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THE IMPACT OF THE USE OF INSTRUCTIONAL MATERIALS ON THE PERFORMANCE OF ADVANCE LEVEL CHEMISTRY STUDENTS IN THE MFOUNDI DIVISION

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By

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Bachelor's Degree in Chemistry

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CERTIFICATION

This is to certify that the Dissertation titled: “the impact of the use of instructional materials on students’ performance in Advance Level Chemistry in the Mfoundi Division” is a bon-fide record of independent research work done by NJOMENY YEMTE Eric under my supervision and submitted to the University of Yaoundé 1 in fulfilment for the award of a Master’s Degree in Curriculum Development and Evaluation.

Name: Pr. NDI Julius NSAMI

Signature: ……

Date: ……

DEDICATION

To my parents

Marcus Njilla Yemte, Rose Manimo Yemte

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This work could not have been undertaken without the support of some people to whom I wish to extend my deepest gratitude for their efforts. Firstly in a very special way I want to express my gratitude to my supervisor Professor NDI Julius NSAMI for his guidance and orientations at each stage of the work. Your advices, points of view and encouragement make this work to be what it should be. Secondly my heartfelt thanks goes to the Faculty of Education of the University of Yaounde 1: to the Dean Pr BELA Cyrille Bienvenue for granting me the opportunity to enroll and carry out research in my choosen area; to all my lecturers most especially Dr SHAIBOU A. HAJI whose theoritical orientations gave me the background knowledge to conceive this work.l also thank the Principals of some Secondary High Schools in the Mfoundi Division of the Centre Region for permitting me carry out studies in their institutions.

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LISTS OF SYMBOLS, ABBREVIATIONS AND ACRONYMS

ANOVA: Analysis of Variance

AWR: Average Weighted Response

CAT: Chemistry Achievement Test

G.B.H.S: Government bilingual High school

GCE: General Certificate of Education

GER: Gross Enrolment Rates

MS: Microsoft office

SPSS: Statistical Package for Social Sciences

UNESCO: United Nations Educational, Scientific and Cultural Organization

V.T.I: Video-Taped Instruction

ABSTRACT

Like other science subjects, chemistry is a practical-oriented discipline that seeks to develop a learner's scientific inquiry and problem-solving skills, which can be achieved with the help of instructional materials. This study aimed to assess the use of instructional materials on students' performance in chemistry in selected high schools in the Mfoundi Division. The aim of the study was further divided into four specific objectives as follows: to assess the use of realia on student's performance; to assess the use of graphic material on students; to evaluate the use of Mock-ups and models in teaching on student's performance; to assess the use of film projector in teaching on students' performance. This study was guided by two theories: Piaget's theory of cognitive development and Gagne's theory of instruction. The research method used was a quantitative-cross-sectional survey. Simple random and stratified sampling techniques were used to select our sample population of 300 participants. Data were collected using questionnaires, and the data were analyzed using SPSS version 21 software. The use of instructional material (realia, graphic material, mock-ups and model and film projector) in teaching chemistry significantly affects students' performance. This indicated that instructional materials promoted students' participation in chemistry lessons. The results of the finding also affirmed that students' academic engagement had a significant influence on the student's performance in chemistry. And finally, the results of the findings established that instructional materials in chemistry had increased the students' lesson retention in chemistry and therefore contributed highly to students' performance in chemistry.

Key words: instructional materials, performance, accessibility, usability, engagement and retention.

RESUMÉ

Comme d'autres matières scientifiques, la chimie est une discipline axée sur la pratique qui cherche à développer chez les apprenants des compétences de recherche scientifique et de résolution de problèmes, qui peuvent être obtenues à l'aide de matériel didactique. Cette étude visait à évaluer l'utilisation du matériel didactique par les étudiants. performances en chimie dans des lycées sélectionnés du département du Mfoundi. Le but de l'étude a été divisé en quatre objectifs spécifiques comme suit ; évaluer l'utilisation de realia sur les performances des élèves ; évaluer l'utilisation de matériaux graphiques sur les performances des élèves ; pour évaluer l'utilisation de.Maquettes et modèles dans l'enseignement sur la performance des élèves ; évaluer l'utilisation du projecteur de film dans l'enseignement sur la performance des élèves. .cette étude a été guidée par deux théories : la théorie du développement cognitif de Piaget et la théorie de l'instruction de Gagné. La méthode de recherche utilisée était une enquête quantitative transversale. .Des techniques simples d'échantillonnage aléatoire et stratifié ont été utilisées pour sélectionner notre échantillon de population de 300 participants. Les données ont été recueillies à l'aide de questionnaires et les données ont été analysées à l'aide du logiciel SPPSS version 21. .l'utilisation de matériel didactique (realia, matériel graphique, maquettes et modèles et projecteur de film) dans l'enseignement de la chimie a un effet significatif sur les performances des élèves. .cela indiquait que le matériel didactique favorisait la participation des étudiants aux cours de chimie. Les résultats de la découverte affirmaient également que l'engagement scolaire des étudiants avait une influence significative sur les performances des étudiants en chimie. .et enfin, les résultats de la découverte ont établi que le matériel didactique en chimie avait augmenté la rétention des cours des étudiants en chimie et avait donc fortement contribué à la performance des étudiants en chimie.

Mots clés : matériel didactique, performance, accessibilité, convivialité, engagement et rétention

CHAPTER ONE: INTRODUCTION

Science is valued in modern schooling as a tool for societal advancement. According to Samuel and Obikezie (2020), science is important in the development of any nation. This is because science is directly linked to the tackling of the problems of humanity (Hallinen, 2011). The contributions of science and technology to the overall development of nations cannot be overemphasized. This is the reason science holds an important position in the curriculum of the nation's educational system (Tera, 2018). Chemistry is an important part of science and one of the science disciplines taught in senior secondary schools (Ogwo, 2014). It plays a crucial role in training students for careers in medicine, industrial chemistry, food science, engineering, and other applied related fields (Taber, 2014).

Chemistry is one of the core subjects of science. As a building block for a range of science disciplines, Chemistry has the potential to link other sciences together and to foster greater scientific literacy (Tera, 2018). Chemistry is the basic gateway and the key to modern technology, medicine, engineering and other sciences (Chikendu, Obikezie & Eke, 2021). The study of Chemistry is needed to develop the necessary skills, intellectual and mental training needed to observe measure and apply scientific attitude and skill towards natural phenomena that include the eagerness to learn and the ability to think critically. In contemporary Cameroon, great emphasis is placed on science for technological development and Chemistry is an important raw material for science. In spite of the relevance of Chemistry in the life of the society (Obikezie & Abumchukwu 2021).

