

UNIVERSITY OF EDUCATION, WINNEBA

Senior High School chemistry teachers' professional competence, attitudes and practices in Organising practical work in the Greater Accra Region, Ghana



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**SENIOR HIGH SCHOOL CHEMISTRY TEACHERS' PROFESSIONAL
COMPETENCE, ATTITUDES AND PRACTICES IN ORGANISING
PRACTICAL WORK IN THE GREATER ACCRA REGION, GHANA**



**WINFRED ANIM
(220010358)**

**A thesis in the Department of Integrated Science
Education, Faculty of Science Education, submitted to the School of
Graduate Studies in partial fulfilment
of the requirements for the award of the degree of
Master of Philosophy
(Science Education)
in the University of Education, Winneba**

FEBRUARY, 2025

DECLARATION

Students' Declaration

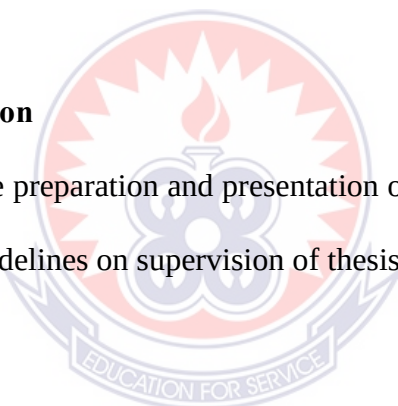
I, WINFRED ANIM, declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

SIGNATURE:.....

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Supervisors' Declaration

I hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Education, Winneba.



NAME OF SUPERVISOR: DR. GODFRED SAFO-ADU

SIGNATURE:.....

DATE:.....

DEDICATION

I dedicate this thesis to my mother, Mary Tettekie Terkpertey for the financial support.



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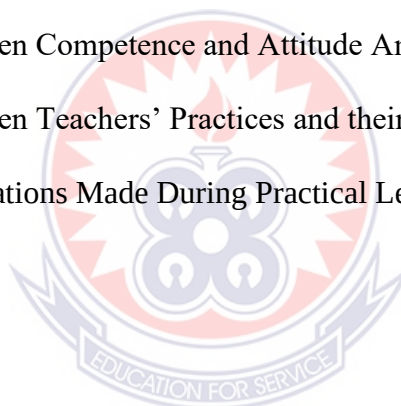


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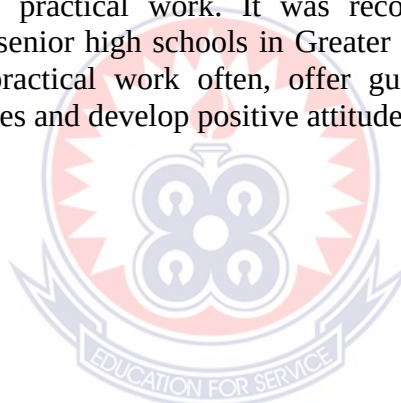
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ABSTRACT

Teachers' competence and attitudes are essential to enhance the quality of the teaching profession. This study employed a descriptive research design to explore the senior high school chemistry teacher's professional competence, attitudes and practices in organising practical work in the Greater Accra Region. A simple random technique was used to select 170 chemistry teachers from 34 randomly chosen senior high schools for the study. A close-ended questionnaire and an observation checklist were used to collect quantitative and qualitative data, respectively. The study finds out that majority of chemistry teachers had a high competency level but exhibited poor practices in organising practical work due to negative attitudes toward organising practical work. The teachers gave clear explanation and demonstrated experiments before practical work, defined problems in simple language, handled all instruments and glassware, used internet to gather information for students and prepared reagents for laboratory practical. Qualitatively, the teachers never supervised students during practical lessons. As a result, students hardly followed rules and regulations and performed practical work without a manual. Besides, practical tasks were not selected from Ghana Education Service approved textbooks. Generally, the attitudes of the teachers were not good enough to translate their high professional competence into actual practice during practical work. It was recommended among others that, Chemistry teachers in senior high schools in Greater Accra Region of Ghana should organised chemistry practical work often, offer guidance and supervise students during practical activities and develop positive attitudes toward practical activities.

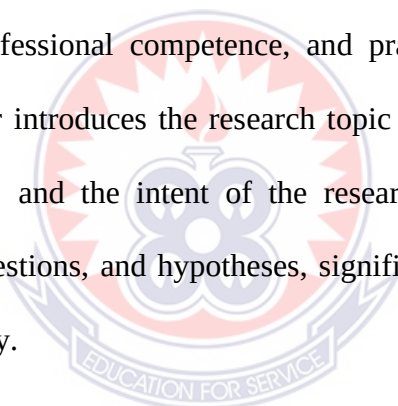


CHAPTER ONE

INTRODUCTION

1.0 Overview

The ineffective implementation of chemistry practical activities in many senior high schools in most developing countries has been linked to teachers' inability to organise practical work, poor attitudes, and low competence (Ogunleye, 2010). Teachers' ability to handle practical exercises will have a directly influence on students' eagerness to participate actively in practical work. Besides, a chemistry teacher who is competent in organising practical lessons is most likely to have a positive attitude toward practical work. This study examined high school chemistry teachers' attitudes, professional competence, and practices in organising practical activities. This chapter introduces the research topic by presenting the background, the problem statement, and the intent of the research work. It also presents the research objectives, questions, and hypotheses, significance of the study, scope, and organisation of the study.



1.1 Background to the Study

Chemistry is an integral part of the science curriculum at the secondary level as its study offers learners opportunities to develop an understanding of the scientific method and the living world (Ministry of Education, 2023). Chemistry acts as a demand subject for numerous work and department of learnedness which have given much to the process of the country. A valid conceptual and hands-on experience of chemistry is necessity for the handling of our natural resources, supply of high-quality medical institution, sufficient provision of food and conducive atmosphere (Emendu, 2014). To accomplish this, the Ghanaian senior high school chemistry syllabus requires chemistry teachers to teach learners to use their conceptual knowledge to

plan investigations to resolve chemistry real-life challenges (Ministry of Education, 2023). In addition, chemistry teachers are mandated to prepare learners with requisite ideas from science, principles, and abilities to solve personal, social, and environmental problems. This cannot be achieved without practical work.

Chemistry practical work demand practicable exercise as well as conceptual studies. Hence, chemistry tutors should be capable in strategising and enforcing the practical activities. Besides to this, chemistry instructors have to own the practical proficiency require in organising, carry on of practical work and ensuring safety and proper handling of chemicals and equipment (Chama & Nachiyunde, 2019)

A professional teacher competency in implementing practical sessions involves his or her ability to construct, design, perform practical sessions, teach practical activities in the laboratory and assess practical sessions (Copriady et al., 2018). Instructors of chemistry with formal training demonstrated a greater level of expertise of tutoring and evaluation in chemistry practical work (Najah et al, 2023).

However, only few of studies have been conducted on high school chemistry tutors' professional competency, attitudes and practices in organizing practical task in Ghana. The insufficient research about chemistry teachers' competence, attitudes and practices in designing practical task in Ghana is the motivation for this research. There is therefore the need to examine high school chemistry tutors' professional competence, attitudes and practices in organizing practical task in the Greater Accra Region.

1.2 Statement of the Problem

Chemistry practical activities effective implementation in numerous high schools in Maputo is a common challenge as there are so countless limitations (Cossa & Uamusse, 2015). These limitations include absence of laboratories and apparatus

for organising practical activities, poor teacher preparation, bad attitudes, and low competence of chemistry teachers in organising practical work. These constraints have made most chemistry instructors either disregard or give less importance on the applicative art advancement parts of studying chemistry, contributing massively to students' failure in WAEC chemistry examinations.

Chemistry teachers' competence and attitudes are vital features that determine the quality of practical lessons (Koksal, 2014). Usually, attitudes fall under the category of competence and possess a well influence on practices of teachers. Competence of chemistry teachers' and attitudes possess a straightway influence on learners' effective participation in practical activities (Cossa & Uamusse, 2015). The inability of chemistry teachers to organise practical work has contributed to the failure of students in chemistry practical examinations. According to (Adodo, 2013), senior high school chemistry teachers do not have the upper hand in organizing practical work for students. Teachers' ability to handle practical work will have a straightway influence on learners' effective participation in practical activities. Chemistry teachers' inability to organise practical work in senior high schools can be attributed to their low levels of competence, bad attitudes, and the adoption of poor practices in organising practical lessons.

The professional competence, attitudes and practices of chemistry teachers are crucial for effective teaching and learning of chemistry. This is because teachers' professional competence, attitudes and practices influence teachers' subject matter, pedagogical skills, classroom management, enthusiasm and passion, differential instruction, use of technology and assessment for learning. A well-rounded teacher not only possess deep subject knowledge but also employs innovative teaching strategies that foster an interactive learning environment and have pedagogical skills

which are essential for delivery effective lessons. Hence, chemistry teachers should demonstrate the competencies that will aid students' learning of chemistry. Ghana Education Services in partnership with the Education Ministry, recruit and employ instructors to instruct at all of Ghana's senior high schools. The requirements for the teaching field were established by them. That is technical beliefs and standards, expertise in the field, and practice of professionalism (Ministry of Education, 2017). There is, therefore, the need to examine the senior high schools' chemistry teachers' professional competence, attitudes, and practices in organising practical work in Greater Accra Region.

1.3 Purpose of Study

The aim of this study was to examine senior high schools' chemistry teachers' professional competence, attitudes, and practices in organising practical work in the Greater Accra Region of Ghana.

1.4 Objectives of the Study

The objectives of the study were to:

1. Appraise chemistry teachers' competency level in organising practical work in senior high schools.
2. Assess chemistry teachers' attitudes toward organising practical work in senior high schools.
3. Examine chemistry teachers' practices during practical work in senior high schools.
4. Establish the association between competence of chemistry teachers' and their attitudes toward organising practical work in senior high schools.

1.5 Research Questions

The study was guided by the following research questions.

1. What is the competency level of chemistry teachers in organising practical work in senior high schools.
2. What are the attitudes of chemistry teachers toward organising practical work in senior high schools.
3. What are chemistry teachers' practices during practical work in senior high schools.
4. What is the relationship between chemistry teachers' competency level and their attitudes in regard to organising practical work in senior high schools.

1.6 Null Hypothesis

A null hypothesis that driven the study was:

Ho: No statistical correlation between chemistry tutors' demographic variables and their competence, attitudes and practices in organising practical work.

1.7 Significance of the Study

This study provides novel data and adequate data on chemistry tutors' competence, attitudes, and practices in arranging chemistry practical activity in high schools in the study Region. The information serves as a guide in planning and designing programs for career development and orientation program for chemistry educators in second cycle schools in the study area and Ghana as a whole to improve the competence of chemistry teachers and promote professional development. Secondly, information on chemistry teachers' professional competence, attitudes, and practices in organising practical work will be used by relevant stakeholders such as

the Ministry of Education, Science Educators, National Curriculum Agencies, and the Ghana Education Service during policy formulation and sensitisation programmes.

The outcome of this study will be informative to chemistry teachers by providing a structure for educators where they could reconsider their teaching methods while performing hands-on work. Besides the findings of the study will be used by heads of second cycle schools in the study area during professional teacher needs assessment and decision-making. This study will give information about the nature and the state of how chemistry practical work is been organized in second cycle schools in Greater Accra and practices adopted by chemistry teachers in teaching and learning practical concepts. It will also guide science teachers and educators during curriculum design and reforms. The findings of the study provide the basis for further research and will help authors of senior high schools' chemistry textbooks when revising their books and the basis to write practical books, according to the research findings.

1.8 Limitations of the Study

Limitations are possible weaknesses and shortcomings that the researcher identified during the research study (Pajares, 2007). This study was limited to senior high schools in the Greater Accra Region of Ghana. Senior high schools in other regions in Ghana should have been part of this study but due to time and financial constraints the study was focused on senior high schools in the greater Accra region. Secondly, the result of this study was generalised to only schools within the Greater Accra Region of Ghana.

1.9 Delimitation of the Study

This study is restricted to only government-owned Senior High Schools in the Greater Accra region offering science programmes. There are forty-four government second cycle schools in Greater Accra and for that matter, only these schools were used in the study. Teachers in these senior high schools that are teaching chemistry were only involved in the study.

1.10 Definition of Terms

It is important to describe terms that could be misunderstood to establish a frame of reference in which the researcher approached the problem. For terms and concepts to carry any meaning that relates to the study, they need to be clearly defined. Hence, the terms used in the write-up are defined below:

Professional teacher: A professional teacher is an individual who has undergone formal education, training, and certification in teaching methods and pedagogy. They typically work in educational institutions and possess expertise in their subject matter or grade level, using their skills to impart knowledge and facilitate learning among students.

Non-professional teacher: A non-professional teacher refers to someone who may not have formal training or certification in teaching. This individual might offer instruction or guidance in a particular subject or skill without necessarily being employed as a qualified educator. They could include mentors, tutors, volunteers, or individuals providing informal education.

Professional competence: Professional competence is a generic, integrated and internalised capability to deliver sustainable effective (worth) performance (including problem solving, realising innovation and creating transformation) in a

certain professional domain, job, role, organisation context and task situation (Mulder, 2014).

In-service training: In-service training refers to professional development or educational programs and workshops designed for individuals already working in a specific profession or field. In the context of teaching, it involves training sessions, seminars, or workshops provided to educators during their employment to enhance their teaching skills, update their knowledge, and improve instructional strategies.

Content Knowledge: Content knowledge pertains to a person's understanding and proficiency in a specific subject area or field. In education, it refers to a teacher's deep understanding and expertise in the subject matter they are teaching, allowing them to effectively convey information, create meaningful learning experiences, and guide students' understanding of the content.

Laboratory: A laboratory is a controlled environment furnished with specific tools, instruments, along with facilities designed for carrying out investigations in science, research, or practical exercises in various fields such as chemistry, biology, physics, and more. In educational settings, laboratories provide hands-on learning experiences for students to apply theoretical concepts and principles.

Science Resource Centre: A Science Resource Centre is a dedicated facility or area within an educational institution that provides resources, materials, and equipment focused on science education. It typically houses books, multimedia resources, models, experiments, and other tools aimed at supporting science teaching and learning activities for students and educators.

