first aid box in their labs. Working in a laboratory is a challenging job, according to Sudha (2010). Many chemicals are made to be used in certain ways, and they can be disastrous if the right safeguards are not taken. Chemical laboratories have a special need for first aid since various chemicals might result in a variety of injuries and long-lasting negative effects (Sudha, 2010).

4.5.2.9 Time allocated

Table 4. 11 Numbers of Periods per Week for Practical Work

Statements	Students		Teachers		Lab technician	
	F	%	F	%	F	%
3 Lesson	26	12.2	0	0	0	0
2 Lesson	80	37.6	7	50	1	50
1 Lesson	64	30	7	50	1	50
No attention	43	20.2	0	0	0	0

*Note: f = frequency, % = percentage

According to Table 4.11 the amount of lessons that include practical lessons per week varied throughout schools. The table indicates that 12.2% represent schools having 3 lessons per week, 37.6% represents 2 lessons and 30% represents having 1 lesson per week, while the schools that were represented by 20.2% have no practical work per week. This further demonstrated that the actual work was not as important to the schools. This explains why most schools do not give much time to using the laboratory. As a result, numerous respondents recommended that there should be an increase in the number of practical lessons.

4.6 Qualitative findings

4.6.1 Factors obstacles Laboratory Implementation

In this survey, a variety of respondents listed numerous recommendations. Among them are the following: not having enough room for a large number of students, not having enough equipment for a large number of students, not having a fume chamber, not having enough time set aside for practical lessons, not having teachers who are eager and prepared to use practical work, not having enough students participating in practical work, not having enough chemicals in school labs, not having enough lab technicians, Furthermore, Nkwocha (1998) believed that

science education would not be effective without laboratory facilities. Furthermore, Anyadiegwu (2018) noted that Nigerian schools do not have enough acceptable laboratory facilities. Furthermore, according to Niyitanga et al. (2021), a lack of sufficient money for education hinders the availability of laboratory facilities in public secondary schools, not having enough students participating in practical work, not having enough chemicals in school labs, not having enough lab technicians, which makes it challenging for scientific teachers to effectively teach concepts.

4.6.2 Improve the factors obstacles laboratory implementation

The following recommendations were made by the respondents on the improvement of the factors obstacles laboratory implementation work in the schools. Among these were designating specific times for practical lessons in the school schedule, acquainting the students with the chemistry practical lessons, giving them more time to work with the lab apparatus, and creating additional space for a larger number of enrolled students in addition to more time for practical lessons. To encouraging students during practical lessons, improving the lab apparatus, fume chamber, and bench, providing adequate practical books for every student to the usage of chemistry practical lessons. To raise students' and teachers' knowledge of the value and positively of practical lessons, foster a collaborative environment during these sessions, and provide a laboratory for every science topic in addition to assessments for chemistry students' practical work. To provide students greater hands-on experience in handling real-world issues, expose them to more practical than theoretical knowledge, and, lastly, put in place strict policies to address laboratory facility theft. Adequate laboratory instructional facilities are necessary in schools to reduce the difficulties faced by science teachers, claims Anyadiegwu (2018). Etiubon (2018) noted that the completion of laboratory facilities in schools signifies an increase in the effectiveness of educational development and leads to enhanced proficiency through increased human capacity, as this facilitates the acquisition of fundamental knowledge and skills for laboratory experiments and lifelong development. Likewise, Eze's (2001) results corroborated the aforementioned findings when he detailed how physical facilities, including classrooms and laboratories, are woefully inadequate, poorly kept, and devoid of necessary gear and equipment.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5. Introduction

The results, conclusions, and suggestions are summarized in this chapter. It also makes recommendations for additional study.

5.1 SUMMARY OF THE STUDY

This study investigated the obstacle in chemistry laboratory implementation in chemistry teaching in Angacha and Funamura secondary schools, Kambata Zone, Central Regional State, Ethiopia. The key findings are summarized below:

The study confirmed the significant role of experimental work in chemistry teaching and learning, highlighting several key influencing factors. The availability of well-equipped chemistry labs and sufficient time allocation for practical courses were found to be crucial. The presence and active involvement of a laboratory technician, along with the consistent use of laboratories and practical lessons, were also identified as essential. The study suggests that regular hands-on instruction in well-utilized laboratories significantly improves students' skills. Simply having lab equipment is insufficient; effective utilization is key to improved teaching and learning outcomes.