Chemistry is an activity-oriented science subject, and the suggested teaching style, guided discovering, is resource-based (NTI, 2017). This implies that the understanding of chemical principles cannot be fully realized without the use of instructional materials. Ogwo (2014) stated that the basic tools that science uses in the learning of science processes are instructional materials. Instructional materials are wide varieties of equipment and materials used for teaching and learning processes to stimulate self-activity on the part of the students. According to Engida (2012) instructional materials increase the rate and quantity of learning by students and at the same time

allow the teacher to use more time on other gainful activities. They make abstract terms, concepts and generalizations more practical and realistic. Instructional materials create in the learners' awareness of problem, open up possibilities for exploration, present meaningful interactions which naturally lead to provision of solutions. Because of the favorable impact instructional materials have on students' performance, their value in increasing successful teaching and learning of science, particularly chemistry, cannot be overstated. The teacher can use instructional resources to help him or her attain the stated aims and objectives. During teaching and learning, all kinds of instructional materials appeal to the sense organs Agina-Obu (2015).

Abdu-Raheem (2014) stated that teachers employ instructional resources to help explanations and make subject matter learning understandable to students during the teaching and learning process. Instructional materials are essential and significant tools need for teaching and learning to promote teacher's efficiency and capture the student's attention in classroom situation. Kochhar (2012) agreed that instructional materials are crucial learning and teaching resources. Fadeiye (2015) stated that instructional materials as concrete or intangible visual and audiovisual aids used by teachers to improve the quality of teaching and enhance student understanding there by improving students' performance. Chemistry as a science subject is hands on activity based and must be taught with instructional materials (Ezeliorah, Ibe & Obikezie 2021). Teaching of Chemistry without instructional materials may result to rote learning.

Background of the study

The background of this study comprises of the historical background, contextual background, conceptual background and the theoretical background.

Historical background

The need for the introduction of science into the secondary school curriculum was only really acknowledged during the nineteenth century. The impetus for this arose from the rapid advances in science made during this period and to the writings of such individuals as Michael Faraday (1791-1867), Thomas Huxley (1825-1895) and Herbert Spencer (1820-1903). These individuals argued strongly for the disciplinary and utilitarian values that the teaching of science would create. The First World War inevitably raised the importance of science in the eyes of the general public

and in 1916 the government appointed a Committee under the chairmanship of J. J. Thomas to enquire into the position of Natural Science in the educational system in Britain especially in schools and universities. The 'Thomson Report' as it became known was published in 1918 under the title 'Natural Science in Education'

The 16th and 17th centuries saw the beginnings of what we now recognize as modern chemistry. During this period, great advances were made in *metallurgy*, the extraction of metals from ores, and the first systematic quantitative experiments were carried out. In the 18th century, the English clergyman Joseph Priestley (1733–1804) discovered oxygen gas and found that many carbon-containing materials burn vigorously in an oxygen atmosphere, a process called combustion.

However, it must be said that since the beginning of the 20th century there has been a gradual increase in the quality of the resources invested in science teaching e.g. in terms of financial, human (teachers and technical support staff), physical (equipment and accommodation). More science subjects have been offered in schools at GCE 'O' and 'A' Level i.e. separate sciences both in the physical and biological disciplines and general science and these have been open to both sexes.

Contextual background

In Cameroon, chemistry is a component of a statutory national curriculum and. chemistry topics form part of the education of all children from 5-16, and equal opportunities legislation ensures that curriculum discrimination between boys and girls is no longer permitted. School chemistry is now universally regarded as a subject that seeks to promote curiosity about the world, knowledge on matter and its Properties**,** Measurements, Atomic Structur, The Periodic Table, Bonding and Chemical Interactions, Chemical Kinetics, Chemical Equilibriumand an insight into the nature of scientific investigation including a critical approach to evidence. Students are also required to display a much wider range of competencies than hitherto.

Chemistry in Cameroon Secondary Education has been developed as an integrated course which aims to contribute towards a mixing of new and old materials so that the new concepts permeate then whole. Secondary schools chemistry syllabus also aims at creating awareness in the student

of the importance of chemistry in the society in which he/shelives. It is conceived to provide a smooth transition from the daily realities of chemistry in the student's life to more concrete concepts without creating a barrier. Cameroon secondary school chemistry covers the requirements of the Cameroon G.C.E. Board Examination Syllabus.

The general aims and objectives for the whole Chemistry course are broken down to specific goals and aims which are progressive. Firstly to Identify patterns in the physical and chemical behaviour of substances; Use experimental techniques and design of experiments; Understand and apply Principles of Chemistry; Handle problems in everyday life by using ideas, concepts and skills developed in the Chemistry course; Create an awareness of chemistry in the Cameroonian society and the world and an application of the social and environmental aspect of Chemistry.Cameroon secondary school chemistry syllabus is design based on the Competency Based Approach with daily life situations as the focal point, using the student centred experimental approach to the teaching of the subject in each of the classes. The experimental resources to be used at all levels of the teaching chemistry include: simple materials in the environment; conventional laboratory chemicals and equipment; microchemistry equipment.

In the Cameroon various high schools use instructional materials at their disposal. Thus, some schools will have more instructional materials than others, depending on the financial strength of each institution. Also, the utilization of these materials depends on the disposition and skills of the teacher to use these instructional materials. The use of instructional materials is encouraged by the government as stated in law No98/004 of the 14 April 1998 section 25, which says that the education provided in schools shall consider scientific and technological advancement and shall be tailored in terms of content and method to national and international economic scientific, technology, social and cultural trends. The scheme of work for advanced-level chemistry is designed in such a way that teaching should be done with the use of instructional materials.

Tambo 2012 recounts that learning materials are now available to some extent in Cameroon, some of which include laboratories, libraries, field work and visual materiala to enhance teaching and learning of science subjects. Most schools in the center region has started using learning materials to ease understanding of students and to motivate them while other schools are still neglecting the

use of these learning objectives to increase performance as a result when absent lead to failure of test and exams of students especially in subjects like chemistry, biology and others.

The survey done by Tateng 2007 on learning materials in Africa, he recounts that Cameroon is among the African countries in central Africa that are making progress in the use of these materials for example communication and information technology (ICT), these materials were introduced in the educational sector by Terry in 2001 which he says the best way for effective learning is to provide real object such as flashcards, radio, and computer with internet to support classroom teaching, also textbooks, photograph, chart is also used to facilitate learning.

Conceptual background

Instructional material: According to Akanbi (2018), instructional materials are aids "designed to enrich the teaching and learning processes and hence contribute to better learning. Adesola et al. (2022) defined instructional materials as any animate materials or inanimate objects as well as human and nonhuman resources that a teacher may use in teaching and learning situations to facilitate desired learning outcomes. Similarly, Mustapha et al. (2022) defined instructional materials as teaching and learning materials that are used by a teacher to assist in providing information for the attainment of required learning experience. Therefore, instructional materials are all the things or materials that may be used by a teacher as part of instructional process in order to deliver effective and successful teaching that can facilitate positive students' learning outcomes. Thus, they are all materials intentionally used by a teacher to impact students' learning during instruction. Instructional resources are materials that assist instructors in making the learning of concepts clear and understandable by students. They reduce oral teaching, increase learners' engagement, interest, and motivation toward learning sciences (Tuimur & Chemwei, 2015).