1.11 Organisation of Study

This study report is presented in five chapters. Chapter One comprise of background of the study, problem statement, the study purpose, research questions,

the significance of the study, the study delimitation, the study limitation, the definition of terms, and the organisation of the study. The review of the relevant literature forms Chapter Two and Chapter Three deals with the research method. This comprises the design of the study, population, sampling techniques, research instrument, data collection procedure and procedure for analysing the data. Chapter Four deals with the presentation of results and discussion of the findings while Chapter Five presents the summary of findings, conclusions and recommendations.



CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter presents a review and synthesis of existing literature about standard practices adopted when performing chemistry practical, the importance of chemistry practical work, teaching methods for chemistry practical work, chemistry teachers' competence in organising practical work, attitudes of chemistry teachers toward practical work, chemistry teachers' practices in organising practical work and factors affecting teaching and learning of chemistry practical lessons. It also highlights the theoretical and conceptual framework underpinning the study.

2.1 Theoretical Framework Underpinning the Study

A theoretical framework is a succinct explanation of the main factors at play in the problem domain to be looked into, along with the researcher's perspective on how the factors interact to create a more potent or thorough model of pertinent phenomena that is not currently available for shedding light on the issue at hand (Badugela, 2012). A theoretical framework gives the investigation direction and prevents the researcher from focusing on the shadows rather than the truth (Schunk, 2012). According to Labaree (2013), the framework for a research study's theory is known as the theoretical framework. The theory that defines the research challenge under which the study is conducted is outlined and defined.

The constructivism theory serves as the foundation for this study. Constructivism encourages students to be more involved in their education by providing a platform for them to pose questions and participate in discussions about the topics that are being presented. Vygotsky (1978) validated up this claim by saying that social interactions play a significant role in knowledge formation. The

constructivism theory emphasizes several teaching and learning strategies, including project work, inquiry, problem solving, and discovery (Schunk, 2012). All these methods place emphasis on the active participation of the learner. Behaviourism was used because in this study, behaviourism defines how chemistry teachers behave when organising chemistry practical work. Chemistry teachers' behaviour impacts how they will successfully manage, teach and organise practical chemistry exercises in senior high schools. Besides, teachers understanding in behaviourism can help them get a better insight into how students learn to acquire knowledge and new skills.

2.1.1 Constructivism

The theory of constructivism is based on the observation and the scientific investigation of how people learn. The teacher is a facilitator, provocateur, creator of opportunity, and co-developer of understanding. Thus, the teacher creates environment with the learners, trying to share the meaning of the materials learned, and to help the learners acquire practical skills (Ritchie & Rigano, 1996). In the most general sense, the teacher encourages learners to use active techniques (experiments, real-world problem solving) to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. The teacher makes sure the learners' prior conceptions are understood.

According to Gray (1997), Constructivist training makes the assumption that learning happens when students actively produce meaning and knowledge instead of just passively absorbing information. Constructivist instruction develops logical thinking skills and produces driven, self-sufficient students (Gray, 1997). Thus, learners are the makers of knowledge. This constructivism theory therefore fits the purpose of this study which sought to examine senior high school chemistry teachers' professional competence, attitudes, and practices in organising practical work with

emphasis on what a teacher can do to help learners to work independently to creating and understanding. The important issue then becomes which constructivist approaches to teaching are teachers using to assist the learners to develop and acquire practical skills and perform better in the chemistry final practical examination?

The use of teaching approaches such as learner-centred, activity based, experimentation, small-group discussions, simulations, field trips, group work and problem-based learning might allow learners to engage in social interactions which will promote critical thinking as well as creativity to bring about practical skills development in chemistry practical. That is why chemistry instructors methods of instruction should help students develop process skills (Ritchie & Rigano, 1996). A study reveals that student incentive and achievement for the purpose to study science improve remarkable if learners contribute actively in creating their own unique ideas and in learning to use that information to evaluate the scientific method (Khan et al., 2011). Ikeobi (2004) study finds out that if students are given enough chances to use tools and resources that aid in the construction of their understanding of phenomena and related scientific concepts, they can learn something useful from a particular laboratory experiment. The theory of constructivism forms the basis of this study because chemistry teachers are supposed to teach practical work and assist students to perform practical tasks. In order for students to do better on practical exams, teachers are expected to help them find, modify, and build their individual ideas as well as obtain practical skills (Vygotsky, 1978).

2.1.2 Radical Constructivism

Radical constructivism, a cognitive theory of learning, posits that knowledge is not passively received but actively constructed by learners through their interaction with the environment. This theory pioneered by Glasersfeld (1984) emphasizes the

individual's role in shaping their understanding of the world. Radical constructivist believes that learners create mental models, based on their experiences and interpretations. These models are constantly being revised and updated as they encounter new information and situations. Knowledge is therefore considered to be subjective and relative to the individual's unique perspective.

Key principles of radical constructivism include that fact that knowledge is constructed and not passively received. Learning is an active process of meaning-making individual experiences and perspectives shape knowledge. The principles of radical and social constructivism have significant implications for how we approach learning and instruction. These theories suggest that teachers should create environments that foster active, collaborative and meaningful learning experiences. Some key implications of constructivism include:

Learner-centered approach: Focus on the individual learner's needs, interests, and prior knowledge.

Active engagement: Encourage learners to actively participate in the learning process through problem-solving, inquiry-based learning, and hands-on activities.

Collaborative learning: Facilitate group work and peer interaction to encourage learners to share ideas, perspectives, and knowledge.

Real-world connections: Connect learning to real-world contexts and experiences to make it more meaningful and relevant.

Authentic assessment: Use assessment methods that measure learners' ability to apply knowledge and skills in authentic contexts.

Radical and social constructivism offer valuable insights into the nature of learning, emphasizing the active role of the learner in constructing knowledge.

2.2 Practical Work in Chemistry

Science Community Representing Education (2008) defines practical task as specific science teaching and learning exercise that allows learners to work alone or work in pairs while handling or noticing actual materials and substances in contrasting to the virtual world. Practical work has been defined in many different ways. Millar (2004) defines practical work as any activity that uses calculation, object or material manipulation, and observation to assist students in making well-informed judgments. Thus, the teacher's job is to help students gain skills by employing various teaching strategies like problem-based learning, group projects, and hands-on activities that help students gain real-world expertise. This could improve the students' comprehension and proficiency in physical science concepts and principles, which would improve their performance on practical tests.

Students can gain practical experience through practical activities that makes them reflect on the society we live in. Two main classifications of exercises are regarded as practical work. They are (1) Investigative efforts are among the core activities, Experimental techniques

And field studies. Core activities include practical exercises which encourage the growth of practical abilities and assist learners in developing their comprehension of scientific ideas and occurrences. (2) Direct related activities which include presentations by teacher, coming across phenomena, Preparing and arranging an investigation, studying outcomes and data evaluation using Information and Communication Technology (ICT). Direct-related activities are either a key component of an investigation or provided valuable first-hand experiences for students.

During practical work students are allowed to interact with materials and to check and observe phenomena in a laboratory. Sabri and Emaus (1999) showed that there was a Students' academic performance in science theory and practical courses was positively correlated with the overall amount of science practical work completed in secondary schools. The study further indicated that the size of this effect ranged between 26 % and 50 % for various science courses. In that same study, it was revealed that the use of laboratory work helped to develop scientific attitudes in the students, which improved their learning of chemistry and development of scientific skills for solving problems. Chemistry practical exercises assist students develop procedures like manipulation and observation so they may comprehend scientific concepts and scientific investigation (Woodlley, 2009).

Practical activity improves pupils' academic performance and creates a link between the mind and practical tasks. Abrahams and Millar (2008) argued that to improve students' comprehension of scientific concepts, practical work needs to involve more hands-on activities. Field Studies, testing in the lab, and experimental tasks are all included in practical work. Teaching practical work entails developing, enhancing, sustaining, and modifying learning to meet the subject goals and retain engagement among students. Additionally, it assists students in developing conceptual and physical understanding and involves learners in the scientific method that has undergone rigorous testing (Millar, 2004). Projects, case studies, and field studies that immerse students in real-world labor and the discovery of workable solutions to tasks and problems should all be a part of the training of practical skills. This entails showcasing manipulative abilities with tools, machinery, and equipment to solve real-world problems (Ministry of Education, 2023).

The most important part of chemistry education is hands-on practice (Abrahams & Saglam, 2010). Students get a vital opportunity to connect scientific principles and ideas with first-hand experience through practical activity (Cossa, 2007). Babalola et al. (2019) mentioned that engaging in hands-on work can improve scientific understanding acquisition, inspire and encourage good attitudes toward science, and help students gain laboratory skills. Njoku (2003) opined that chemistry is practical-oriented and the interest of learners in chemistry practical activities is indispensable for their mastery of the subject while Na'Omi (2013) justify that practical exercises can be considered as an approach that could be embraced to make the teacher's job a reality. Again, practical work enhances the academic achievement of students and their level of acquisition of scientific process skills (Antwi et al., 2021).

The efficient implementation of applied chemistry activities in numerous schools in underdeveloped nations is a common challenge as well as multiple limitations (Cossa & Uamusse, 2015). These limitations consist of absence of laboratories coupled with apparatus for organizing practical activities, poor preparation, bad attitudes, and minimal competence of instructors of chemistry in organising practical activities.

A study outcome conducted in Ethiopia revealed that chemistry senior high school students had inadequate process skills and failed practical examinations. The student's failure was attributed to poor knowledge, low competence and bad attitudes of teachers towards organising practical work, vanished of teachers during hand-on activities, late commence of teaching practical activities, brief time frame designated for practical activity, and teachers' not having information on using modern equipment (Mesfin et al., 2016). In a similar study, Chama and Nachiyunde (2019)

found that the competence and attitudes of chemistry teachers toward organising practical work were low. Similar findings were also observed in a study carried out by Eya et al. (2020) in Nigeria. The situation in senior high schools in Ghana may not be different and needs to be investigated.

2.3 Importance of Chemistry Practical Work

Practical work is considered to be a vital component in the learning of science (Hattingh et al., 2007). Kandjeo-Marenga (2008) stressed the importance of any science researcher to have a profound understanding of what practical work is about, what it necessitates and what can be regarded as good practice in science education. Hattingh et al. (2007) reported that practical work should be performed successfully on a daily basis to promote understanding of scientific concepts and theories. Furthermore, the choice to incorporate practical work into teaching and learning activities is dependent on many variables including the teacher's understanding of concepts. The extent to which teachers engage practical work depends on the degree of involvement and participation of the learners.

Practical work creates a platform for learners to fundamentally utilize their minds in learning the standards and laws of science (Ufonabasi & Nsimeneabasi, 2017). Practical work plays a vital role as it permits learners to alternate between hypothetical thoughts thereby coordinating involvement. Learners are anticipated to have the capacity to recognize and value scientific information as dependable based on perceptions and reproducible experiments (Wilkinson & Ward, 1997). Mwangi and Sibanda (2017) postulated that practical work assist teachers to create a genuine understanding in learners. They emphasised that practical activities should engage learners in activities where they can physically manipulate objects, following

guidelines set to facilitate this for them. Learners become excited when an opportunity is given to them to undertake practical lessons.

It is crucial for learners to understand scientific processes and develop skills in manipulation to process scientific information and conduct scientific investigations. Abrahams and Reiss (2012) contend that in spite of the fact that they found it vital for learners to deal with a range of objects and materials to create desired phenomena, most of these cannot be compared to the utilization of formula-style activities. The majority of the practical work's effects were derived from the work that students did, observed, and exerted (Abrahams & Reiss, 2012). Kaptan and Timurlenk (2012) assert that one unique aspect of science courses is practical work, which is often seen to have an impact on enhancing students' attitudes toward practical work. It primarily demonstrates that students who demonstrate an interest in engaging in practical activities have a more positive attitude when compared to only theoretical learning.

It is important that learners are presented with a fully integrated course, which allows them to improve their practical skills by carrying out practical work and inquiries within the syllabus objectives to achieve the targets. Exploring phenomena, interpreting information and applying knowledge during practical (experimental and investigative) activities are crucial to understanding the worth and limits characteristic of common substances, methodologies and their application to our ways of life. This requires progressed development through the practical and successful utilization of resources and processes.

Lee and Sulaiman (2018) study indicated that, Practical activity is a helpful way to foster positive impact on students' motivation and comprehension of learning. Practical work also encourages students' curiosity, excitement, new experiences, and comprehension of a subject, which improves their capacity to work with peers and

serves as a powerful incentive to raise performance as students become more confident in the subject. In agreement with what was said by Lee and Sulaiman (2018) the current researcher postulates that Science education cannot be complete without practical work. Therefore, there is no doubt that practical work is a fundamental part of the teaching and learning of science. Due to the fact that practical work helps learners to expand their essential science knowledge, it elevates their motivation and understanding of scientific theories as related to practical work and concepts about the natural world.

Students learn faster when they partake in practical activities than any other learning strategy because doing practical work gives them a chance to see objects and manipulate them physically as opposed to just seeing them presented in textbooks or on the internet. Seeing them physically also gives them a chance to learn how they operate when they manipulate them physically, as opposed to merely memorising these facts from verbal teaching. Nonetheless, practical work cannot provide full guarantees that learners will learn and achieve all required practical objectives from teachers. Millar and Abrahams (2009) demonstrated that after doing a practical task for weeks, students can only remember specific surface-level facts. The majority of students found it difficult to remember what they had learnt. Thus, it is necessary to perform the practical work.

Engaging in practical tasks facilitates the connection between chemistry in the classroom and chemistry in both traditional and modern industries or situations in the real world. Students learn how to tackle real-world chemical-based problems by designing experiments using their theoretical knowledge through practical work. Through hands-on activities, students can strengthen their scientific abilities and use

their senses to make precise observations. Additionally, they can learn how to appropriately handle scientific tools and materials (Ministry of Education, 2023).

2.4 Teaching Methods for Chemistry Practical Work

Teaching methods are the most essential techniques used by teachers to achieve a lesson's goals. (Borich, 2007). Thus, teachers of all disciplines including chemistry teachers' use various teaching methods for achieving lesson objectives. In order to acquire more chemistry knowledge, practical activities should involve projects, case studies and field studies where students will be intensively involved in practical work and in the search for practical solutions to problems and tasks. practical work is necessary for students to gain a delight fluency in using scientific apparatus and instrument for scientific experiments, developing hypotheses, arranging and strategising experiments, persevering through the execution of experimental activities, using the senses to make accurate observations of color, form, and texture and be able to classify them, employing measurement devices and equipment for reading and measuring, assessing data according to its worth (good, bad, reliable, unreliable), and drawing conclusions and predictions from written or graphical data (Ministry of Education, 2023).