The study revealed that chemistry students generally hold positive attitudes towards laboratory experimental work. However, the emphasis placed on specific skills during practical lessons by teachers and lab technicians significantly influences student perceptions. The study suggests that an overemphasis on rote procedures rather than genuine scientific inquiry might lead students to prioritize theoretical learning over practical experimentation. Furthermore, the findings indicate that consistent use of lab equipment and facilities fosters student enthusiasm and participation, which are vital for skill development.

The study examined the extent of school administration support for laboratory facilities and

related follow-up. While the allocated time for practical work was deemed sufficient by some, students, lab technicians, and teachers advocated for more time (Table 4.11). Despite having well-equipped labs, the study revealed that these labs were often shared by multiple subjects (Table 4.8). This finding suggests a need for schools to invest in additional laboratories to adequately support chemistry instruction.

5.2. CONCLUSIONS

Based on the study findings, several key conclusions emerge. Laboratories are essential for fostering student interest and skill development in chemistry. However, their effectiveness hinges on proper integration and adequate resources. The study revealed that some schools, despite having well-equipped labs, often shared them among all science subjects. This necessitates a concerted effort from chemistry teachers and lab technicians to ensure dedicated time slots for chemistry experiments each week, maximizing the use of shared facilities. Consistent and regular lab use is crucial for cultivating positive student attitudes towards practical chemistry. Teachers, lab technicians, and school administrators should also emphasize the real-world applications of experimental work, connecting classroom learning to practical experiences. Sufficient time allocation for practical lessons is paramount, enabling both teachers and students to bridge the gap between theory and practice. Creating a conducive learning environment involves providing adequate laboratory equipment, spacious accommodation, functional furniture, a skilled lab technician, a laboratory handbook, and necessary safety equipment. Finally, government and stakeholders should prioritize equipping all public schools with at least two dedicated laboratories. The absence of lab technicians can overburden teachers, potentially leading to discouragement and avoidance of practical work.

5.3. RECOMMENDATIONS

This study recommends the following specific research topics:

- The impact of computer-assisted laboratory instruction on student understanding of secondary school chemistry and their role as a remedy for the challenges of laboratory experimentation

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APPENDIXES

Appendixes-I

Participant Information Sheet

Dear Respondents, Good morning/ Good afternoon! Thank you to your will of interesting to this study based Questionnaire

My name is _____ I'm post graduate student in Hawassa University and interesting to graduating research study in Angacha secondary school and funamura secondary school.

Title of the study: - factor obstacles in chemistry laboratory implementation: A Case of Angacha and funamura secondary school, kabata zone central regional state, Ethiopia.

Duration of the study: - October - March 2015

The purpose of this study is to determine the factors obstacles in chemistry laboratory implementation: A Case of Angacha and Funamura secondary school, Kabata zone central regional state, Ethiopia.

In order to attain this goal, I request your honest and genuine participation. No individual response will be passed to a third person; it is used only for the purpose of this study. It is your full right not to participate, to discontinue or to participate in the study. If you do not like to participate you are not obliged to answer the questionnaire. There will be no negative impact on you whatever your decision is. But your honest participation will have contribution to generate information that can be used in analyzing determine the factors obstacles in chemistry laboratory implementation: A Case study of Angacha and Funamura secondary school.

Thank you so much for your cooperation in responding this questionnaire!!!

TADESSE SHOMORO

Tele: +251916756675/+251967053461 E-Mail addresses: tadesseshomoro16@gmail.com

Appendixes-II

Participant consent form

I confirmed that I have been given, had read and understand the information sheet for above study and received to answers any questions raised about this research study.

I understand that any participation in this study is voluntary and that I am free to withdraw from this study at any time without giving reason and without any rights being affected in any way.