According to Ajemba et al., (2021), instructional materials include, modern textbooks, equipment, consumables like chemicals and reagents, models, charts etc. and the physical learning environments, which include the science classrooms and laboratories. Similarly, Adesola et al. (2022) gave examples of some instructional materials to include, cardboard paper, real objects, CD ROM, CD ROMs, charts, radio, DVDs, test tube holders, clinostat, reptile hook, models, diagrams, and pictures. Matazu (2022) identified prints, textbooks, magazines, newspapers, slides, photos, workbooks, and electronic media as examples of instructional resources. Instructional

materials comprised locally made tools (such as improvised materials like mosquito net, wooden ring/iron, thread, and needle) or imported tools (e.g., aspirator and clinostat) that help to facilitate the teaching/learning process (Chukwunazo et al., 2022; Effiong & Igiri, 2015). They could also be print or non-print objects.

Academic performance: Academic performance is the measurement of student achievement across various academic subjects. Teachers and education officials typically measure achievement using classroom performance, graduation rates and results from standardized tests. Factors influencing high academic achievement include: attendance to lectures, early revision, prioritization of learning needs, deep learning, learning in small groups, mind mapping, learning in skills lab, learning with patients, learning from mistakes, time management, and family support. Academic performance is the outcome of students' effort in examinations. Students' academic performance is determined by a number of factors (Eze et al. 2016). Academic performance is measured by the average marks of the students.

According to Narad and Abdullah (2016) academic performance is the knowledge gained which is assessed by marks by a teacher and/or educational goals set by students and teachers to be achieved over a specific period of time. They added that these goals are measured by using continuous assessment or examinations results. Academic performance has been defined and explained by several authors. According to Narad and Abdullah (2016) academic performance is the knowledge gained which is assessed by marks by a teacher and/or educational goals set by students and teachers to be achieved over a specific period of time. They added that these goals are measured by using continuous assessment or examinations results.

Arhad, Zaidi and Mahmood (2015) also indicated that academic performance measures education outcome. They stressed that it shows and measures the extent to which an educational institution, teachers and students have achieved their educational goals. Similarly, Yusuf, Onifade and Bello (2016) opined that academic performance is a measurable and observable behaviour of a student within a specific period. He added that it consists of scores obtained by a student in an assessment such as class exercise, class test, mid-semester, mock examination, and end of semester examination. Again, Martha (2009) emphasized that academic performance of students is defined

by a student's performance in an examination, tests, and in a course work. Willcox, (2011) define academic performance as the level of knowledge shown in an area or subject compared to the norm, and it is generally measured using the grade point average.

Chemistry: Chemistry is one of the core subjects of science. As a building block for a range of science disciplines, Chemistry has the potential to link other sciences together and to foster greater scientific literacy (Tera, 2018). Chemistry is the basic gateway and the key to modern technology, medicine, engineering and other sciences (Chikendu, Obikezie & Eke, 2021). The study of Chemistry is needed to develop the necessary skills, intellectual and mental training needed to observe measure and apply scientific attitude and skill towards natural phenomena that include the eagerness to learn and the ability to think critically. In contemporary Cameroon , great emphasis is placed on science for technological development and Chemistry is an important raw material for science.(Obikezie & Abumchukwu 2021).

Chemistry is defined as the study of nature, composition and properties of matter and the changes it undergoes (Ojokuku, 2010). Science Teachers Association of Nigeria (STAN, 2016) broaden the definition of chemistry as a branch of science that studies the properties of matter in terms of compositions, structures, transformations, interactions and energy implications of chemical changes. Chemistry can also be defined as the constitution, properties and uses of matter and the changes it undergo as a consequence of alterations in the composition of their molecules.

Theoretical background

This study adopted two theories Jean Piaget's theory of cognitive development and Gagne's theory of instruction (Gagne's nine events of instruction).

Jean Piaget's theory of cognitive development

Jean Piaget (1896-1980), a Swiss psychologist, is best known for his pioneering work on the development of intelligence in children. His studies have had a major impact on the fields of psychology and education. In his work Piaget identified the child's four stages of mental growth. In the Sensorimotor Stage, occurring from birth to age 2, the child is concerned with gaining motor control and learning about physical objects. In the Preoperational Stage, from ages 2 to 7, the child

is preoccupied with verbal skills. At this point the child can name objects and reason intuitively. In the Concrete Operational Stage, from ages 7 to 11, the child begins to deal with abstract concepts such as numbers and relationships. Finally, in the Formal Operational Stage, ages from adolescence to adulthood, the child begins to reason logically and systematically. This research make use of the fourth stage of piaget's theory of cognitive development which is the formal operational stage.

At this stage, individuals perform concrete operations on things and they perform formal operations on ideas. Formal logical thinking is totally free from perceptual and physical barriers. At this stage, adolescents can understand abstract concepts. They are able to follow any specific kind of argument without thinking about any particular examples. Adolescents are capable of dealing with hypothetical problems with several possible outcomes. This stage allows the emergence of scientific reasoning, formulating hypotheses and abstract theories as and whenever needed (Miller, 2011).

From his observation of children, Piaget understood that children were creating ideas. They were not limited to receiving knowledge from parents or teachers; they actively constructed their own knowledge. Piaget's work provides the foundation on which constructionist theories are based. Constructionists believe that knowledge is constructed and learning occurs when children create products or artifacts. They assert that learners are more likely to be engaged in learning when these artifacts are personally relevant and meaningful (Constructivism, n.d.).

Educational Implications An important implication of Piaget's theory is adaptation of instruction to the learner's developmental level. The content of instruction needs to be consistent with the developmental level of the learner. The teacher's role is to facilitate learning by providing a variety of experiences. "Discovery Learning" provides opportunities for learners to explore and experiment, thereby encouraging new understandings (Kafia & Resnick, 1996). Opportunities that allow students of differing cognitive levels to work together often encourage less mature students to advance to a more mature understanding.

Gagne's theory of instruction (Gagne's nine events of instruction)

Educational psychologist Robert Gagne developed positions that evolved into a theory that is based not only on the standards of behaviorists but also on cognitive theories and the theory of information processing (Domou & Kameas, 2016). His mode of instruction consists of a taxonomy of learning outcomes, conditions of learning, and nine events of instruction (Ullah et al. 2015). These nine events follow a design process that reflects a variety of learning situations, which is why this model is among the most used ones in the development of elearning products (Gutierrez, 2018).