To engage students in hands-on activity and encourage analytical thinking and a deeper understanding of chemical principles, teachers typically implement a variety of effective instructional tactics during chemistry practical tasks. These tactics include planned activities that enhance curiosity and problem-solving abilities, as well as guided inquiry, which inspires students to examine chemical phenomena. Incorporating multimodal materials, imagery, and presentations helps make difficult chemical reactions easier to understand, engage students, and make abstract ideas easier to comprehend. Encouraging cooperative learning settings where students

cooperate develops communication skills, teamwork, and a common understanding of subjects. Relating practical experiments to real-world applications bolsters relevance and significance in students' minds, while prioritising safety protocols and essential laboratory skills ensures a secure and skilful laboratory environment. Problem-based learning tasks students with authentic challenges, encouraging critical thinking and decision-making within a practical context. Recognising diverse learning needs through differentiated instruction, fostering reflection and discussion, utilising formative assessments, and providing constructive feedback and reinforcement further enrich the learning experience, solidifying connections between laboratory findings and theoretical concepts covered in lectures or readings.

Teachers typically use the standard method of experimentation in their instructional and educational discussions, which involves simple instruction or extremely organized training (Ibrahim et al., 2014). The conventional method, which is frequently referred to as "recipe learning," involves having students to learn attentively throughout the entire experiment without thinking but by following the teacher's instructions. A study carried out by Adarkwah and Amenorfe (2022) in Ghana showed that when delivering double indicator titration classes, instructors employ the lecture format rather than hands-on activities, which has a detrimental impact on students' academic achievement. The study concluded that, instead of teaching in abstract terms or letting their students sit in the classroom passively, chemistry teachers should employ teaching strategies that let their students interact and use their five senses and other talents to handle equipment and materials (Adarkwah & Amenorfe, 2022).

Findings of studies that have shown that compared to individual laboratory work strategies, group work combined with laboratory experiments greatly improved

students' acquisition of practical chemistry abilities (Tsobaza & Njoku, 2021; Cheruiyot, 2020). Chemistry practical work can be carried out more fruitfully using group work teaching and learning strategy than individual work. A study presented by Cheruiyot (2020) in Narok, Kenya revealed that chemistry was taught by lecturers through lectures, with no hands-on activities. Consequently, students performed poorly during end-of-semester examinations. The study found that the teaching method employed for teaching chemistry hardly motivated students which translated to low performance of students.

When teaching practical work, guided discovery is a more effective means of knowledge acquisition than traditional techniques like lectures (Bajah & Asim, 2002). Students are encouraged to study through guided discovery, which also guarantees improved knowledge retention, a deeper comprehension, and the acquisition of practical skills (Froyd & Simpson, 2008).

Science instructors can utilize demonstration as a hands-on method to help their students learn specific abilities (Woodley, 2009) and it is beneficial to learners in many ways including encouraging inclusiveness (Meyer et al., 2003). Demonstration can be a valuable successful way to teach practical work when resources for practical work are limited or class sizes are too big (Hayward, 2003).

Group experiments are regarded as an important component of practical work learning since they allow teachers to engage with the real handle of tools and apparatus (Tifi et al., 2006). Group experiments give students the opportunity to actively participate in advancement of knowledge in science and abilities as well as the use of scientific instruments. Kandjeo-Marenga (2011) states that as learners work in groups they help each other, make recommendations, clarifications, confront others, communicate to others what next action required to be taken, and share views

as they try to solve problems. Group experiments provide students the chance to connect with other learners and reconstruct their own way of thinking (Muijs & Reynolds, 2011).

A field trip is a kind of environmental laboratory exercise or field work that teachers and students engage in specific components of a subject to provide students with the chance to learn (Obeka, 2010). A field trip is a form of learning through experience that allows students to see tangible examples of classroom theories outside of the conventional classroom environment. Field trips provide a valuable teaching and learning experience in a novel setting. According to Nawi and Azmi (2016), Field trips can be a useful technique for improving students' participation and offering special chances to understand specific subjects, such as legal principles, by placing them in a more appropriate and authentic situation. Ehirim et al. (2021) found that the field trip enables chemistry students the chance to expand their practical understanding of the industrial application of chemistry and keeps them interested and participated. Teaching outdoor practical activities has the benefit of enabling students to actively participate in observation, thought processes, and planning and overseeing the entire practical activity (Abraham & Millar, 2008). A study carried out by Dasun, Ariya and Kazi (2023) on effects of field trip technique on attitude and academic achievement shows that the use of field trips improves students' attitudes toward a subject, increases their comprehension of the learning process, and boosts their academic performance.

Field trips encourage participation, analytical thinking, and a deeper comprehension of concepts, all of which have a good impact on the performance of learners, especially in science experts' courses (Kisiel, 2013). Again, students visit to museums were beneficial associated with higher academic accomplishment because

they allowed students to participate in experimental and participatory learning, which increased information retention and application (Kisiel, 2013). Study has demonstrated that educational field trips to cultural locations have a significant impact on students' academic performance in a variety of disciplines as well as their motivation and involvement (Falk & Balling, 2010).

Science instructors must employ adaptable, innovative, and learner-centered teaching strategies to support students' varying learning preferences (Al Maghraby & Alshami, 2013). Teachers should use instructional strategies that give students the chance to learn, share their understanding, and have enough exposure to the material they will be expected to cover in exams. This could be done by giving learners more problems to work on and chances to learn the subject content in real-life situations through undertaking practical work in the laboratory. Fishburne and Hickson (2001) proposed that effective science teaching and learning strategies, like group projects, lab experiments, and problem-based learning, enable students to engage with one another and support one another to gain practical skills and a greater understanding of the subject. Khoboli and Toole (2011) argued that teachers' dedication to constructive instructional methods does not imply that all practical abilities are acquired using these techniques; rather, the selection of teaching strategies should be based on the goals of a practical lesson to be taught, the time and resources available, and other factors.

By utilizing various teaching strategies and include hands-on activities in their classes, teachers can further encourage the teaching of practical work in the classroom (Shadrack & Isaac, 2012). Using a variety of teaching techniques when teaching practical work has several benefits, including increasing students' interest and focus as well as extends and providing teachers with the adaptability to deal with a variety of

difficulties that arise during the teaching and learning process (Pretty, 2009). It is imperative for teachers to use varied instructional strategies such as demonstrations, cooperative strategy, guided-inquiry and activities method during teaching and learning of practical lessons.

2.5 Chemistry Teachers' Competence in Organising Practical Work

Competence refers to the combination of abilities, information, and character traits that allow someone to perform tasks effectively and produce the desired outcomes. Competence is not a static state but rather a dynamic process of continuous acquisition and adaptation. It comprises displaying mastery in a particular profession by applying knowledge and skills in real-world situations. Competence can be regarded from a variety of angles, including social and technical skills. Technical competence is the term used to describe specialized knowledge in a given profession, such as programming, accountancy, or surgery. Conversely, social competence encompasses organizational skills, communication talents, and the ability to function well in a variety of settings and teams. Adikwu et al. (2018) view competence as learned attitudes and abilities that show up as the capacity to use cognitive and social abilities to solve difficulties in daily life. Unique significant element in assessing the achievement of instructing is the instructors' competence in the teaching and learning technique. Affective competence describes the affective traits of teachers or the attitudinal aspects such as interest, motivation, incentives, diligence, obedience, honesty and punctuality.

Teachers' ought to have sufficient subject-matter expertise and possess both pedagogical and content understanding (Ministry of Education, 2012). The instructor should have strong technical pedagogical expertise and know how to integrate Information and Communication Technology (ICT) into their lessons to enhance

learning. They should also employ a wide range of learning organization strategies and where appropriate, use settings outside of the educational setting (Ministry of Education, 2017; 2023).

Analytical competence connotes the mental actions of instructors and also define the part of intelligence and motor action competence is concerning the psychomotor skillfulness or procedure skillfulness of instructors in teaching of chemistry practical. Katane and Selvi (2006) describe competence is the set of abilities, expertise, and skills needed to put together an activity in an effective manner. competency in teaching refers to the capacity to demonstrate in the workplace capabilities and knowledge acquired through training (Adodo 2013).

Chemistry practical work demand practicable exercise as well as conceptual studies. Consequently, chemistry tutors should be competent in designing and enforcing the practical activities. Apart from that, Chemistry instructors must be equipped with the practical abilities necessary for preparing, carrying out, and guaranteeing the safety and appropriate treatment of chemicals and equipment (Chama & Nachiyunde, 2019). Practical chemistry can be a tough subject for students to understand because it involves a lot of abstract and complicated topics. During practical work, proficient chemistry instructors should be able to explain these ideas in an understandable, succinct, and captivating way. This could entail employing a range of instructional strategies, such as group projects, hands-on tasks, and presentations. Chemistry Teachers must also be able to tailor their teaching of practical work to the individual learning styles and needs of their students during practical session. This may involve using different types of visuals providing additional support materials and inspiring learners to inquire and ask for explanation.

Teachers are hoped to possess a delightful order of competence and also have command of the subject content prior to bringing in practical lessons to the learners. This will improve efficient instructing of the subject in the senior high schools. According to Fadzil and Saat (2017), teachers have a major role to play in educating students on the proper handling of scientific equipment and materials. They should possess a strong and credible understanding of science including the mastery of practical skills.

A study conducted on competences owned and utilised by high school chemistry teachers indicated that the instructors were unskilled in preparing and carrying on chemistry practical activity (Eya et al., 2020). Additionally, the chemistry teachers' incompetent of evaluating chemistry practical at the levels of affective and psychomotor domains. The study suggested that there should be regular organisation of conferences, seminars and workshops for chemistry teachers in the areas of designing and conducting practical as well as how to handle some of the common equipment, Chemistry teachers should acquire knowledge on how to evaluate students affective and psychomotor skills in practical classes (Eya et al., 2020).

The outcome of a study conducted by Chama and Nachiyunde (2019) in selected schools in Kitwe District found that most of the practical activities designed by teachers were procedural in nature hence they were characterised by learners following laid down procedures. It was noted that the focus of most of these practical activities was to expose learners to pieces of apparatus, verify and confirm what was discussed during theory lessons. The study's findings showed that practical activities hardly fostered the development of a wider range of science process skills and learners were unable to construct meaning out of the data they collected.

Hence there were minimal opportunities for learners to think creatively, construct knowledge and understanding of chemistry concepts. The research concluded that there was the need for chemistry teachers to strengthen their education programs in terms of student exposure to practical activities especially investigative ones and headmasters should organise workshops and continuous professional development for chemistry teachers to train them on how to design practical activities and chemistry teachers should design practical activities that provide opportunities for learners to understand chemistry concepts and develop science process skills.

A teacher's professional competency in implementing practical sessions involves his or her ability to construct, design, perform practical sessions, teach practical activities in the laboratory and assess practical sessions (Copriady et al., 2018). The result of a study carried out in Secondary Schools in Makurdi, Benue State Nigeria indicated that the chemistry teachers' knowledge and skill in organising practical work were above average, but their affection was below average in practical chemistry.

Their overall competence was moderate. They further stated that motivation, appropriate and prompt remuneration for chemistry teachers' and provision of adequate laboratory materials will improve the affection toward secondary school chemistry practical. The degree of competence in the entire phase of arranging, preparing, administering and assessing of practical exercise is at the medium level. It was suggested that endeavours must be made up to expand instructors' competence and obtainment of more complicated laboratory materials (Copriady, 2014). The finding of a research work carried out by Odum et al. (2013) in Cross River State, Nigeria revealed that most teachers (>75.0%) could not identify (through writing of names and uses) commonly used pieces of laboratory apparatus.

A similar study conducted in Nairobi-Kenya indicated that strategies teachers used to teach practical lessons never focused on the learners' minds-on activities (Ituma et al., 2015).

2.6 Attitudes of Chemistry Teachers Toward Practical Work

An attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour (Baumeister & Vohs, 2007). Attitude is a way a person views and evaluates something or someone. It is a predisposition or a tendency to respond positively or negatively toward a certain idea, object, person or situation (Chawla et al., 2013). Attitude is structured along three dimensions: cognitive (perceptions and beliefs), affective (likes and dislikes, feelings, or evoked emotions), and behavioural (actions or expressed intentions toward the object based upon the "cognitive" and "affective" responses). Attitudes can be measured by making inference. Data is need on which to base our inference. Such data can be collected using various instruments such as questionnaire, interview, direct behavioural observation, implicit association test and affective misattribution procedures.

A crucial component of social research is attitude measuring, which sheds light on people's attitudes, opinions, and behavioural intentions for a range of subjects. Numerous tools have been created to measure attitudes from observational techniques to self-report surveys, each with special benefits and difficulties in capturing the complexity of human emotion (Hiyama & Sugimoto, 2021). Likert scales, semantic differential scales, and projective approaches are just a few of the various sorts of these tools that are designed to elicit particular responses that capture the complex nature of people's attitudes (Gure, 2015).

Chemistry teachers should have positive attitude because it can inspire students to be more engaged and motivated and install confidence among students. Positive attitude of chemistry teachers toward practical work would encourage students to learn the content much better, helps with comprehension, knowledge retention, and the development of cognitive skills. Students who participate in chemistry experiments, like their teachers' approaches to learning display good attitudes toward the subject. Besides positive attitude of chemistry teacher can boost students learning experience and create a better learning environment for them. A positive attitude from chemistry teachers toward practical work enhances the educational experience, enriches student learning, and prepares them for future academic and professional endeavours in the field of chemistry.

Teachers should demonstrate effective leadership qualities in the classroom, expose learner to scientific procedures, develop appropriate management skills that do not dehumanise the learners from learning and shows high levels of attendance and punctuality during practical lessons (Ministry of Education, 2012). instructors have to assure that learners are good enough ready before each practical activities, and also insure that practical activities are begin in the second year alongside the theory classes (Ministry of Education, 2023).