I understand that the researcher will hold all information and data collected necessarily in confidence and all efforts will be made to ensure that I cannot be identified as a participant in study and I give permission for the researcher to hold relevant personal data I confirm that I am aware that participation in this study involves my being that the data recorded will be used by researcher for research purpose and destroyed after this research project in accordance with Hawassa university procedures and standards.

I agree to take part in the above study

Participant Name _____ participance Name _____

Signature _____ Signature _____

Date _____ Date _____

Name of person taking consent _____

signature _____ Date _____

Appendixes-III

ASSENT FORM FOR SECONDARY SCHOOL STUDENTS (AGE ≤ 17 YEARS OLD)

Study title: - factors obstacles in chemistry laboratory implementation: A Case study of Angacha and Funamura secondary school, Kabata zone central regional state, Ethiopia

Place of study: - Angacha and Funamura secondary school

Ethics committee referred: - Hawassa University, Natural and computational sciences
Department of Chemistry ethics approval committee

Contact phone number: - +251916756675/+251967053461

Participant's Name: _____ Date of Birth: _____

(Full Name in BLOCK CAPITALS) (Day/Month/Year)

Please circle all you agree with:

Have you read this form (or had it read to you)? Yes No

Has the researcher explained this study to you? Yes No

Do you understand what this study is about? Yes No

Have you asked all the questions you want? Yes No

Are you happy to take part in this research study? Yes No

If any answers are “no” or you **don’t** want to take part, **don’t** sign your name!

If you **do** want to take part in this study, please write your name and today’s date below.

You will be given a copy of this signed form

Participant’s Full Name: - _____

Participant’s Signature for Assent: - _____

Date: - _____

Statement of Person Obtaining Informed Assent

I, the undersigned, have fully explained the details of this research study to the participant named above.

Name of Person Conducting Assent Discussion _____

Signatures of Person Conducting Assent Discussion _____

Date _____

APPENDIX IV: QUESTIONNAIRE FOR STUDENTS

Section A: Demographic Information

Instruction: For the following items, please indicate your answer by ticking (√) in the square brackets provided.

1. Gender: (a) Male (b) Female

2. Age: (a) 25 & below years (b) 26-30 years (c) 31-40 years and above

3. Level of educational background: (a) masters degree (b) Bachelors (c) Diploma (d) KSCE (E) other

4. Length of year you study in school (a) less than 2 (b) 2-5 (c) 6-10
(d) 11-12

Section B: The Extent practicability of experimental activities in chemistry laboratories

The table below shows some of the factual aspects of the extent of the use of practical work in teaching and learning chemistry. Respond by putting a tick (√) to either YES or NO, based on the correctness of the following statements.

No	Statements	Yes	No
5	Our school has Chemistry Laboratory		
6	Our chemistry laboratory adequate laboratory equipment		
7	There is enough time allocated for practical lessons to complete practical tasks		
8	Our school has adequate laboratory technicians		
9	We always make use of the available laboratories for our practical lessons		
10	Most of the students fear sciences		
11	Constant use of practical work improves students' interest in learning chemistry		

Section C. obstacles of the Attitude towards and attention of the students, teachers and lab technicians to conduct the experiments in school laboratories

Rate the statement by putting a tick (√) in the column with the most appropriate letter depending on how you feel about each statement.

No	Statements	5	4	3	2	1
12	Practical work in chemistry helps students acquire skills in doing experiments					
13	Practical makes it possible for students to learn chemistry while using all their senses					

14	Practical works makes the learning of chemistry more difficult					
15	Laboratory chemicals make me fear chemistry					
16	Practical works in chemistry is too demanding for the students					
17	I prefer doing experiments by myself to watching the teacher perform them					
18	Practical work increases students' interest in learning chemistry					
19	I prefer reading my chemistry book to doing experiments					

5= SA (Strongly Agree), 4 = (Agree), 3 = (Undecided), 2 = (Strongly Disagree), and 1 = (Disagree)

Section D:

I. Attitude of school administrators to laboratory materials and facilities on the teaching of chemistry practical Instruction: Put by a tick (√) in the appropriate square brackets [] provided.

20. The laboratory materials and facilities indicated below are available in our laboratory and they are of good quality.