Gagné posited that not all learning is equal and each distinct learning domain should be presented and assessed differently. Therefore, as an instructional designer one of the first tasks is to determine which learning domain applies to the content. Essential to Gagne's ideas of instruction are what he calls "conditions of learning": internal conditions deal with what the learner knows prior to the instruction, external conditions deal with the stimuli that are presented to the learner, e.g. instructions provided by the teacher. The first step in Gagne's theory is specifying the kind of outcomes to be achieved. He categorised these outcomes into five types: verbal information, intellectual skills, cognitive strategies, attitudes, and motor skills. The second step is to organize appropriate instructional events. Gagne's "Events of Instruction".

Problem statement

The transmission of facts, ideas and information from the teacher to the students in a systematic order or procedure is referred to as teaching. During this process, instructional material, otherwise known as teaching aids meant to make instruction more meaningful, clear and interesting to students. There is a general impression that science education is not achieving the desired objectives, especially with a high incidence of students' poor performance in chemistry and other science subjects in the Cameroon General Certificate of Education (GCE) examinations. This situation has assumed a precarious dimension in all secondary schools in Mfoundi division. The failure of the educational system to provide adequate and appropriate teaching-learning aids to improve students' academic performance is of great concern to government, educational institutions and other concerned citizens. It is believed that better performance could be achieved

if adequate instructional materials are made available to schools and used appropriately in teaching-learning.

However, the literature has shown that teachers have been depending on the excessive use of words to express and convey chemical ideas (Stammes et al., 2020; Udogu & Enukora, 2017), theories, principles and fact-related skills and competencies to learners during teaching, which is completely teacher-centred via the lecture method (Sevian & Talanquer, 2014). Additionally, teachers have played a role in ensuring that learning materials are available in chemistry lessons, although not enough for all the learners, especially in classrooms with a large number of learners. This method of teaching denies learners their active engagement in learning chemistry, which makes some students consider it as a white-man's "magic' (Udogu & Enukora, 2017), yet chemistry is the science that they experience in their everyday life. Hence, this study's motivation is to determine the influence of the use of instructional materials on the academic performance of secondary school students in chemistry.

Purpose of the study

This study aims to assess the influence of instructional materials on students' academic performance in Chemistry in some secondary high schools in Mfoundi Division.

Objectives

Specifically, this study seeks to:

- Examine the effects of Graphic Material on secondary school students' academic achievement in Chemistry.
- Explore the effects of laboratory experience on secondary school students' academic achievement in Chemistry.
- Investigate the effects of using micro lab kits on secondary school students' academic achievement in Chemistry.
- Examine the effects of field trips on secondary school student's academic achievement in Chemistry.

Research questions

- To what extent does the use of Graphic Material affects secondary school students'

academic achievement in Chemistry.

- What are the effects of laboratory experience on secondary school students' academic achievement in Chemistry .
- What are the effects of micro lab kits on secondary school students' academic achievement in Chemistry.
- To what extent does filed trips effects secondary school student's academic achievement in Chemistry.

Research Hypothesis

The following hypotheses were tested at p=.05

H_{A1}: The use of Graphic Material in teaching has a statistically significant effect on secondary school student's academic achievement in Chemistry.

H_{O1}: The use of Graphic Material in teaching has no statistically significant effects on secondary school student's academic achievement in Chemistry.

H_{A2}: Laboratory experience in teaching statistically significantly affects secondary school student's academic achievement in Chemistry.

H_{O2}: Laboratory experience in teaching has no statistically significant effects on secondary school student's academic achievement in Chemistry.

H_{A3}: The use of micro lab kits in teaching has statistically significant effects on secondary school student's academic achievement in Chemistry.

H_{O3}: Using micro lab kits in teaching has no statistically significant effects on secondary school student's academic achievement in Chemistry.

H_{A4}: The use of field trips in teaching statistically significantly affects secondary school student's academic achievement in Chemistry.

H_{O4}: The use of field trips in teaching has no statistically significant effects on secondary school student's academic achievement in Chemistry.

Significant of the study

Since it is the role of the Ministry of Secondary Education (MINESEC) to provide instructional resources to all public secondary and secondary schools in Cameroon, it is hoped that, the findings of this study will be useful. The findings of this study may be useful in improving on the policies

that govern the allocation and disbursement of funds in secondary schools. Policies may be reviewed at different levels in the education sector, to increase on the allocation of funds. This may lead to increased supply of instructional materials to public schools thus improving acquisition of chemistry concepts.

This study will provide learners with systematic and scientific basis for worthwhile functional and productive learning experience and activities naturally leading from abstract to concrete ideas. It will help the leaners to have access and make use of the learning materials available to them.

The findings of this study might also be of benefit to the, guardians and donors. They could willingly be involved in provision of instructional materials. This would form a strong educational bond between students, teachers and their/guardians when the students see their participation in ensuring acquisition of chemistry skills.

This study is important for the following reasons; the results of this study will be useful to the ministry of secondary education and the various stakeholders in selecting appropriate instructional materials to improve students' performance; the teachers will be able to know key instructional materials that will facilitate their teaching process;

In addition, the study might also help in upgrading the policies governing chemistry instruction. It may help teachers and school heads to put more emphasis on the use of chemistry instructional material during the teaching of chemistry. This would help in attaining set chemistry objectives, increase students' involvement in chemistry activities, thus improving performance and development of positive attitude towards this discipline. The study will be of immense benefits to the government, ministry of education, and the educational policy makers and administrators as it will emphasize the important of instructional materials in lesson delivery.

Furthermore, it is anticipated that data collected from this study would add more information and knowledge to the existing literature about chemistry instructional material. Researchers and other educationists can benefit from this data and add to what the researcher would have started. Researchers can as well identify gaps in this study which they would like to fill.

Scope of the study

This research focuses on the Impact of the use Instructional Materials on students' Performance in Advanced level Chemistry in Mfoundi Division. The target population of this study are the high school students. This study focuses on instructional materials use in the teaching and learning of chemistry and how these instructional materials affect students' performance. This study is delimited to upper sixth students in some schools in Mfoundi Division.

Operational definition of terms

Graphic Material: Graphic materials are materials used for instruction characterized by their vivid nature, can be clearly described and are able to effectively present message in which it is designed for. According to Achuonye (2004), graphic materials are arts by which we express ideas in lines, pictures, sketches, and diagrams; it includes materials which inculcate facts and ideas clearly and succinctly through a combination of drawing, words and pictures.

Laboratory: The laboratory is a place where scientific exercises are conducted by the science teachers for the benefit of the students (learners). The laboratory exercises include; experiments, and other activities which help the students in acquiring scientific skills.

Micro lab kits: Micro science equipment comes in small lunch-size boxes which are entire laboratories on their own. With the 'box laboratory', students become active as they observe, manipulate, analyse, reflect and process ideas to draw conclusions about chemical and natural phenomena.

Field trips: A field trip, is a school-sanctioned excursion away from the classroom and other traditional study environments, to observe, interact with different settings, conducting basic research and/or experiencing new activities not readily found in school (Behrendt & Franklin, 2014). It is a form of experiential learning that allows students to experience concepts discussed in textbooks firsthand and pick up new knowledge through interaction. As such, it carries a slew of benefits.