The chemistry teachers' attitudes and attributes toward the twenty-first century skills were explored (Shidig & Yamtinah, 2019). It was found that the chemistry teachers expressed moderate positive attitudes and attribute toward the twenty-first century skills and lacked the ability to learn and communicate effectively. The results of research conducted by Gecer and Zengin (2015) showed that teachers were not familiar with tools and equipment in the laboratories and unable to use them. The study also revealed that teachers were unable to use teaching methods and techniques

effectively in laboratory during practical activities. Its study reported that from time to time, new developments and curricula should be integrated into the education system. Additionally, teachers must attend the introductory seminars about new developments in education that are held in city centres. Inyega and Inyega (2017) reported that teachers appear to have a pleasant improvement in attitude toward the aims of instruction and learning, employing suitable instructional techniques, schedules for work, potential to get around the restrictions on teaching and performing hands-on activity in chemistry. This finding differs from that of a study that indicated that chemistry instructors got a negative behaviour regarding organising practical activity for students in senior high school at Nsukka Local Government Area of Enugu State, Nigeria (Okorie & Ugwuanyi, 2019).

The attitude of chemistry teachers guides their behavior and also vary according to time and previous experience (Niwas, 2018). An instructor possessing a good behavior regarding his or her work will like supplementary information to advance the work they do. Competence on the other hand is the capability of an instructor to display on-the-job skills and information obtaining through adequate training (Adodo, 2013). There must be a greater association among chemistry teachers' competence and attitudes in organising practical work because each of them includes a human being having knowledge, comprehension, and skillfulness. A study by Koksai (2014) contends that a whole competency and attitudes are important to better the standard of the teaching industry. Hence, attitudes are commonly regarded within the range of competence, and they possess a deep influence on teachers' procedures and practices. A chemistry tutor who is capable in organising practical work is most certainly to possess a good attitude toward practical work.

Furthermore, a competent and professional chemistry teacher knows how to perform experiments and execute practical tasks successfully (Widyatiningtyas, 2010). Chemistry teachers are hoped to possess a delightful order of competence, good attitude and also have command of the subject content prior to bringing in practical lessons to the learners.

The attitudes of chemistry teachers in organising practical work are not encouraging in senior high schools in Ghana. The failure of students in WASSCE in chemistry practical papers has been attributed to teachers' inability to organise chemistry practical lessons and poor attitudes, and low professional competence in organising practical work. According to (Adodo, 2013), senior high school chemistry teachers do not have the upper hand in organising practical work for students. Teachers' ability to handle practical tasks would have a straightway influence on students' proactive participation in practical activity.

2.7 Chemistry Teachers' Practices in Organising Practical Work

Practices in context of organising practical work in a chemistry laboratory refer to the established methods, procedures, and routines that teachers and students follow to ensure that laboratory activities are conducted efficiently, safely, and effectively (Cooper et al., 2006). The term "practice" in the context of education generally refers to the activities, strategies, methods, and behaviours employed by teachers during teaching and learning (Grossman et al., 2009). These activities encompass a wide range of actions including lesson planning, classroom management, assessment techniques, and the organisation of practical work among others. Effective teaching practices are essential for creating, engaging and conducive learning environments that promote student learning and achievement (Hattie, 2009).

It is crucial for chemistry teachers to adopt standard or good practices in organising practical work. The reasons for adopting good practices when organising chemistry practical work include:

- **Safety:** Hazardous chemicals, glassware, and equipment are frequently used in chemistry investigations. Adequate arrangement guarantees adherence to safety procedures, diminishing the possibility of mishaps and guaranteeing a secure educational setting for students.
- **Efficiency:** Smooth transitions between various stages of an experiment are made possible by well-organised practical labour. This effectiveness increases learning time, reduces downtime and fosters student engagement.
- **Efficient Education:** Well-organised and unambiguous hands-on learning aids in students' comprehension of the goals and methods of experiments. When teachers plan their practical assignments well, students are less distracted by organisational elements and are able to concentrate on understanding the scientific principles.
- **Resource Management:** Time, money, and chemicals may all be used more effectively when practical activities are well organised. This is crucial in educational environments with constrained funding and resources.
- **Reproducibility:** Scientific experiments must be reproducible to be valid. Proper organisation of practical work ensures that experiments are consistently replicated, which is a fundamental aspect of scientific inquiry.
- **Assessment:** Teachers can more easily and accurately assess students' knowledge and abilities when practical work is structured properly. It offers a methodical framework for observing and assessing student performance.

- **Skill Development:** Students acquire important skills including organisation, time management, and planning when they take part in well-organised practical work, these are transferable capabilities that are useful not only in science but also in other fields of study. Chemistry teachers need to be adept at organising practical work since it has a direct impact on student learning outcomes, safety, and quality of instruction.

Some key good practices that need to be adopted by chemistry teacher for organising practical work are adequate preparation and planning, the use safe and injury free equipment, effective supervision and assistance, time management, record keeping and documentation, post laboratory activities comprising clean-ups and debriefing.

The chemistry teachers' practice in organising practical work was explored in Malaysia (Sani, 2014). It was found that teachers aim for organising practical work was divided into three: conceptual, procedural and affective domains. Again, the enforced practical task was extremely organised in the know that all information regards to the manner to carry on the practical task, what to take note of and what the awaited outcome would be, was given to the learners. Similar research conducted in Ethiopia found that teachers believed that chemistry practical work was relevant to students' learning (Seid et al., 2022). Nonetheless, the laboratory work was rarely performed and there was insufficient equipment (chemicals and instruments) in the laboratory for organising practical work. Vinko et al. (2020) reported that most teachers involve their students in chemistry demonstrations by asking them to write down, comment on, and explain their observations. On the contrary, Ituma and Twoli (2015) found that, the techniques for teaching practical activity did not sufficient concentrate on the activities and the thoughts of the students. Notwithstanding,

facilitators needed materials to assist effective execution of student-oriented research base practical activity in schools.

Analysis of results that explored chemistry teachers practices in organising practical work revealed that practical works were done without teacher supervision and assessment of students and teaching methods used during practical lessons did not motivate students resulting to low performance (Cheruiyot, 2020; Byusa et al., 2021). Sani (2014) evaluated instructors' procedures to practical activity in Malaysia secondary schools and found that instructors' knowledge about practical activity were in line with their aim for organising practical activities. Practical activity that instructors presented encouraged basic level of research. Teachers' practices during practical work were restricted by confined materials, prescribed texts, the volume of material required to be instructed and their science information knowledge. The capacity for learners to learn was limited by the lack of introduction to real scientific research and poor teacher demand.

Teachers should develop the ability to select, adapt and develop pedagogical materials to meet instructional objective, create a safe and encourage learning environment and develop skills in assessment to monitor and evaluate learning (Ministry of Education, 2012). Teachers should Sets meaningful tasks that encourage learner collaboration and leads to purposeful learning, produces and uses a variety of teaching and learning resources that enhance learning, integrates a variety of assessment modes into teaching to support learning, and again listens to learners and gives constructive feedback (Ministry of Education, 2017).

Chemistry teachers are to make the subject engaging and encouraging through preparing hand-on activities for students to enhance their easy understanding of the subject content and prepare learners to use their conceptual though to plan

experimentation to answer chemistry practical challenges. (Ministry of Education, 2023)

2.8 Factors Affecting Teaching and Learning of Chemistry Practical Activities

Teaching and learning materials and equipment affect chemistry practical lessons. Teaching and learning materials help learners to comprehend and highly a sense and approaches of science including issue resolving, critical reasoning and the scientific approach. Again, teaching aids are used to reinforce what is learned in the theory class and hence encourages the spirit of experimentation. Adequate and appropriate use of teaching aid improve learners high ground comprehension of ideas and a theory and also promotes the development of scientific attitudes such as objectivity, honesty, curiosity, patience, open-mindedness in students. Instructional aids significantly contribute to students' achievements in chemistry practical. Inadequate use of teaching aids during practical work hinders students' understanding. When teaching materials and equipment are not of good quality for them to produce accurate results during practical lessons, they will affect chemistry practical lessons and for that matter students will not be able to acquire the necessary skill and knowledge for their future careers as scientists. The lack of chemicals, equipment, materials and apparatus are among the commonly perceived factors affecting the teaching of practical lessons (Jacobs et al., 2004).

Practical work cannot take place if basic experimental resources are not available in laboratories. The availability of practical materials and facilities in the laboratories are important for teaching practical skills (Likoko et al., 2013). Learners' performance in practical examinations can be affected by the quality and number of teaching resources during practical lessons. Schools with adequate facilities the

learners tend to perform well in examinations compared to the poorly equipped schools (Likoko et al., 2013).

Chemistry teachers' who are incompetent lack the requisite skills to improvise unavailable laboratory equipment materials and lack manipulating skills. Incompetence, unwillingness of some chemistry teachers' to conduct practical and lack of manipulation skills among chemistry teachers, instructors' lesser expertise of practical activity, unavailability of instructors at hands-on learning activities, late start time of teaching a practical activity, not being aware and incentive from leadership of the schools and hazardous workplaces are key factors that hinders the teaching and learning practical lessons in senior high schools in developing countries (Seid et al., 2022; Dan-Ologe & Shittu, 2012).

Besides, negative attitudes of teachers towards practical work, undersupply of apparatus in the laboratory and very short time assign for practical activities affect the effective implementation of practical activities (Anza et al., 2016; Dada & Anbesaw, 2016; Nwaka & Ngozi, 2018). In situations where a chemistry teacher is devoid of knowledge and skills to manipulate the laboratory equipment and not able to improvise materials when not available, then the teaching and learning of the practical lesson is simply ignored (Ali, 2001; Jacobs et al., 2004). It is important for chemistry teachers to have knowledge on how to facilitate practical work, draw up practical activities for learners as well as to prepare and set appropriate materials and equipment for learners. Chemistry teachers are supposed to pass through the required and adequate training with emphasis on how to effectively carryout chemistry practical instructions to enhance students' interest and achievement in chemistry classes (Nwaka & Ngozi, 2018; Richman, 2017).

2.9 Conceptual Framework

A conceptual framework is a written or visual presentation that explains key factors, concepts or variables and the presumed relationship among them in a study. According to Mutai (2000) a conceptual framework is a hypothesis model identifying various variables and the relationship among them. This study was based on the assumption that chemistry teachers' influences practical work in chemistry. Key characteristics about chemistry tutors in second cycle schools in the Greater Accra such as professional competence, attitudes and practices in organising practical work can affect practical work. The conceptual framework (Figure 1) of this study comprises the independent variables (professional competence, attitudes, practices of chemistry teachers) and their interconnections with dependent variables (practical work).

The chemistry teacher's competence, attitudes and practices influence how they organise, supervise and assist students during practical work. It is said that chemistry teachers with high competency level, positive attitudes and good practices toward organising practical activities are able to produce quality practical work.

Conceptual framework of the study shown in Figure 1. Teachers' professional competence has influence and can affect practical work. Therefore, Teacher demonstration of knowledge on experiment, clear explanation of subject matter, use of different teaching methods can influence practical work. Besides, supervision and evaluation of practical work have a direct effect on the quality practical work.

Again, teachers' attitudes can affect practical work. Meaning that teachers organising practical work frequently, teachers' professional commitment to practical work, punctuality and offering guidance to learners have a direct impact on practical work which leads to increase in practical work and quality practical work.

In addition, teachers' practices influence quality of practical. Meaning that, teachers' use of appropriate resources, use of appropriate equipment, immediate feedback to learners can positively affect practical work which will result in quality practical work.

The conceptual frame work (Figure 1) was created in order to present the association amongst the independent variable and study's dependent variable. The dependent variable is the practical work whereas the independent variable are the teachers' professional competence, attitudes and practices. The figure 1 arrows show how one variable affects another with a particular relation to the study objective directing this study. According to Figure 1, teachers' professional competence, attitudes and practices influence one another and have a direct influence on practical work. Hence, practical work in chemistry is influenced by teachers' professional competence, attitudes and practices (Figure 1). In the study, the conceptual framework revealed the variable necessary in the study examining. Consequently, it acts as the study "map" in conducting this study which was meant to examine high school chemistry teachers' professional competence, attitudes and practices in organising practical work in the Greater Accra Region, Ghana.

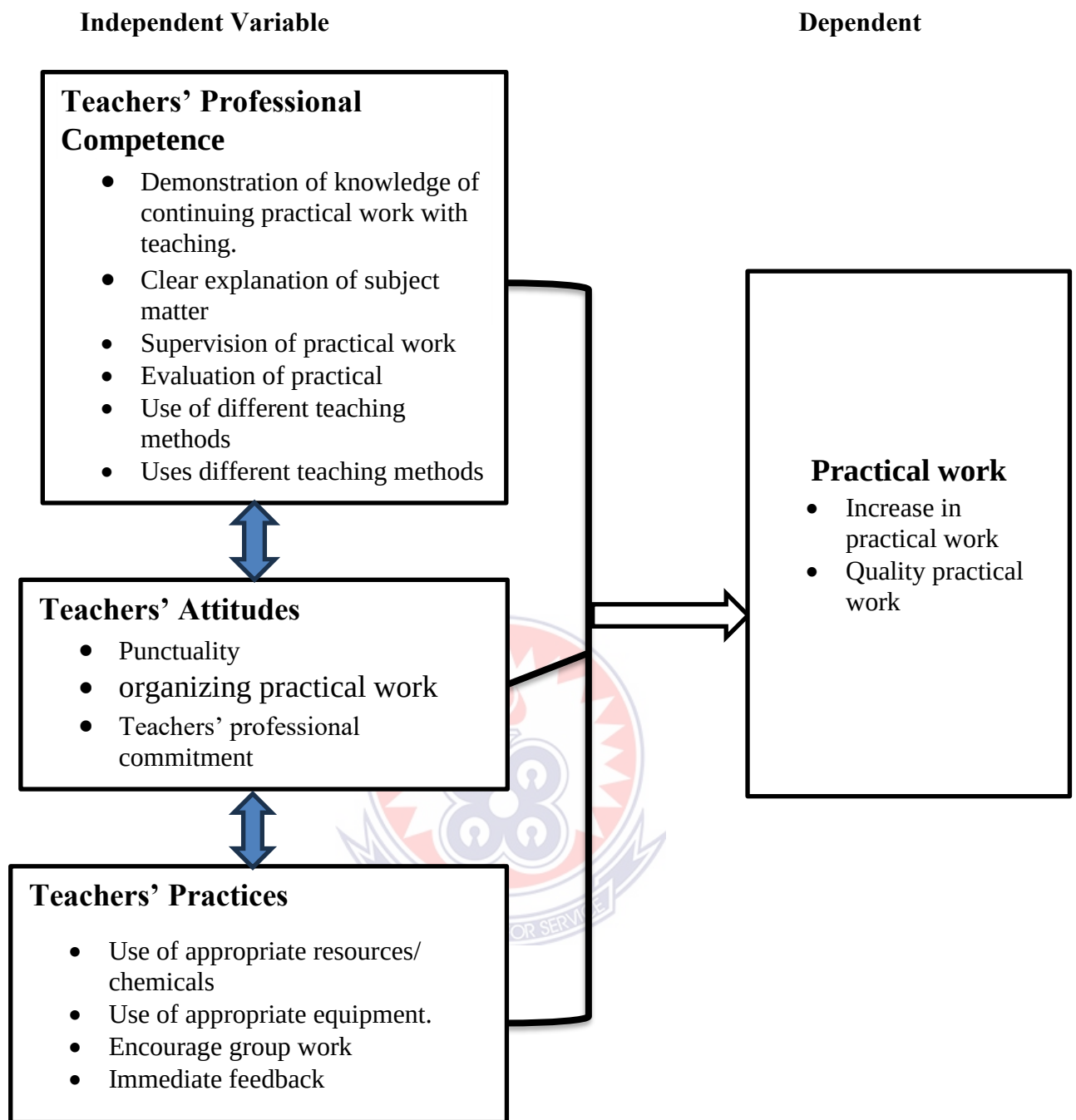


Figure 1: Conceptual framework of the Study

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This chapter outlines the methods used for carrying out this study. It describes the study area and highlights the research design, sampling procedure, research instruments, data collection procedures and data analysis.