No	Materials	5	4	3	2	1
I	Benches					
II	Tap water					
III	Stools/chairs					

IV	Equipment (pipette, burette, measuring cylinder etc)					
V	Heating apparatus					
VI	Functioning fume cupboard					
VII	Chemicals					
VII	First aid box					

II. Time allocated for Practical Work on the Teaching of Chemistry class

Instruction: For the following items, please indicate your answer by putting a tick (√) in the square brackets [] provided.

21. How many periods per week per class do you incorporate practical lessons in Chemistry?

(a) 3 lesson (b) 2 lesson (c) 1 lesson (d) No attention

APPENDIX V: QUESTIONNAIRE FOR CHEMISTRY TEACHERS

Section A: Demographic Information

Instruction: For the following items, please indicate your answer by ticking (√) in the square provided.

1. Gender: (a) Male (b) Female

2. Working experience: (a) less than 2 (b) 2-5 (c) 6-10 (d) 11-15
(e) 16-20 (f) more than 20

3. Average size of students in class you teach: (a) 15-20 students (b) 20-25
(c) 25-30 (d) more than 30

4. Level of your educational background: (a) masters degree (b) Bachelors
(c) Diploma (d) KSCE (E) others

5. Length of service year in school (a) less than 2 (b) 2-5 (c) 6-10
 (d) 11-12

Section B: The Extent practicability of experimental activities in chemistry laboratories

The table below shows some of the factual aspects of the extent of the use of practical work in teaching and learning chemistry. Respond by putting a tick (√) to either YES or NO, based on the correctness of the following statements.

No	Statements	Yes	No
6	Our school has Chemistry Laboratory		
7	Our chemistry laboratory adequate laboratory equipment		
8	There is enough time allocated for practical lessons to complete practical tasks		
9	Our school has adequate laboratory technicians		
10	We always make use of the available laboratories for our practical lessons		
11	Most of the students fear sciences		
12	Constant use of practical work improves students' interest in learning chemistry		

Section C: Obstacles of the Attitude towards and attention of the students, teachers and lab technicians to conduct the experiments in school laboratories

Rate the statement by putting a tick (√) in the column with the most appropriate letter depending on how you feel about each statement.

No	Statements	5	4	3	2	1
13	Practical work in chemistry helps students acquire skills in doing experiments					
14	Practical makes it possible for students to learn chemistry while using all their senses					
15	Practical works makes the learning of chemistry more difficult					
16	Laboratory chemicals make me fear chemistry					
17	Practical works in chemistry is too demanding for the students					
18	I prefer doing experiments by myself to watching the teacher perform them					
19	Practical work increases students' interest in learning chemistry					
20	I prefer reading my chemistry book to doing experiments					

5= SA (Strongly Agree), 4 = (Agree), 3 = (Undecided), 2 = (Strongly Disagree), and 1 = (Disagree)

Section D:

I. Attitude of school administrators to laboratory materials and facilities on the teaching of chemistry practical Instruction: Put by a tick (✓) in the appropriate square brackets [] provided.

21. The laboratory materials and facilities indicated below are available in our laboratory and they are of good quality.

No	Materials	5	4	3	2	1
I	Benches					
II	Tap water					
III	Stools/chairs					
IV	Equipment (pipette, burette, measuring cylinder etc)					
V	Heating apparatus					
VI	Functioning fume cupboard					
VII	Chemicals					
VII	First aid box					

II. Time allocated for Practical Work on the Teaching of Chemistry class

Instruction: For the following items, please indicate your answer by putting a tick (√) in the square brackets [] provided.

22. How many periods per week per class do you incorporate practical lessons in Chemistry?

(a) 3 lesson (b) 2 lesson (c) 1 lesson (d) No attention

APPENDIX VI: QUESTIONNAIRE FOR CHEMISTRY TECHNICIAN

Section A: Demographic Information

Instruction: For the following items, please indicate your answer by ticking (√) in the square provided.