Academic performance: Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university.

Organisation of the study

Organization of the study is an outline of the chapters of the research project. Chapter one is systematically organized to cover the background to the study, statement of the problem, scope of the study, research objectives, research questions, significance of the study, definition of terms and organization of the study, conceptual definition of terms, operational definition of terms . Chapter two outlines review of literature which is basically the views advanced by other scholars about the subject matter of the study. The chapter also discusses theoretical review and conceptual framework of the study. Chapter three on the other hand, describes the methodology that was employed in the study. It entails research design, nature of the research, study population, sample techniques and sampling frame, instrument and instrumentation, data analysis procedure, validity and reliability of the instrument, methodological challenges. Chaptered four presents the analysis of data collected from the two items in the study questionnaire. The findings are analysed and presented in the form of frequency tables, numerical values and percentages for comparison of the responses. The responses are presented followed by a brief interpretation guided by the research objectives and a discussion on research findings from the analysis of the data. This chapter presents the summary of the study findings together with conclusions of the study. Chapter five covers a summary of the findings and discussions of the research questions; it also presents the discussions and conclusions recommendations of the study as well as suggestions for further studies.

CHAPTER TWO: LITERATURE REVIEW

This chapter presents the relevant literature for this study. It present the conceptual framework of the study, review of study by research objectives, theoretical framework and lastly empirical reviw of related studies

Conceptual Framework

Concept of instructional materials

Instructional materials have been used in the chemistry classrooms since ancient times. Learning materials are the tools that can be used by instructors and teachers within the classroom context, in order to facilitate the learning and understanding of concepts among learners (Arop et al., 2019; Khalil & Elkhider, 2016; Wang, 2021). These materials are mostly used to support teachers in achieving the objectives that are set for a particular lesson (Choppin et al., 2020; Kanellopoulou & Darra, 2018). According to Hayat et al. (2017), these materials make learning real, enjoyable, practical, and pleasurable for the learners. Also, instructional materials facilitate the illustration and reinforce the acquisition of skills, viewpoint, perspective, and ideas (Arop et al., 2019). Furthermore, research has indicated that a large number of learners are not interested in perusing science subjects at the secondary school level (Nbina & Mmaduka, 2014; O-saki, 2007).

According to Akanbi (2018), instructional materials are aids “designed to enrich the teaching and learning processes and hence contribute to better learning”. Adesola et al. (2022) defined instructional materials as any animate materials or inanimate objects as well as human and non-human resources that a teacher may use in teaching and learning situations to facilitate desired learning outcomes. Similarly, Mustapha et al. (2022) defined instructional materials as teaching and learning materials that are used by a teacher to assist in providing information for the attainment of required learning experience. Instructional materials are materials which assist teachers to make their lessons explicit to learners. They are used to transmit information, ideas and notes to learners (Ijaduala 2020). Usman and Adewumi (2016) state that instructional materials can be referred to as the widely variety of equipment and materials used for teaching/learning by teachers to stimulate self-activity on the part of the pupils. According to Faize and Dahan (2011) instructional materials are print and non-print items that are designed to impact information to students in the educational process. Instructional materials include items such as prints, textbooks, magazines, newspapers, slides, pictures, workbooks, electronic media, among others.

According to Nolan (2022), instructional materials are learning aids that employ both sight and sound to impart meanings to students and enhance their educational experience. According to Abdullahhi (2010), instructional materials are tools locally made or imported that help to facilitate the teaching/learning process. Obanga (2005) view them as materials things which are used to composed ported that could make tremendous enhancement of intellectual use impact the instructional materials. Instructional materials are those channels of communication which promote the effectiveness of instruction and help the teacher to communicate ideas effectively to student (Ali, 2012). Instructional materials include all the substantial resources that a teacher can use to implement instruction which facilitates students' achievement. It should be noted that it is not all lessons or topics that can be effectively taught without the use of instructional material (Olumorin,Yusuf, Ajidagba & Jekayinfa, 20 10). According to Awolaju (2015), instructional materials play a key role in concretizing learning of science in general. Instructional materials make learning meaningful and help to improve students' level of comprehension of the abstract or difficult concepts. According to Umoru (2016). instructional material enhances, facilitate, and make teaching and learning lively and concrete.

Instructional materials are tools, instruments and resources used in educational lessons to facilitate the achievement of stated objective. Instructional materials are tools locally made or imported that help to facilitate the teaching-learning process (Abdullahi 2010). According to Obanya (2001), instructional materials are didactic materials things which are supposed to make learning and teaching possible. In support of these views, Agina-obu (2005), described instructional materials as concrete or physical objects which provide sound, visual or both to the sense organs during teaching.

Instructional materials are materials that assist in deeping students. Egunjobi (2009) conceptualized instructional material as aids which make it easier for the teacher to impart knowledge and skills to the learners. The researcher stressed that teaching materials and facilities save time, make learning more effective and promote interest for both teacher and the learners. (Ricardo, 2008) viewed instructional materials as tools used to supplement the written or spoken word in the transmission of knowledge, attitude and idea and to emphasize, clarify or vitalize the instruction. Silver (2010) asserted that instructional material is written and pushed text books and

related core materials (including those specific material which is used by the teacher for classroom instruction) needed by a state or local education authority or agency, for use in primary and post primary schools instruction including specifically requested teachers' editions of such materials. He further lamented that teaching aids or instructional materials consist of carefully planned and selected resources to facilitate teaching leaning process, instructional materials are all the object, things, peoples used to promote the teaching learning of chemistry.

Okoye and Olu (2008) opined that, instructional materials are all the tools that can be used by the teacher to provide help and encouragement to learners and learning activities. 12 Such materials bring together man and materials in systematic co-operation to effectively solve educational problems. Adesanya (2011) viewed realia like text books, chalkboard, models, comics chart, and other non-projected tools which brings about efficacy and efficiency in the teaching and learning process and invariably, promotes and enhance the achievement of instructional objectives. While, Abdullahi (2012) referred to instructional materials to mean all those resources used to supplement the normal learning process of seeing, reading and writing.

Therefore, instructional materials are all the things or materials that may be used by a teacher as part of instructional process in order to deliver effective and successful teaching that can facilitate positive students' learning outcomes. Thus, they are all materials intentionally used by a teacher to impact students' learning during instruction.

Classification of Instructional Materials

Instructional materials for teaching are classified differently by scholars. Shuaibu (2011) lamented that, instructional materials are being classified into three major categories namely: visual materials; audio materials; and audio-visual materials

Visual Materials; Visual materials involve the use of visual perception in the development of skills and understanding which include: Three dimensional material objects, models and specimens, Three dimensional material objects, models and specimen, Three dimensional material objects, models and specimens, Printed materials textbooks, workbooks, journals, newspapers, magazines, newsletters, Boards, chalkboard, bulletin boards, flannel or flat boards, Still pictures:

non-projected (photograph illustrations) and Graphics: charts, graphs, maps, globes, posters, diagrams

Audio Materials: Audio materials convey messages through sound productions which include the following, Radio, record player and tape recorder. Audio

Visual Materials: e.g. motion pictures, television, computer, video tape/cassette, AVD/MP3/CD Players etc.