3.1 Study Area

The study was conducted in senior high schools that are open to public in the Greater Accra Region of Ghana. For this study, Greater Accra Region was taken into consideration because it is one of the regions in Ghana with the greatest number of senior high school chemistry teachers. Besides, senior high schools in the region have science resource centers that make it easy for teachers to organise chemistry practical work.

The Greater Accra Region occupies 1.4 % of the total land area of Ghana and has a population of 5,455,692 (Ghana Statistical Service, 2022). There are 29 Metropolitan, Municipal and District Assemblies (MMDAs) across the region. The region has two Metropolitan Assembly, 24 Municipal Assemblies and three District Assemblies. The Greater Accra Region has 44 public senior high schools. The Metropolitan Assembly have with four senior high schools while the Municipal and District Assemblies have 35 and five senior high schools, respectively. 34 schools from both Municipal and District Assemblies participated in this study.

3.2 Research Design

The descriptive survey research design was employed for this study. The descriptive design use application of scientific approach by urgently assessing and

investigating the baseline materials, interpreting data, arriving at generalisation and prediction (Salaria, 2012). It is argued that the descriptive research design investigates the relationship between non-manipulated variables in an existing phenomenon (Rubin & Babbie, 2001). Babbie (2001) recommends the descriptive survey design for the intention of drawing a general conclusion from a representative of a whole number of people so that cross-references can be made regards some peculiarity, features or conduct of a group of people. The descriptive design guides a researcher to observe, describe and document aspect of a situation as it naturally occurs.

3.3 Population

The study target population composed of chemistry teachers in 44 public schools in the Greater Accra Region. There were 250 chemistry teachers in the 44 public senior secondary schools at the time of study (Ghana Education Service, 2022). Accessible population was senior high school teachers of chemistry who have taught chemistry for at least three years, as they may have covered a complete senior high school chemistry syllabus. The accessible population was 170.

3.4 Sample and Sampling Technique

A simple random sampling method was used to choose 170 chemistry instructors from 34 randomly chosen senior high schools in Municipal and District Assemblies in the Greater Accra Region. The sample consisted of 140 males and 30 females. Simple random sampling eliminates systematic bias, enhances precision and ensures that the sample obtained is representative. The senior high school chemistry teachers chosen from the Municipal and Districts Assemblies formed the sample size. Sixty eight percent (68.0 %) senior high school chemistry teachers for the study were chancily picked. Because, Patton (2002) study shows that 30% of individual of the

target group of people is adequate in a descriptive survey research, the number of chemistry teachers used for the study was justified.

3.5 Research Instrument

A closed-ended questionnaire and an observation checklist were used to collect quantitative and qualitative data, respectively. The question items developed by Ofori-Appiah et al (2020) to evaluate teachers' professional competence, attitudes and practices in organising practical work was adopted in this study. The questionnaire was used as one of the main instruments for this study because it can provide a quicker and more precise data collection procedure and make data processing easier (Krosnick, 2018). The questionnaire consisted of two parts, one and two. Part 1 comprised of eight concerns designed to gather data on demographic characteristics of respondents, including gender, age, years of teaching experience, academic qualification, and professional qualification, area of specialisation, in-service training and in-service training organisers. Part two consisted of three sections.

There were actually three categories in Part 2: A, B, and C. Section A contain 13 statements to elicit data on chemistry teachers' professional competence in organising practical work. Section B captured 10 statements to collect data on chemistry teachers' attitudes regard organising practical activity while section C comprised 17 items to obtain information concerning the way chemistry tutors do their practical work. In part 2, every item was closed-ended and used a five-point Likert scale. The Likert scale is among highly simple and also widespread used psychometric instruments in social science and educational study (Joshi et al., 2015). Robson (2002) indicated that, Likert-scale appears interesting to participants and

people love finishing a scale of this nature. Neuman (2000) on the other hand, take into account the simpleness and quick of use of the Likert scale as its real strength.

According to South et al. (2022) Likert scales allow investigators to collect quantifiable assessments of individual features, producing quantitative data that may be summed up and also displayed in a manner equal to that of other quantitative data collected for evaluation. The responders were questioned to rate the seriousness of their answer per item on the five-point Likert scale. The following criteria were used to rate positive statements: strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1). However, the following ratings were assigned to negative statements: strongly agree (1), agree (2), neutral (3), disagree (4) and strongly disagree (5). It was crucial to score in reverse order to lessen responders' prejudice.

There were 15 items on the observation checklist, which gathered data on how practical tasks were establish for learners, the apparatus and substances used, approaches used and how the practical tasks were overseed. The observation checklist was used to look at what happens in the laboratory during practical work and to see if the opinions that respondents indicated in the questionnaire aligned with their actions. An observation schedule was employed because it allowed the researcher to fully describe behavior in a special, natural environment. (Ary et al., 2010).

3.6 Validity of Instrument

In order to ensure the content and face validity of the instrument, the research instruments were given to the researcher's supervisors, experts and senior lecturers in Science Department of University of Education, Winneba to vet the items for comments and suggestions before administering them to the participant. The items were vetted in terms of their relevance to the subject matter, coverage of content area, appropriateness of language usage and clarity of purpose. The supervisors' comments

and suggestions were used to make changes and corrections which were included in the final instruments. According to Kothari (2004), validity of the research instrument can be determined by using a panel of persons who shall judge how well the measuring instrument meets the standards.

3.7 Pilot Testing

A pilot study is a mini-version of a full-scale study or a trial run in preparation for the complete study (Baker, 2002). According to Lancaster et al. (2004), a pilot study can reveal deficiencies in the design of a proposed investigation or procedure and these can then be addressed before time. The questionnaire and an observation checklist were pilot tested before being used to gather data for the study in selected senior high schools in the Eastern region of Ghana. The results of the pilot study were subjected to statistical analysis to gain the coefficient value of reliability. The pilot test purpose was to assess reliability and validity of the research instruments.

3.8 Reliability of Instrument

Reliability refers to the extent to which independent administration of the same instrument consistently yields the same or similar results under comparable conditions (De-Vos et al., 2005). The Statistical Package for Social Sciences (SPSS) was used to ascertain the Cronbach alpha coefficient value for the questionnaire, which was found to be 0.863. According to Leech et al. (2005), Cronbach alpha coefficient value of 0.70 and above shows appropriate internal consistency and that alpha value between 0.60 and 0.69 shows minimum adequate reliability. The questionnaire was reliable as the Cronbach alpha coefficient value was above 0.70. To establish the reliability of the observation checklist the Cohen's kappa coefficient value was determined. In this study a Cohen's kappa coefficient value of 0.75 was

acquired. McHugh (2012) reported that observational data is deemed reliable if its inter-rater reliability falls between 0.61 and 0.80. This implies that reliability of the observation checklist in this study was reliable.

3.9 Data Collection Procedure

Data was collected using the questionnaire and observation checklist. Permission was sought from the Greater Accra regional director of the Ghana Education Service (GES), the directors of Municipal and District Assemblies and senior high school directors in order to conduct the study. The questionnaires were administered to 170 senior high school chemistry tutors with a minimum of three years of experience in teaching in the Municipality and District Assemblies of the Greater Accra region. The researcher and three disciplined research assistants from the University of Education, Winneba conducted the questionnaire straightly to the respondents. The researcher and research assistants spell out the purpose of the study and any part of the questionnaire that caused challenge to the respondents. All the participants were guaranteed that the data they will present would be confidential. Each responder was given sufficient time frame to complete the questionnaire. The questionnaire was completed and collected the same day with a 100 % return rate. One and half month were used to collect data from respondents.

A sub-sample of two teachers, one from a Municipal Assembly (TMA) and the other from a District Assembly (TDA) were used for the study second stage. An 80 minutes practical lesson each was observed using the observation protocol or checklist by the researcher. Two days were used to collect data from respondents during practical session. Two schools were used for the observation due to time and financial constraint. The purpose of selecting two teachers was that the analysis of the quantitative data revealed similar responses by teachers and exhibit possible common

behavior during practical lesson. The observation was to cross check and identify discrepancies between respondents' competence and attitudes toward practical work based on the quantitative data gathered during the first phase. During the practical lesson, every observable behaviour (verbal and non-verbal) of the teachers were ticked.

3.10 Data Analysis

The data gathered from the respondents were entered into the Statistical Package for Social Sciences for statistical analysis. The data were analysed using Chi-square to determine whether or not associations exist between the categorical variables at $\alpha = 0.05$.

The questionnaire given to Respondents on teachers' competence level was presented with 13 statements. The positive statements were scaled as follows: strongly agree = 5; agree = 4; neutral = 3; disagree = 2; strongly disagree = 1. The total possible score for respondents ranged from 13 to 65. On the basis of the scores, respondents' competence level was characterized as follows: High = greater than 70% of 65; Moderate = from 50% of 65 to 70% of 65; Low = less than 50% of 65.

The questionnaire given to Respondents on teachers' attitudes contains 10 statements. The positive statements were weighted as follows: strongly agree = 5; agree = 4; neutral = 3; disagree = 2; strongly disagree = 1. The weights were reversed for negative statements. The maximum possible score for respondents was 50. Three levels of attitude were considered on the basis of the scores. The levels are: Good = greater than 70% of 50; Moderate = from 50% of 50 to 70% of 50; Bad = less than 50% of 50.

The questionnaire given to Respondents on teachers' practices was presented with 17 statements in this section. The positive statements were scaled as follows:

strongly agree = 5; agree = 4; neutral = 3; disagree = 2; strongly disagree = 1. The total possible scores for respondents ranged from 17 to 85. The practices of the respondents were classified into three levels: Good = greater than 70% of 85; Moderate = from 50% of 85 to 70% of 85; Bad = less than 50% of 85. Likert-type data can be classified and treated based on percentage range (such as <50%, 50 – 70%, >70%), which can be categorised into low, moderate and high level (Boone & Boone, 2012)

3.11 Ethical Consideration

The researcher obtained research permission letter from the Department of Science Education, University of Education, Winneba. Besides, permission to conduct this study was acquired from Greater Accra regional director of education. The heads and principals of senior high schools of the participating schools were duly informed of the intended study through letter of recommendation from the Science Education Department, University of Education, Winneba and regional director of GES in the Greater Accra region. The participants were requested to give their consent to voluntarily participate in the study before administering the instruments. They were assured of confidentiality and anonymity by informing them that no real names of the participants and the schools would be used.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This chapter presents the analysis of data and discussion of the findings.

4.1 Demographic Characteristics of the Respondents

The demographic information of respondents is shown in Table 1.

Table 1: Demographic Characteristics of Respondents (N=170)

Variables	No. of Respondents	Percentages (%)
Sex category		
Male	140	82.4
Female	30	17.6
Age (years)		
Below 26	2	1.2
26 – 30	30	17.6
Above 30	138	81.2
Teaching Experience (years)		
3 – 5	66	38.8
6 – 8	46	27.1
9 – 11	22	12.9
12 – 14	8	4.7
Above 14	28	16.5
Educational status (highest)		
Diploma	0	0.0
1 st Degree	128	75.3
2 nd Degree	42	24.7
Area of Specialisation		
Chemistry	146	85.9
Other science aspects	24	14.1
Professional status		
Professional	130	76.5
Non-professional	40	23.5
In-service training attendance		
Yes	138	81.2
No	32	18.8
In-service training organiser		
GES	94	68.1
GAST	10	7.3
School	32	23.2
Kofi Annan Institute	2	1.4

Findings on Demographic characteristics of respondents

The results in Table 1 shows that,

- The number of male chemistry teachers 82.4% in the study region was much greater than their female counterpart.
- Majority of the respondents 81.2% were above 30 years.
- A high proportion of respondents 38.8% have three to five years teaching experiences.
- Majority of the respondents 75.3% had first degree and also respondents with specialisation in chemistry constitute 85.9%.
- Most professional chemistry teachers 76.5% were higher than non-professional teachers.
- A high proportion of chemistry teachers 81.2% received in-service training.
- Majority of the respondents 68.1% had in-services training from Ghana education services.

The results show that most of the teachers were male (170, 82.4 %). indicating that the chemistry teachers in the study region were male dominated than female. This finding agrees with a study conducted by Owoyemi and Adesina (2021), which demonstrated that the male teachers were higher compared to the female teachers. More than 80.0 % of the participants were above 30 years. Few respondents (<19.0 %) were below 30 years. The participants had varied years of teaching experience. Three out of five teachers had three to eight years of teaching experience while less than 18 % had teaching experience between nine and 14 and above 14 years. Akinsolu (2005) advocated that experienced teachers need to be retained in schools if higher productivity is to be obtained because learners achieve more from these teachers. On

this note, the experienced chemistry teachers in the study region may results in high productivity.