1. Gender: (a) Male (b) Female

2. Working experience: (a) less than 2 (b) 2-5 (c) 6-10 (d) 11-15
 (e) 16-20 (f) more than 20

3. Average size of students in class you teach: (a) 15-20 students (b) 20-25
(c) 25-30 (d) more than 30

4. Level of your educational background: (a) masters degree (b) Bachelors
(c) Diploma (d) KSCE (E) others

5. Length of service year in school (a) less than 2 (b) 2-5 (c) 6-10
(d) 11-12

Section B: The Extent practicability of experimental activities in chemistry laboratories

The table below shows some of the factual aspects of the extent of the use of practical work in teaching and learning chemistry. Respond by putting a tick (√) to either YES or NO, based on the correctness of the following statements.

No	Statements	Yes	No
6	Our school has Chemistry Laboratory		
7	Our chemistry laboratory adequate laboratory equipment		
8	There is enough time allocated for practical lessons to complete practical tasks		
9	Our school has adequate laboratory technicians		
10	We always make use of the available laboratories for our practical lessons		
11	Most of the students fear sciences		
12	Constant use of practical work improves students' interest in learning chemistry		

Section C: obstacles of the Attitude towards and attention of the students, teachers and lab technicians to conduct the experiments in school laboratories

Rate the statement by putting a tick (√) in the column with the most appropriate letter depending on how you feel about each statement.

No	Statements	5	4	3	2	1
13	Practical work in chemistry helps students acquire skills in doing experiments					
14	Practical makes it possible for students to learn chemistry while using all their senses					
15	Practical works makes the learning of chemistry more difficult					
16	Laboratory chemicals make students fear chemistry					
17	Practical works in chemistry is too demanding for the students					
18	students prefer doing experiments by themselves to watching the teacher perform them					
19	Practical work increases students' interest in learning chemistry					
20	students prefer reading their chemistry book to doing experiments					

5= SA (Strongly Agree), 4 = (Agree), 3 = (Undecided), 2 = (Strongly Disagree), and 1 = (Disagree)

Section D:

I. Influence of the Implementation of Laboratory Materials and Facilities on the Learning of Chemistry Practical: Put by a tick (✓) in the appropriate square brackets [] provided.

20. How many Laboratories does your school have?

(a) One Lab for each of the three science subjects (Bio, Chem. and Phy) []

(b) Two Labs for the three science subjects (Bio, Chem., Phy) []

(c) One Lab for all the science subjects (Bio, Chem., Phy) []

(d) None []

21. The laboratory materials and facilities indicated below are available in our laboratory and they are of good quality.

No	Materials	5	4	3	2	1
I	Benches					
II	Tap water					
III	Stools/chairs					
IV	Equipment (pipette, burette, measuring cylinder etc)					
V	Heating apparatus					
VI	Functioning fume cupboard					
VII	Chemicals					
VII	First aid box					

II. Time allocated for Practical Work on the Teaching of Chemistry class

Instruction: For the following items, please indicate your answer by putting a tick (✓) in the square bracket provided.

22. How many periods per week per class do you incorporate practical lessons in Chemistry?

(a) 3 lesson (b) 2 lesson (c) 1 lesson (d) No attention

APPENDIX VII:

Hawassa University School of Graduate Studies College of Natural and Computational Sciences, Department of Chemistry

INTERVIEW SCHEDULE FOR School Leaders' (Principals') Questionnaire

Section A: Demographic Information

Instruction: For the following items, please indicate your answer by ticking (✓) in the square provided.

1. Gender: (a) Male (b) Female

2. Working experience: (a) less than 2 (b) 2-5 (c) 6-10 (d) 11-15
(e) 16-20 (f) more than 20

3. Average size of students in class you teach: (a) 15-20 students (b) 20-25
(c) 25-30 (d) more than 30

4. Level of your educational background: (a) masters degree (b) Bachelors
(c) Diploma (d) KSCE (E) others

5. Length of service year in school (a) less than 2 (b) 2-5 (c) 6-10
(d) 11-1

SECTION B: School principal's perception towards factors influencing chemistry laboratory work in study area

1. How many chemistry teachers and lab technicians do you have in your schools?

2. Does your school have a specific chemistry laboratory? If yes? How the laboratories are organized?

3. Which facilities miss in the chemistry laboratory?

4. Is there any financial support to your school for laboratory organization?

5. How about the motivation of teachers and students of chemistry practical that support effective teaching and learning process?