The instructional materials (teaching aids) are classified into graphic materials, still pictures, motion pictures, audio materials, three dimensional materials, computer aided and computer managed instructions (Dike, 2008) Instructional materials can further be classified as follows, print and non-print, visual, audio and audio visual

The Significance of Instructional Materials

Many educationists agree that instructional materials bring about improvement in the teaching/learning process as well as permit teachers and students to interact as human beings in a climate where people control their environment for their own best purposes (Aniayewu, 2010).

Also, most educators generally and equally agree that the creative use of variety of instructional materials will increase the probability that student would learn more, return better and bring about the skills they are expected to perform (Adewoyin,2011).

Apart from their ability to process meaningful sources of information, instructional materials help the teacher with the means of extending his horizon of experience as well as providing the teacher with rich sources of procuring communicative materials which could be produced jointly by the teacher and the students (Osalusi, 2012).

Furthermore, several researches have been conducted to test the value of instructional materials and other sensory devices. These researches here proved that instructional materials when properly used in teaching learning situations can accomplish a lot of complex tasks (Lowenstein, 2012).

The instructional materials also offer real experiences in giving the teacher basis for thinking and understanding. They supply concrete basis for conceptual thinking and therefore reduce meaningless responses of students (Ismail & Aleem, 2013).

At the same time, they overcome the limitations of time, space and size by helping the students to understand things that are too small or too big, or too slow or too fast (Adeniyi, 2011). Therefore, instructional materials can provide members of a group with a common or joint experience. The break language barriers and ease difficulties and in the end make the lesson more meaningful. They save time and thus enable students grasp ideals more effectively and faster. Likewise, they help to simplify and emphasis facts and clarify difficulties. They reinforce other teaching methods and materials. They improve the efficiency of other method and effectiveness of teaching process.

Use of instructional material in the teaching and learming of chemistry

Chemistry, being the oracle of modern science, serves as a link between other science subjects such as physics, biology, and sometimes geography and mathematics (Nbina & Mmaduka, 2014). Chemistry is a fundamental subject, which applies to different careers and industrial processes. Högström, Ottander, and Benckert (2010) highlight that careers such as agriculture, geology, pharmacy and medicine among others are hinged on chemistry (Ngatijo et al., 2019). Overton and Randles (2015) argued that despite its importance, chemistry proves a difficult subject for many science learners. Scholars have asserted that chemistry curricula mostly incorporate abstract concepts (Bodner, 2015; Ngatijo et al., 2019), which are central to further instructions in both chemistry and other sciences (Högström et al., 2010). Hence, chemistry teachers should beware of the instructional strategies and procedures they use to deliver intended content (Ngatijo et al., 2019); so that meaningful learning of these abstract and complex chemistry concepts can be accomplished.

Successful implementation of the chemistry curriculum is dependent on the instructional materials available for both teachers and learners in lesson sessions. According to Khalil and Elkhider (2016), the term instructional material means all theoretical, practical and skill-oriented resources, which are accessible and available to facilitate the learning acquisition of various learning skills.

In addition, instructional materials bring the hope of delivering educational facts and experiences vividly and widely with realism that the printed media could hardly achieve (Arop et al., 2019).

Chemistry instrumental materials are objects which the learner can see, tough and hear from and which can be add to the effectiveness of learning. It is believed that all learning outcomes are the resort of sensory experiences. Much appeal is made to the sense of hearing in learning process. If there is to be improvement in the learning process as of Chemistry, the greater potentials that sight can offer are to be taken advantage of instructional materials can be of value to both learners and teaching, and is of much assistance to the learner to grasp all that is taught in the classroom for the day, (Abdulqudus, 2015).

Instructional materials varies for each subject, under the umbrella of chemistry in practical, there are reagents, practical text books, exercise book for writing. (Amadiohasw 2020). However real effectiveness of use of instructional materials depend on the student and teachers, it is quite unfortunate that some chemistry students find it default to access materials to aids in easy assimilation of the chemistry studies concepts, (STAN 2020). There is need to make use of instructional materials which help the students to bring out their best in all the topics under chemistry, (Olayinka AB 2016). Even though instructional materials do not perform magic in the learning activities of students, they are learning devices needed for the students to understand topics taught under chemistry (Anajite et – al., 2019).

With the use of instructional material a chemistry teacher can barely explain and describe a pipette, burette or any other learning equipment in chemistry; but it is hard to tell the learners what exactly a pipette or a burette look like, without a picture or physical equipment for clarity (Choppin et al., 2020). The picture of a pipette or burette is considered a instructional material that would help the students to comprehend the concepts behind their use. Also, these materials are among the materials needed by teachers and other instructors to assess the knowledge acquired by their learners from the lesson (Ko et al., 2013). Therefore, instructional materials have a vital impact on the learning process and the acquisition of various skills.

Research in chemistry education has indicated that the introduction of modern and innovative methods and teaching-learning have led to developments in the overall system of education (Aydin-Günbatar & Demirdöğen, 2017; Stammes et al., 2020). However, it is assumed that using the hands-on strategy motivates learners' active engagement in the lesson by making learning a more realistic and exciting experience. Working through hands-on in line with a popular proverb, which states 'I hear, I forget'; 'I see, I remember and 'I do, I understand'. Besides, Cirenza et al. (2018) and Holstermann et al. (2010) identified experimentation, the manipulation of symbols and objects, as well as learners' interaction, as being among the learners' hands-on activities that can assist in the learning of chemistry.

According to them, the respective hands-on activities reflect on how they can enhance learning. Schwichow et al. (2016) further highlighted that learning can be accomplished through a careful and thoughtful selection of appropriate teaching strategies that would help in promoting students' ability to create the scientific and mathematical meaning of concepts rather than the passive reception of ideas. Therefore, the learning of the subject matter can be strengthened and emphasized when a learner experiences a learning activity as enjoyable, pleasant, stimulating, and relevant through the design process (Stammes et al., 2020).

Searching and designing instructional materials increases learners' knowledge, thereby enabling them to learn how to think scientifically and understand how scientists work in natural life (Alkan, 2019). According to Ibe et al. (2021), deliberate practice and the continuous engagement of chemistry students in the design process are needed, so that learners become familiar with the content. According to Valdez et al. (2015), these practices are more effective when a learner is in an interactive environment and critically analyses the problem. An interactive classroom environment gives room for learners to exercise their ideas, knowledge and competencies (Holstermann et al., 2010; Wood, 2006). Wood (2006) asserts that group discussions create an active learning environment that improves students' ability to work and communicate with others, as well as to develop awareness and control of their thinking. In addition, (Holstermann et al., 2010) highlighted that when learners work in groups, it is possible to predict various solutions for a given task; since they share experiences.