A greater proportion of the teachers (>75.0 %) had first degree with specialisation in chemistry. These teachers were mostly professional teachers and had in-service training from the Ghana Education Service (GES). That is, the teachers in the study region had the requisite qualification for teaching chemistry in the senior high schools. The minimum teaching qualification of professional teachers for second cycle level is a bachelor's degree in education (Ministry of Education, 2012). Abe and Adu (2013) found out that teachers' qualification contributed to the improvement of students' scores in their academic performance. The qualification for chemistry teachers in the study region had been good enough to enhance their competence and attitudes towards teaching and learning.

Research Question One. What is the competency level of chemistry teachers' in organising practical work in senior high schools in the Greater Accra Region of Ghana?

4.2 Competence of Chemistry Teachers' in Organising Practical Work

The professional competence of chemistry teachers' in organising practical work is highlighted in Table 2.

Table 2: Chemistry Teachers' Competence in Organising Chemistry Practical Work

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted Mean
1. Giving clear explanation before practical work.	86 (50.6%)	36 (21.2%)	0 (0.0%)	16 (9.4%)	32 (18.8%)	3.15
2. Demonstrate experiments before students carry out the experiment.	74 (43.5%)	48 (28.2%)	48 (28.2%)	0 (0.0%)	0 (0.0%)	3.05
3. Helping students to write reports on experiments.	34 (20.0%)	48 (28.2%)	38 (22.4%)	48 (28.2%)	32 (18.8%)	3.04
4. Preparing reagents and solutions for titration experiments.	86 (50.6%)	28 (16.5%)	38 (22.4%)	18 (10.6%)	0 (0.0%)	3.93
5. Design laboratory manual to serve as a guide for students	50 (29.4%)	66 (38.8%)	30 (17.6%)	24 (14.1%)	0 (0.0%)	3.34
6. Do not Arrange field trips for students	36 (21.2%)	26 (15.3%)	54 (31.8%)	42 (24.7%)	12 (7.1%)	2.16
7. Connecting glassware for laboratory synthesis of gases	24 (14.1%)	46 (27.1%)	80 (47.1%)	20 (18.8%)	0 (0.0%)	3.16
8. Organising laboratory practical for the identification of ions	66 (38.8%)	70 (41.2%)	18 (10.6%)	16 (9.4%)	0 (0.0%)	3.02
9. Linking lesson with experience	0 (0.0%)	0 (0.0%)	34 (20.0%)	66 (38.8%)	70 (41.2%)	1.78

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted Mean
10. Linking the concrete and abstract experiences of students	0 (0.0%)	0 (0.0%)	32 (18.8%)	68 (40.0%)	70 (41.2%)	1.78
11. Using the internet to gather information for students	70 (41.2%)	68 (40.0%)	32 (18.8%)	0 (0.0%)	0 (0.0%)	3.78
12. Defining problem (topic) in simple language	86 (50.6%)	46 (27.1)	22 (12.9%)	16 (9.4%)	0 (0.0%)	3.81
13. Handling all instruments and glassware	66 (38.8%)	72 (42.4%)	16 (9.4%)	16 (9.4%)	0 (0.0%)	3.89

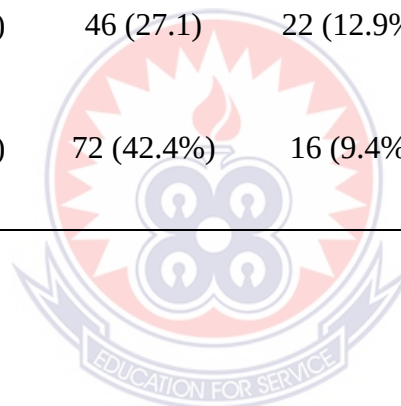


Table 2 shows that 122 out of 170 respondents representing 71.8% agreed that they give clear explanation before practical work while 48 (28.2%) respondents disagreed to the same statement. Also 122 out of 170 respondents depicting 71.7% respondents agreed that they demonstrate experiment before students carry out the experiment while 48 (28.2%) have no opinion.

In term of helping students, 82 out of 170 respondents representing 48.2% agreed that they help students to write report on experiment while 80 (47%) respondents opposed to the same expression. Also, 114 out of 170 respondents depicting 67.1% coincided that they Preparing reagents and solutions for titration experiments, 38 (22.4%) possess no view while 18 (10.6) opposed to the same expression. Moreover, 136 (80%) of the respondents agreed that they organise laboratory practical for the identification of ions, 18 (10.6%) possess no view, while 16 (9.4%) disagreed.

Besides, gather information, 138 out of 170 participate representing 81.2% agreed that they use the internet to gather information for students while 32 (18.8%) possess no view. Also, 132 out of 170 participate representing 77.7% agreed that they define problem (topic) in simple language, 22 (12.9%) possess no view while 16 (9.4%) opposed to the same expression. Besides to this, 138 out of 170 teachers' representing 81.2% agreed that they handling all instruments and glassware, 16 (9.4%) possess no view while 16 (9.4%) opposed to the same expression.

Findings on Chemistry teachers' competence in organising chemistry practical work

The results in Table 2 shows that,

- Most of the respondents, (71.8%) give clear explanation before practical work.

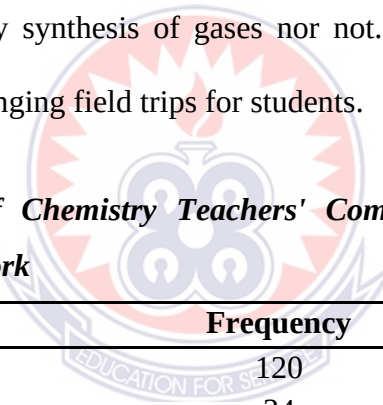
- Majority of the teachers' (48.2%) help students to write reports on experiments.
- High proportion of teachers' (67.1%) preparing reagents and solutions for titration experiments and also majority of teachers (80%) also organise laboratory practical for the identification of ions.
- High proportion of respondents (81.2%) uses the internet to gather information for students.
- A greater number of respondents (71.7%) demonstrate experiment before students carry out the experiment.
- Most of the teachers (81.2%) handling all instruments and glassware.
- Majority of the respondents 80% reported not linking lesson with experience.
- Most of the respondents 81.2% reported not linking the concrete and abstract experiences of students.
- A large percentage of responders 68.2% reported that they do design laboratory manual to serve as a guide for students.
- Majority of the respondents 41.2% reported that they connect glassware for laboratory synthesis of gases.
- Majority of respondents 36.5% reported that they do not arrange field trips for students.
- Majority of respondents 77.7% reported define problem (topic) in simple language.

Table 3, summarises the competency level of chemistry teachers in organising practical work. The respondents mean scores on the chemistry teachers' professional competence in organising practical work ranged from 1.78 to 3.84 (Table 2). Three items had a mean score below 3.0. About 77 % of participants mean score responses

to the items shown in Table 2 were above 3.0, indicating high competence in organising practical work.

The results show that responders (>70.0 %) gave clear explanation and demonstrated experiments before practical work. A huge proportion of the participants (>70.0 %) reported to define problems in simple language, handled all instruments and glassware, used internet to gather information for students, prepared reagents for laboratory practical including titration experiments and identification of inorganic ions. About half of the responders reported helping students to write reports on experiments. Conversely, four out of five people reported not linking lessons with abstract experience of students. Almost half of the participants neither connected glassware for laboratory synthesis of gases nor not. About three out of every 10 people reported not arranging field trips for students.

Table 3: Summary of Chemistry Teachers' Competency Level in Organising Practical Work



Competence Level	Frequency	Percentage
High	120	70.6
Moderate	34	20.0
Low	16	9.4
Total	170	100.0

Analysis of results on Table 3 shows that participants who had high competency level in organising practical work for senior high school students in the study region were 40.0 % more than those who had low to moderate competency levels. This suggests that a large percentage of responders were competent in organising practical activities.

Research Question Two. What are chemistry teachers' attitudes toward organising practical work in senior high schools in the Greater Accra Region of Ghana?

4.3 Attitudes of Chemistry Teachers' Toward Organising Practical Work

The attitudes of chemistry teachers' toward organising practical work are shown in Table 4.

Table 4: Attitudes of Chemistry Teachers' Toward Organising Practical Work

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted Mean
1. I like chemistry practical.	46 (27.1%)	0 (0.0%)	46 (27.1%)	24 (14.1%)	54 (31.8%)	2.76
2. I wish I don't have chemistry practical often.	40 (23.5%)	94 (55.3%)	24 (14.1%)	12 (7.1%)	0 (0.0%)	2.05
3. Chemistry practical helps me to teach the theory well in class	0 (0.0%)	42 (24.7%)	24 (14.1%)	80 (47.1%)	24 (14.1%)	2.49
4. Chemistry practical motivates students.	40 (23.5%)	0 (0.0%)	40 (23.5%)	18 (10.6%)	72 (42.4%)	2.52
5. I like to expose my students more to science equipment during practical.	0 (0.0%)	38 (21.2%)	24 (14.1%)	108 (63.5%)	2 (1.2%)	2.60
6. I like working with science equipment despite the problems I have when using them.	52 (30.6%)	2 (1.2%)	94 (55.3%)	6 (3.5%)	16 (9.4%)	3.40
7. Chemistry practical makes me appreciate chemistry better.	12 (7.1%)	0 (0.0%)	48 (28.2%)	60 (35.3%)	50 (29.4%)	2.20
8. Write-up in chemistry practical is a very useful exercise.	34 (20.0%)	16 (9.4%)	24 (14.1%)	50 (29.4%)	46 (27.1%)	2.66
9. Chemistry practical help me acquire scientific skills.	0 (0.0%)	12 (7.1%)	46 (27.1%)	64 (37.6%)	48 (28.2%)	2.13
10. Chemistry practical is not boring	22 (12.9%)	34 (20.0%)	24 (14.1%)	36 (21.2%)	54 (31.8%)	3.39

Table 4 shows that 78 out of 170 respondents representing 45.9% disagreed that they like chemistry practical, 46(27.1%) possess no view, while 46(27.1%) agreed to the same statement. Besides to this, 134 out of 170 teachers' representing 78.8% agreed that they wish they don't have chemistry practical often, 24(14.1%) possess no view while 12(7.1%) disagreed to the same statement. Also, 104 out of 170 participate representing 61.2% disagreed that chemistry practical helps me to teach the theory well in class, 24(14.1%) possess no view while 42(24.7%) agreed to the same statement.

In addition, Table 4 shows that 90 out of 170 respondents representing 53% disagreed that chemistry practical motivates students, 40(23.5%) possess no view while 40(23.5%) agreed to that. Again, 110 out of 170 respondents representing 64.7% disagreed that they like to expose students to more science equipment during practical, 24(14.1%) possess no view while 38(21.2%) coincided to the same expression. Coupled with this, 96 out of 170 teachers' representing 56.5% disagreed that write-up in chemistry practical is a very useful exercise, 24(14.1%) have no opinion, while 50(29.4%) agreed to that statement.

Furthermore, Table 4 reveals that 112 out of 170 teachers' depicting 65.8% disagreed that chemistry practical help them acquire scientific skills, 46(27.1%) possess no view, while 12(7.1%) agreed to that. Again, 110 out of 170 respondents representing 64.7% disagreed that chemistry practical makes me appreciate chemistry better, 48(28.2%) have no opinion while 12(7.1%) agreed to that statement.

Findings on Attitudes of Chemistry Teachers' Toward Organising Practical Work

The results in Table 4 shows that,

- A large number of respondents 45.9% indicated they do not like chemistry practical.
- A greater number of respondents 78.8% wish they don't have chemistry practical often.
- A huge proportion of participates 61.2% indicated that chemistry practical does not help them to teach the theory well in class.
- A high proportion of respondents 64.7% indicated that they do not like to expose their students more to science equipment during practical.
- Most of the respondents 56.5% indicated that write-up in chemistry practical is not very useful exercise.
- Majority of the teachers 65.8% indicated that chemistry practical does not help them to acquire scientific skills.
- Most of the respondents 64.7% reported that chemistry practical does not make them appreciate chemistry better.
- Most of the respondents 30.6% like to work with science equipment despite the problems they face when using them.
- High proportion of participates 53% reported that chemistry practical does not motivates students.
- Majority of the respondents 53% reported that chemistry practical is not boring.

Summarises the chemistry teachers' attitude toward organising practical work is shown in Table 5.

Table 5: Summary of Respondents' Attitude toward Organising Practical Work

Attitude Level	Frequency	Percentage
Good	50	29.4
Moderate	80	47.1
Bad	40	23.5
Total	170	100.0

The participants mean scores on their attitudes toward organising practical work spans from 2.05 to 3.40 (Table 5). The results revealed that about 45.0 % of the participants disliked chemistry practical. Few respondents (27.0 %) showed interest in organising chemistry practical. As a result, a significant number of responders (>75.0 %) wished not to have chemistry practical often. Half of the participants agreed that chemistry practical is boring whereas the rest said otherwise. Approximately 60.0 to 65.0 % of the participants disagreed that practical helps them to acquire scientific process skills. Consequently, those participants did not appreciate chemistry better.

More than 60 % of the participants reported not exposing their students to science equipment during practical work (Item 5). This could be attributed to the fact that most respondents (>50.0 %) regarded practical work as an activity that hardly motivated students. Few respondents (<31.0 %) desired working with science equipment despite the problems they faced when using them. The study found that a little above half of the respondents viewed write-up in chemistry practical as not useful.

The results reveal that few participants (<30.0 %) had good attitude towards organising practical work. Roughly one out of five respondents had bad attitude towards organising practical work. About 47.0 % of the participants had a modest attitude towards organising practical work.

Research Question Three. What are chemistry teachers' practices during practical work in senior high schools in the Greater Accra Region of Ghana?

4.4 Practices of Chemistry Teachers' During Practical Work

The practices of chemistry teachers' in organising practical work are shown in Table 6.