Students performance

There is no consensus among educators about the best way to measure students' academic performance, which they consider as one of the most challenging tasks (Chiekem, 2015). The complexity of the challenge is that various approaches can be used to determine learning outcomes, including academic performance (Carini et al., 2006; Lamas, 2015). For instance, while some studies associate student academic performance with examination or assessment outcomes (Odeh et al., 2015), others relate it to success in completing planned learning goals (Bossaert et al., 2011). Some researchers have alluded academic performance to assessment indicators like learning aptitude, academic success achieved through mental abilities, and function of intelligence (Brown et al., 1989; Peng & Kievit, 2020; Yahaya et al., 2012). Other literature refers to student academic performance as grade point average (GPA) of students' scores achieved in a course or feedback on mastery of content in a subject (Ahmad, 2014; Allen, 2005; Mushtaq & Khan, 2012). The diversities in assessment approaches of students' academic performance have exemplified challenges that confront educators in measuring academic performance.

According to (Khan, Ullah, 2021; Ullah, 2020), the performance is the outward demo of thoughtful notions, services, thoughts, and information of an individual that grades signify the achievement score of students. According to Kobal and Musek (2001), academic performance represents the arithmetical scores of students' knowledge and the degree that he gains in schoolwork and the educational system. The achievement score of students may be achieved efficiently if all the factors affect students' educational presentation. Achievement outcome has been considered as a function of two characteristics, "skill" and "will "and these must be considered "and these must be considered individually because keeping the will alone may not assure success if the skill is lacking.

In all educational systems, performance is considered one of the significant factors of students' learning. Cai and Cao (2019) assert that academic performance is not only about students' performance in school, but should also include all aspects of their knowledge, competence and literacy development. Academic performance in a narrow sense refers to the measured performance of students through examinations at a certain study stage. In empirical studies of academic performance, a considerable number of researchers adopt such definitions of academic

performance, especially in empirical studies of primary and secondary school students, researchers often define academic performance as students' examination results, for example, Bao (2008), Ye (2013), Chen (2015), Li (2016), Li and Chai (2018) all define academic performance as a definition of a learner's the performance of teaching and learning assessments, such as final examination results, achieved by the person in school.

Wang (2021) believed that students performance can be equated with academic achievement. In a study of personality traits and academic achievement of secondary school students, Zhao and Guo (2012) measured academic achievement using students' midterm and final grades in language, mathematics, and foreign language subjects. Through an empirical study, Tang (2016) found that preschool education can improve students' future academic achievement (in the case of mathematical literacy) and can also promote educational equity. Minkowski (2015) believes that academic performance contains values, analytical problem solving and social skills, among others, and Bowie (2015) believes that academic performance value added is divided into three dimensions: core competencies, citizenship, and professionalism possessed.

Use of instructional matrials and students performance

According to Bajah, (2002) the followings were some of the reasons for using instructional materials:

- Instructional materials help to promote meaningful communication and effective learning.
- Instructional materials ensure better retention, thus making learning more permanent.
- Instructional materials help to overcome the limited classroom by making inaccessible to be accessible.
- Instructional materials provide a common experience upon which late learning can be developed.
- Instructional materials help to stimulate and motivate students to learn.
- Instructional materials encourage participation especially if students are allowed to manipulate materials used
- A good instructional material can supplement spoken or written words.
- It can bring teaching to life in a way which word cannot.

- Words can describe people, places and objects but a picture immediately brings reality.
- A teaching aid can simplify and clarify what is complex and difficult to express in words.
- Instructional materials have motivational value for them to develop the interest of the student.
- Instructional materials also promote retention.
- They save time, and energy what you will explain in ten minutes, will be possible in less time with the use of instructional materials.

The influence of instructional materials in promoting students academic performance and teaching and learning in educational development is indisputable. The teaching of chemistry in Cameroon secondary schools needs to be properly handle instructional materials are materials which assist teachers to make their lessons explicit to learners.

Education, according to (Kakure 2016). Consists of two components inputs and output. According to him, inputs consist of human and material resources and outputs are the goals and outcomes of the educational process. Instructional materials which are educational inputs are of vital importance to the teaching of any subjects in the school curriculum. In all human society past and presents, education has been instrumental impacting positively to the survival of individuals and the society, indeed instructional materials provides concepts and attitude to the students which improved his/her skills, ability to reason and makes him/her informed about what is going on globally (Tukur,2019).

The use of instructional materials makes different continents to shape their rules and regulations, to accommodate others (Ekpoj 2022). This is done by providing them with the socio – cultural and poetical ways. It makes students understand more effective (Lardi, 2016). Instructional materials stimulates the students desire to learn, enhance learning process by making as simulation and memorization of material (Kayi 2018).

The teacher can use instructional resources to help him or her attain the stated aims and objectives. During teaching and learning, all kinds of instructional materials appeal to the sense organs. This allows the learner to have hands-on experience when he or she sees, hears, touches, feels, or

manipulates concrete items and situations, conducts experiments, or interacts with them (Ehirim, Iwuchukwu, and Okenyi, 2020). Teachers should choose and employ a variety of teaching resources that allow students to read, hear, see, touch, and taste in order to achieve stated instructional objectives or actively participate in intellectual, emotional, and physical components. When the student is fully engaged in the process through the use of wellprepared and presented instructional materials, meaningful learning occurs. Because of the relevance of instructional resources, any endeavor to improve effective chemistry teaching and learning must include the availability and use of instructional materials.

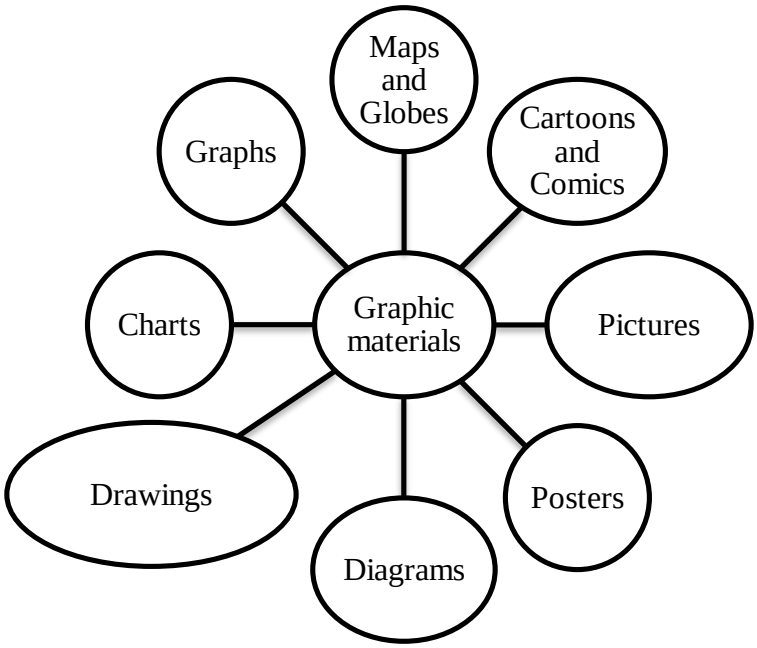
Review of literature by reseach objectives

Use of Graphic Material and students performance

Graphic materials are materials used for instruction characterized by their vivid nature, can be clearly described and are able to effectively present message in which it is designed for. According to Achuonye (2004), graphic materials are arts by which we express ideas in lines, pictures, sketches, and diagrams; it includes materials which inculcate facts and ideas clearly and succinctly through a combination of drawing, words and pictures.