Table 6: Chemistry Teachers' Practices in Organising Practical Work

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted Mean
1. I supervise what students do during practical.	42 (24.7%)	32 (18.8%)	16 (9.4%)	54 (31.8%)	26 (15.3%)	3.06
2. I teach the theory before students perform the practical.	78 (45.9%)	48 (28.2%)	0 (0.0%)	0 (0.0%)	44 (25.9%)	3.68
3. I do not allow students to work in groups during practical lessons.	74 (43.5%)	0 (0.0%)	16 (9.4%)	54 (31.4%)	26(15.3%)	3.25
4. I do not give students immediate feedback when they need directions to proceed.	86 (50.6%)	0 (0.0%)	58 (34.1%)	0 (0.0%)	26 (15.3%)	3.71
5.The theory lessons are not linked to real life situation.	0 (0.0%)	18 (10.6%)	16 (9.4%)	74 (43.5%)	62 (36.5%)	4.06
6. I organised group work because there are not enough reagents and glassware.	94 (55.3%)	32 (18.8%)	18 (10.6%)	0 (0.0%)	26 (15.3%)	3.99
7. I don't go around supervising students during practical.	60 (35.3%)	32 (18.8%)	52 (30.6%)	0 (0.0%)	26 (15.3%)	2.41
8. I provide the appropriate instruments for chemistry practical	110	16 (9.4%)	18 (10.6%)	0 (0.0%)	26 (15.3%)	4.08

(64.7%)

9. Students perform chemistry practical with guidance.

74 (43.5%)

0 (0.0%)

16 (9.4%)

18 (10.6%)

62 (36.5%)

3.04

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted Mean
10. There is no equipment/ glassware or materials in the school laboratory, so I do not organize chemistry practical.	0 (0.0%)	68 (40.0%)	16 (9.4%)	18 (10.6%)	68 (40.0%)	3.51
11. Students get the opportunity to handle every piece of the instruments in our school laboratory.	0 (0.0%)	42 (24.7%)	34 (20.0%)	68 (40.0%)	26 (15.3%)	3.46
12. The instrument in the laboratory give inaccurate results	42 (24.7%)	0 (0.0%)	16 (9.4%)	86 (50.6%)	26 (15.3%)	3.31
13. I allow students to design their own experiments during chemistry practical	36 (21.2%)	42 (24.7%)	16 (9.4%)	50 (29.4%)	26 (15.3%)	2.95
14. I allow the students to perform experiments based on WAEC past questions	36 (21.2%)	50 (29.4%)	16 (9.4%)	68 (40.0%)	0 (0.0%)	3.32
15. I select practical task from GES approved textbooks	36 (21.2%)	0 (0.0%)	16 (9.4%)	50 (29.4%)	68 (40.0%)	2.33
16. I have enough chemical for chemistry practical.	36 (21.2%)	74 (43.5%)	34 (20.0%)	0 (0.0%)	26 (15.3%)	3.55

17. Where there are no materials (glassware, equipment) I do not improvise.	36 (21.2%)	42 (24.7%)	16 (9.4%)	50 (29.4%)	26 (15.3%)	3.07
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Table 6 shows that 80 out of 170 respondents representing 47.1% disagreed that they do not supervise what students do during practical, 16(9.4%) possess no view while 74(33.5%) agreed to that statement. Also, 136 out of 170 teachers representing 80% disagreed that the theory lessons are not linked to real life situation, 16(9.4%) possess no view while 18(10.6%) coincided to that expression. Again, 126 out of 170 participates representing 74.1% agreed that they organise group work because there are not enough reagents and glassware, 18(10.6%) have no opinion while 26(15.3%) disagreed to that.

Besides, 92 out of 170 respondents representing 54.1% agreed that they do not go around supervising students during practical, 52(30.6%) have no opinion, 26(15.3%) opposed to the same expression. Again, 126 out of 170 respondents depicting 74.1% coincided that they provide the appropriate instruments for chemistry practical, 18(10.6%) have no opinion while 26(15.3%) disagreed that. 74 out of 170 respondents representing 43.5% agreed that Students perform chemistry practical in the school laboratory with guidance, 16(9.4%) possess no view while 80(47.1%) opposed to the same expression.

Coupled with, 86 out of 170 respondents representing 50.6% disagreed that there is no equipment/ glassware or materials in the school laboratory, so they do not organise chemistry practical, 16(9.4%) have no opinion while 68(40%) coincided to the same expression. Also, 94 out of 170 teachers depicting 55.3% opposed that Students get opportunity to handle every piece of the instruments in our school laboratory, 34(20.0%) have no opinion while 42(24.7%) agreed to that. Again, 78 out of 170 respondents representing 45.9% coincided that they allow students to design their own experiments during chemistry practical, 16(9.4%) possess no view while 76(44.7%) opposed to the same expression. Besides to this, most of the respondents

50.6% indicated that students are allowed to perform experiments based on WAEC past questions.

In addition, 118 out of 170 respondents representing 69.4% disagreed that they select practical task from GES approved textbooks, 16(9.4%) possess no view while 36(21.2%) coincide to the same expression. Also, 78 out of 170 teachers representing 45.9% coincide that where there are no materials (glassware, equipment) they do not improvise, 16(9.4%) possess no view while 76(44.7%) opposed to the same expression.

Findings on chemistry teachers' practices during practical work

The results in Table 6 shows that,

- Most responders 47.1% do not supervise what students do during practical work
- A lot of respondents 74.1% indicated that they teach the theory before students perform the practical.
- Majority of the teachers 46.7% indicated that they allow students to work in groups during practical lessons.
- A huge proportion of the respondents 50.6% indicated that they do not give students immediate feedback when they need directions to proceed.
- Most of the respondents 80.0% indicated that theory lessons are linked to real life situation.
- Most of the participants 74.1% indicated that they organised group work because there are not enough reagents and glassware.
- Majority of the respondents 46.7% allow students to work in group work during practical work.

- A high proportion of teachers' 54.1% do not go around supervising individual students during practical work.
- Most of the respondents 74.1% provide the appropriate instruments for chemistry practical work.
- A lot of teachers 65.9% indicated that the instruments in the laboratory do not give inaccurate results.
- Majority of the respondents 47.1% provide no guidance for students when performing practical work.
- A lot of participants 50.6% indicated that they organize chemistry practical if there is no equipment / glassware or materials in the school laboratory.
- Most of the respondents 69.4% indicated that selected practical task are not from Ghana Education Services approved textbooks.
- Most of the teachers 55.3% indicated Students do not get the opportunity to handle every piece of the instruments in our school laboratory.
- Majority of the teachers 50.6% indicated that they students allow to perform experiments based on WAEC past questions.
- Majority of the teachers 45.9% reported that they do not improvise where materials were not available for practical work.

The results show that two out of every five respondents pulled out hardly organised chemistry practical lessons because there were no materials, glassware or equipment (Item 10). Some participants (44.0 %) improvised where there were no materials such as glassware and equipment. About 45 % of the respondents hardly improvised where materials were unavailable. About half of the participants reported not supervising students during practical work. Some respondents (44.0 %) reported

that students performed chemistry practical in the school laboratory without any guidance.

Approximately, half of the participants reported that students designed their own experiments during chemistry practical periods. A significant number of participants (>73.0 %) taught theory before students performed practical. However, the theory lessons were not linked to real life situation. Approximately, two out of every five respondents allowed students to work in groups during practical lessons. According to most participants (>70.0 %), group work was organised because reagents and glassware were not enough.

The study found that most participants (70.0 %) did not select practical task from Ghana Education Service (GES) approved textbooks. However, half of the respondents allowed students to perform experiments based on WAEC past questions. In all, majority of the respondents (65.0 %) exhibited poor practices in organising practical work (Table 7). Few respondents (15.0 %) exhibited good practices in organising practical work.

Table 7: Summary of Chemistry Teachers' Practices in Organising Practical Work

Practice Level	Frequency	Percentage
Good	26	15.3
Moderate	34	20.0
Poor	110	64.7
Total	170	100.0

Research Question Four. What is the relationship between chemistry teachers' competency level and their attitudes toward organising practical work in senior high schools in the Greater Accra Region?

4.5 The relationship between chemistry teachers' competency level and their attitudes toward organising practical work

The relationship between chemistry teachers' competency level and their attitudes toward organising practical work is shown in Table 8.

Table 8: Relationship Between Competence and Attitude Among Chemistry Teachers'

Competence						
	High	Moderate	Low	Total	χ^2	$p - \text{Value}$
Attitude	f (%)	f (%)	f (%)	f (%)		
Good	34(20.0)	12(7.1)	4(2.4)	50(29.4)		
Moderate	62(36.5)	10(5.9)	8(4.7)	80(47.1)		
Bad	24(14.1)	12(7.1)	4(2.4)	40(23.5)	6.024	0.197
Total	120(70.6)	34(20.0)	16(9.4)	170(100.0)		

The outcome demonstrated that there was statistically no significant correlation between chemistry teachers' attitude and their competence ($p = 0.197 > 0.05$). This suggests that the competency level of the chemistry teachers had no influence on their attitude (Table 8).

The null hypothesis that there was no significant link between chemistry teachers' competence and their attitude toward organising practical work was accepted ($p > 0.05$).

Findings on Relationship between competence and attitude among chemistry teachers'

The results in Table 8 shows that,

- There is no significant correlation between chemistry teachers' attitude and their competence.

Table 9: Relationship Between Teachers' Practices and their Competence and Attitudes

	Practice				χ^2	<i>p</i> – Value
	Good	Moderate	Bad	Total		
Competence	f (%)	f (%)	f (%)	f (%)		
High	14(8.2)	30(17.6)	76(44.7)	120(70.6)	12.899	0.012
Moderate	10 (5.9)	4(2.4)	20(11.8)	34(20.0)		
Low	2(1.2)	0(0.0)	14(8.2)	16(9.4)		
Total	26(15.3)	34(20.0)	110(64.7)	170(100.0)		
Attitude						
Good	10(5.9)	12(7.1)	28(16.5)	50(29.4)	6.742	0.150
Moderate	14(8.2)	16(9.4)	50(29.4)	80(47.1)		
Bad	2(1.2)	6(3.5)	32(18.8)	40(23.5)		
Total	26(15.3)	34(20.0)	110(64.7)	170(100.0)		

Table 9 shows that there was no statistically significant association between chemistry teachers' attitudes and their practices in organising practical work. The null hypothesis there was no statistically significant link between chemistry teachers' attitudes and practices in organising practical work was accepted ($p = 0.150 > 0.05$).

4.6 Results of Observation Made During Practical Lessons

The results of observations made during practical lessons conducted by a senior high school teacher from a Municipal (TMA) and a District Assembly (TDA) are shown in Tables 10.

Table 10: Results of Observations Made During Practical Lessons

ITEM	ACTIVITY	REMARKS	
		CTMA	CTDA
1	Teacher set up practical work for students	√	√
2	Teacher gives clear explanation before practical work	√	√
3	Teacher links theory lessons with real life situation	X	X
4	Teacher supervises students while performing practical tasks	X	X
5	Students use the right glassware/instruments during practical work	√	√
6	Students follow rules and guideline when performing practical work	X	X
7	Students work in group during practical lessons	√	√
8	Teacher teaches theory before practical is organised	√	√
9	Teacher marks students' work and provide immediate feedback	√	√
10	Teacher provides enough reagents/instruments during practical lessons	√	√
11	Teacher monitors the correct use of chemical during chemistry practical work.	X	X
12	Teacher goes round to supervise individual work	X	X
13	Teacher motivates students during practical work	√	√
14	Teacher provides practical manual for students during laboratory work	X	X
15	Students are given enough time to complete the task/practical work	√	√

*TMA = Teacher from a Municipal Assembly; TDA = Teacher from a District Assembly; √ means it the item observed was practiced; X means the item observed was not practiced.

Analysis of the qualitative data revealed that teachers set up practical for students with the right glassware and gave clear explanation prior to practical work. Teachers taught theory before practical lessons, marked students work and provided immediate feedback. However, teachers hardly supervised students during practical lessons and never linked theory lessons with real life situation. Students hardly followed rules and regulations and carried out practical work without manual, although, they worked in groups and were given ample time to complete practical work.

4.7 Discussion

Teachers' competencies and attitudes are essential to enhance the quality of the teaching profession. Attitudes are generally considered within the scope of competence, and they have a profound impact on teachers' practices (Addo, 2013). This study explored the senior high school chemistry teacher's professional competence, attitudes and practices in organising practical work. The study's findings indicated that the chemistry teachers in the study schools are male dominated challenging the advocacy for gender equity among staff in the study area. The study found that the chemistry teachers in the schools under study were competent in carrying out practical work for students. This outcome differs from that reported by Adikwu et al. (2018), which showed that chemistry teachers in Nigeria had low competency level in carrying out practical work.

Competent teachers have the requisite knowledge, skills and values for teaching and conducting practical work (Koksal, 2014). Deakin (2008) argued that competence encompasses understanding and skills, which result to efficient real human action. On this premise, the high chemistry teachers' competency level in this study implies that the high proportion of teachers had the required knowledge, understanding and skills to conduct practical lessons for students. Teachers gave clear explanation and demonstrated experiments before practical work, defined problems in simple language, handled all instruments and glassware, used internet to gather information for students and prepared reagents and solutions for laboratory practical including titrimetric experiments and qualitative identification of ions

About 70.0 % of chemistry teachers exhibited bad to moderate attitudes toward organising practical work. The low to moderate attitude of the teachers suggests that they may not have the desire to gather information to improve upon

practical activities. This outcome agrees with findings of studies carried out in Nigeria which showed that the attitudes of teachers toward organising practical work were low to moderate (Mesfin et al., 2016; Eya et al., 2020). The teachers had low interest in organising chemistry practical because they saw chemistry to be boring, half of the teachers reported not supervising students during practical work, a greater number of respondents 78.8% wish they do not have chemistry practical often, majority teachers reported chemistry practical does not make them appreciate chemistry better and teachers reported they do not like chemistry practical.

The qualitative data found that teachers hardly supervised students during practical lessons and never linked theory lessons with real life situation. Consequently, students hardly followed rules and regulations during practical work. Besides, practical task was not selected from Ghana Education Service (GES) approved textbooks. According to the quantitation data, students worked in groups during practical lessons because reagents and glassware were not enough, teachers do not improvise where materials were not available for practical work, teachers do not give students immediate feedback when they need directions to proceed and teachers provide no guidance for students when performing practical work. Findings of the research showed that most chemistry teachers (60.0 %) exhibited poor practices in organising practical. This quantitative finding justifies the view that the efficient delivery of chemistry practical tasks in numerous underdeveloped nations like Maputo is a widespread challenge owing to poor practices among teachers in organising practical lessons (Cossa & Uamusse, 2015). It is argued that practical work enhances the academic achievement of students and their level of acquisition of scientific process skills.

The poor practices among teachers in organising practical work in senior high schools in the Greater Accra Region may hinder students from acquiring the desired process skills. The high level of professional competence among the teachers in conducting chemistry practical was not translated into actual practice due to bad to moderate attitude towards practical work. Consequently, the study found no statistically significant correlation was found between the teachers' competence and their attitudes toward organising practical work ($p>0.05$). This finding did not validate the view that there should be a higher relationship between chemistry teachers' competence and attitudes in organising practical work because both involve an individual having knowledge, understanding, and skills (Adodo, 2013).

Statistically, years of experience significantly correlated with competence, attitudes, and practices, suggesting that years of experience played a critical role in the teachers' competence, attitudes and practices in organising practical work. The study shows that chemistry teachers' competence correlated with their practices in organising practical work. Nonetheless, there was no significant link between chemistry teachers' competence and their attitudes toward organising practical work. Improving the attitudes of chemistry teachers could enhance their practices during practical work among the high competency.

The Ghanaian senior high school chemistry syllabus requires chemistry teachers to educate learners to utilise their theoretical concepts to design experiments to resolve chemistry practical challenges (Ministry of Education, 2023). In addition, chemistry teachers are mandated to prepare learners with requisite scientific ideas, principles, and skillfulness to solve personal, social, and environmental problems. By 2023, the Sustainable Development Goal (SDG) 4, Target 4.4, which says that 'ensure inclusive and equitable quality education and promote lifelong learning opportunities

for all', intends to substantially increase the number youth and adults who have relevant skills for employment and entrepreneurship. This cannot be achieved without practical work. The bad to moderate attitudes and the poor practices among teachers in organising chemistry practical activities means the teachers may either neglect or place less emphasis on the practical skills development of learning chemistry to help achieve the SDG 4, Target 4.4.



CHAPTER FIVE

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter summarises the research findings, conclusions, and recommendations from the study. The summary of findings, conclusions, and recommendations were prepared following the study's purpose and research objectives. Finally, areas for additional research were suggested for future studies.

5.1 Summary of Findings

The findings of the study are summarised below:

1. The chemistry teachers in the study region exhibited high competence in organising practical work. Teachers gave clear explanation and demonstrated experiments before practical work, defined problems in simple language, handled all instruments and glassware, used internet to gather information for students and prepared reagents and solutions for laboratory practical including titrimetric experiments and qualitative identification of ions.
2. The teachers' exhibited bad attitudes toward organising practical work. Teachers' wishes they don't have chemistry practical often, perceived practical work does not help them to teach the theory well in class and also does not help them to acquire scientific skills. Teachers reported they do not like to expose their students more to science equipment during practical.
3. The teachers' exhibited poor practices in organising practical work. Teachers reported not supervise and monitor what individual students do during practical work while some reported provide no guidance for students when performing practical work. Teachers reported practical task are not from Ghana Education Services approved textbooks and Some teachers reported not

improvising where materials were not available for practical work. However, most of the respondents provide the appropriate instruments for chemistry practical work.

- 4 There is no significant correlation between chemistry teachers' attitude and their competence.

5.2 Conclusions

The study shows that chemistry teachers in senior high schools in the Greater Accra Region of Ghana gave clear explanation and demonstrated experiments before practical work, defined problems in simple language, handled all instruments and glassware, used internet to gather information for students and prepared reagents for laboratory practical including titrimetric experiments and qualitative identification of ions. The teachers had a high competency level but exhibited bad practices in organising practical work due to negative attitudes toward organising practical work. The teachers saw chemistry practical to be boring and hardly linked theory lessons with real life situation. Additionally, practical task was not selected from Ghana Education Service (GES) approved textbooks. Generally, the attitudes of the teachers were not good enough to translate their high professional competence into actual practice during practical work. The attitudes of the teachers had no influence on the teachers' competence.

5.3 Recommendations

Considering the findings of the project, the following recommendations are made:

1. Chemistry teachers in senior high schools in Greater Accra Region of Ghana should linking lessons with abstract experience of students, connected glassware for laboratory synthesis of gases and arrange field trips for students

2. Chemistry tutors in senior high schools in Greater Accra Region should design practical manual to serve as a guide for students during practical work.
3. Chemistry teachers in senior high schools in Greater Accra Region of Ghana should organise chemistry practical work often, prioritise practical work and develop positive attitude toward practical work.
4. Chemistry teachers in senior high schools in Greater Accra Region of Ghana should guide and supervise students to during chemistry practical work. Additionally, chemistry teachers should select practical task from Ghana Education Service (GES) approved textbooks.
5. The teachers should concentrate on the pedagogical development because content knowledge alone would not ensure professional teaching of chemistry practical
6. Attitudinal and behavioural change programmes regarding effective implementation of practical work should be organised for chemistry teachers in second cycle schools in the Greater Accra Region.

5.4 Suggestions for Future Research

1. A further study may be conducted in other regions of Ghana for a more generalised conclusion to be on chemistry teachers' professional competence, attitude and practices in organizing practical work in another region.
2. This study focused on chemistry teachers. It is suggested that further research should be conducted to explore the attitudes of students toward practical work in senior high schools in the study region.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR CHEMISTRY TEACHERS

UNIVERSITY OF EDUCATION, WINNEBA

Dear Respondent,

This study is purely for academic purposes. You will be contributing to its success if you answer the item as frankly and honestly as possible. Your responses will be kept confidential. Moreover, your anonymity is assured by neither writing your name nor indicating your school. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issues raised.

General Instruction

Please tick [☐] the appropriate bracket or column or fill in the blank spaces where necessary.

PART I: Bio Data

1. Sex:
Male [☐] Female [☐]
2. Age:
Below 20yrs [☐] 26-30yrs [☐] Above 30yrs [☐]
3. How long have you been teaching chemistry?
3-5yrs [☐] 6-8yrs [☐] 9-11yrs [☐] 12-13yrs [☐] above 14yrs [☐]
4. What is your academic qualification?
(a) Diploma [☐]
(c) 1st Degree [☐]
(e) 2nd Degree [☐]
5. What is your area of specialisation?
(a) Physics (b) Chemistry (c) Biology (d) Integrated Science
(e) Any other, specify

6. What is your professional status?

(a) Professional ☐

(b) Non-Professional ☐

7. Have you ever had any in-service training in teaching chemistry?

(a) Yes (b) No

8. Who organizes the in-service training programme?

(a) GES ☐ (b) GAST Organizers ☐

(c) Any other, specify

PART II

SECTION A: Chemistry Teachers' Competence, Attitudes, and Practices in Organising Practical Work.

There are three questionnaires in this section. The questionnaires have been numbered Q1 – Q3. Q1, Q2 and Q3 contain statements about chemistry teachers' competence, attitudes, and practices in organising practical work respectively. Each statement is followed by five responses with corresponding weight; Strongly agree=5; Agree=4; Neutral=3; Disagree=2; Strongly disagree=1. There are no "right" or "wrong" responses. Your feeling about each statement is what is important. Tick [☐] the appropriate column under the response that expressed your opinion about the item. Be sure to respond to all items. If you change your mind about your response to an item, just cross it out and tick [☐] another. Some statements in this questionnaire are fairly similar to others; don't worry about this. Simply give your opinion about each of the statements.

Q1: Chemistry teachers' competency level in organising practical

Item	Statement I have competence in:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	Giving clear explanation before practical work.					
2	Demonstrate experiments before students carry out the experiments.					
3	Helping students to write reports on experiments.					
4	Preparing reagents and solutions for titration experiments					
5	Designing laboratory manual to serve as a guide for students					
6	Arranging field trips for finding answers to students' questions					
7	Connecting glassware for laboratory synthesis of gases					
8	Organizing laboratory practical for the identification of cations and anions					
9	Linking lesson with experience					
10	Linking concrete and abstract experiences of students.					
11	Using the internet to gather information for students.					
12	Defining problem (topic) in simple language.					
13	Handling all instruments and glassware					

SECTION B: Chemistry teachers' attitude toward practical work

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	I like chemistry practical					
2	I wish I don't have chemistry practical so often					
3	Chemistry practical helps me to teach the theory well in class					
4	Chemistry practical motivates students					
5	I like to expose my students more to science equipment during practical					
6	I like working with science equipment despite the problems I have when using them					
7	Chemistry practical makes me appreciate Chemistry better.					
8	Writing up chemistry practical is a very useful exercise to me					
9	Chemistry practical help me acquire scientific skills					
10	Chemistry practical is boring					

SECTION C: Chemistry teachers' practices during practical work

	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	I supervise what students do during practical.					
2	At school, I teach the theory before students perform the practical.					
3	I allow students to work in groups during practical lessons.					
4	I give students immediate feedback when they need directions to proceed.					
5	The theory lessons are not related to the practical.					
6	I organize group work because there are not enough reagents and glassware					
7	I don't go around supervising students during practical					

8	I provide the appropriate reagents, glassware, and instruments for chemistry practical.					
9	Students perform chemistry practical in the school laboratory without any guidance					
10	There are no equipment/glassware or materials in the school laboratory, so I do not organise chemistry practical.					
11	Students don't get the opportunity to handle every piece of the instrument in our school laboratory					
12	The instruments/equipment in the Chemistry laboratory give inaccurate results so I don't organize practical					
13	I allow students to design their own experiments during chemistry practical					
14	I allowed the students to perform experiments based on WAEC past questions					
15	I select practical tasks from GES-approved textbooks					
16	I have enough chemical for chemistry practical					
17	Where there are no materials (glassware, equipment) I improvise					

APPENDIX B

OBSERVATION CHECKLIST

UNIVERSITY OF EDUCATION, WINNEBA

A. Class information

Date..... Location of School.....

Time of Observation..... Start..... End.....

Class..... Teacher's Gender.....

Number of Students.....

Number of Boys..... Number of Girls.....

B. Laboratory Context: Rate the adequacy of the physical environment.

1. Laboratory resources:
 Rich in resources..... Sparsely equipped.....

Comments.....

2. Laboratory space:
 Crowded..... Adequate
 space.....
 Comments.....

3. Laboratory arrangement:
 Inhibits interaction among students..... Facilitate
 interaction.....
 Comments.....

C. Laboratory Activities during Practical Lesson

S/N	ACTIVITY	REMARKS	
1	Teacher set up practical work for students		
2	Teacher gives clear explanation before practical work		
3	Teacher links concrete and abstract experiences of students		
4	Teacher supervises students while performing practical tasks		
5	Students use the right glassware/instruments during practical work		
6	Students follow rules and guideline when performing practical work		
7	Students work in group during practical lessons		
8	Teacher teaches theory before practical is organised		

9	Teacher marks students' work and provide immediate feedback		
10	Teacher provides enough reagents/instruments during practical lessons		
11	Teacher monitors the correct use of chemical during chemistry practical work.		
12	Teacher goes round to supervise individual work		
13	Teacher motivates students during practical work		
14	Teacher provides practical manual for students during laboratory work		
15.	Students are given enough time to complete the task/practical work		



APPENDIX C



UNIVERSITY OF EDUCATION, WINNEBA

FACULTY OF SCIENCE EDUCATION

DEPARTMENT OF INTERGRATED SCIENCE EDUCATION

P.O. Box 25, Winneba, Ghana

+233 (020) 2041077

ise@uew.edu.gh

Our ref. No.: ISED-PG.1/Vol.1/

23rd February, 2023

Dear Sir/Madam,

LETTER OF INTRODUCTION

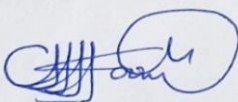
I write to introduce to you the bearer of this letter **Mr. Winfred Anim**, with index number 220010358 a postgraduate student in the University of Education, Winneba who is reading a Master of Philosophy programme in Science Education.

As part of the requirements of the programme he is undertaking a research topic – *Senior High School Chemistry teacher's professional competence, Attitude and Practices in Organizing Practical Work*. He needs to gather information to analysed the said research topic and he has chosen to do it in Greater Accra Region.

I would be grateful if he would be given the needed assistance to carry out this exercise.

Thank you.

Yours faithfully,



DR CHARLES KWESI KOOMSON
AG. HEAD OF DEPARTMENT



www.uew.edu.gh

APPENDIX D

GHANA EDUCATION SERVICE

In case of reply the
Number and date of this
Letter should be quoted



REGIONAL EDUCATION OFFICE
P. O. BOX M.148
ACCRA

My Ref: GES/GAR/HRMD/OL/2023/190
Your Ref.

REPUBLIC OF GHANA

15th June, 2023

LETTER OF INTRODUCTION

I write to introduce to you Mr. Winfred Anim, an MPhil student of Department of Integrated Science Education at the University of Education, Winneba who has selected some Second Cycle Schools in the region to conduct a research (List of the schools attached).

The focus of his research is on "Senior High School Chemistry Teacher's Professional Competence, Attitude and Practices in Organizing Practical Work". This is in partial fulfilment for the award of an MPhil Degree.

He is required to make personal contacts with you to arrange for convenient times to undertake the exercise in order not to disrupt instructional hours.

I would be grateful if he could be given the necessary assistance he needs for his work.

I am counting on your cooperation.

A handwritten signature in blue ink, appearing to read 'Stephen Abamfo'.

MR. STEPHEN ABAMFO
AG. DIRECTOR OF EDUCATION
GREATER ACCRA REGION

Cc: ✓ Mr. Winfred Anim, Dept. of Integrated Science Education, UEW, Winneba.

APPENDIX E

Ebenezer Senior High School
P.O Box 12 MP
Dansoman - Accra

15th May, 2023

The Regional Director
Ghana Education Service
Greater Accra Region

Dear Sir,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I would like to ask permission from your noble office to administer a questionnaire among chemistry teachers'. This is in view of my thesis entitle "Senior High School Chemistry Teachers' Professional Competence, Attitudes and Practices in Organizing Practical Work". The respondents of my study are public senior high chemistry teachers' in your prestigious schools.

The survey would last only about 5 to 10 minutes and would be arranged at a time convenient to the teachers' schedule. Participation in the survey is entirely voluntary and there are no known or anticipated risks to participation in this study. All information provided will be kept in utmost confidentiality and would be used only for academic purposes.

Your approval to conduct this study will be greatly appreciated. Thank you in advance for your interest and assistance with this research.

Yours faithfully



Winfred Anim

(0542457975)