Figure 1: Categories of Graphic Materials

Graphical materials used in instruction can be categorized into the following;



Use of graphic material in the teaching and learning of chemistry

Chemistry is a part of science which studies matter including the structure, properties, energy and changes that accompany matter through phenomena in daily life (Kolomuc & Tekin, 2011). Generally, concepts in chemistry are abstract and students had difficulty in understanding the concept (Stojanovska, 2014). In addition, the concept of chemistry includes mathematical calculations that requires mathematical skills to solve chemical problems (Hafsah, Hashim, Zurida , Jusoff, & Yin, 2014). Such discussion requires mastery of chemistry in a multi representation. This statement is strengthened by several experts who state that in studying scientific concept and methods, an understanding of the forrm of representation is needed (Waldrip, Prain &Carolan, 2010).

Chemists concerned with chemical education also employ these representations to communicate information to students, which can be observed in the images drawn in the blackboard used in classrooms and didactic books fulfilled with tables, charts, schemes and equations along words, pictures and illustrations. Graphics are visual media used to summarize data and represent relationships between variables effectively (Kilic, Sezen & Sari, 2012). The same data will be easier to read and understand when they are presented in graphical form than presented in a prose. The ability to read and interpret graphs requires mathematical thinking, so graphs are often considered as a mathematical tool. In fact, graphs are not only used in mathematics but also used in various fields of science such as statistics, social sciences (psychology and sociology) and natural science (chemistry, physics and biology).

Anike (2020) describes a diagram as a two-dimensional geometric representation of information according to some visualization techniques. Closely related to this, Canan (2017) views diagrams as graphic Organizers (GO) which is the visual representations that show the organization or structure of concepts as well as relationships between concepts.It is important to employ graphic organizers in the high school Chemistry lessons to help students better understand abstract Chemistry concepts and to connect the concepts to each other in a meaningful way in their cognitive structure. Canan (2017) explain how graphic organizers can be used within secondary Chemistry teaching duration by presenting different types of graphic organizer examples and the benefits of using them for teaching and learning of secondary Chemistry lessons.

Ajayi and Angura(2017) argued that one of the innovative teaching methods in which diagrams are used as the central focus is the Collaborative Concept Mapping Instructional Strategy which involves interactions during concept mapping process to create a shared understanding of previously studied concepts and construct knowledge. This method is a collaborative way of sharing ideas in which a group of students comes together to brainstorm, generate a pool of concepts or facts, which when put together, they eventually come up with a map that represents the thought of the group.

In science education, the function of graphics is to enhance students' comprehension about scientific concepts, build conceptual frameworks, and summarize subject matter. Graphics also play a role in improving students' science process skills such as explaining the relationship between various information or data and making conclusions from those data (Kali, 2005). The inability of students to read and interpret graphs will increase student's anxiety about using graphics and it will affect the quality of students' learning (Seckena & Zan 2013). Teachers who effectively use graphic representations in learning will provide oppurtinity for students to work with various types of graphs and it will be able to improve students' understanding of graphs (Kilic, Sezen & Sari, 2012).

In addition, learning that is supported by graphical representation will help students build meaning for the basic concepts of subject they are learning. Omar, Mohammed and Paimin(2014) observed that most Students have visual learning style and prefer visually presented learning materials with sufficient pictures, diagrams and flow charts for better comprehension.

Use of laboratory experience and student performance

Science learning has a special characteristic that cannot be missed, namely laboratory work (Berg, Bergendahl, Lundberg & Tibell, 2003; Golinski, 1999; G. M. Tesfamariam, Lykknes & Kvittingen, 2017). Ezeliora (2021) observed a science laboratory as a workshop where science is done or where scientific activities are carried out under conducive environment. According to Ambibola (2018), one major aspect of science education that is of great concern is in the areas of availability and effectiveness of use specialized and relevant science equipments, facilities and instructional materials. School laboratories that are well designed, stocked and safe for teaching

and learning science ensure active practical exercises (Katcha, 2015) Laboratory work is indispensible part of science instruction and no effective science education exists without practical work (Udo, 2016).

Learning by doing in science subjects, particularly in chemistry is very important in enabling students to understand what they are learning. This has been emphasized by various researchers and academics mostly those who advocate for learning by doing (Köller et al., 2015; Muleta & Seid, 2016; & Shana & Abulibdeh, 2020). Learning by doing enhances students' motivation, interest, and understanding of chemistry concepts (Shana & Abulibdeh, 2020). It also enables students in developing different skills like observational skills, communication, questioning skills, and problem-solving (Tesfamariam et al., 2014).

On the other hand, practical work allows students to use all the five senses during learning because while they are experimenting, they can see, hear, touch, taste, and also smell the products of experiments (Köller et al., 2015). This promotes active participation, and engagement in learning, and it draws students' attention to the lesson. It is exploration-based learning in which students build their levels of confidence and creativity, occasioning improved performance and sustained motivation to learn.

In addition, learning through chemistry practicals is regarded as learning by hands-on activities. Hands-on can be captured as learning by experience (Kagan, 1992). Students' experience in the chemistry laboratory when doing experiments gives them a more realistic experience of the content. This way of learning provides a conducive learning environment for students. Tesfamariam et al. (2014) highlighted that practical work leads to better learning of chemistry concepts. Practical work as hands on activities allow students to engage in kinesthetic learning. Kinesthetic learning is the learning style in which information is processed through movement and touch (Navaneedhan, 2015). Learners absorb more information by doing rather than merely listening or seeing.

Omiko (2015) stated that "hands-on experience" encourages students develop a spirit of inquiry and allows them to acquire scientific skills and the right attitude to handle scientific tools and

materials. The frequent utilization of the laboratory equipment and apparatuses effectively, student needs to understand not only how to do the experiments, but why the experiments are worth doing and what purpose they serve for better understanding of the concepts, relations or processes.

The laboratory learning environment provides unique learning opportunities and is effective in helping students construct their knowledge (Gupta, Hill, Valenzuela & Johnson, 2017; Lunetta, Hofstein & Clough, 2007), develop logical skills through inquiry (Dkeidek, Mamlok-Naaman & Hofstein, 2012; Hofstein & Mamlok-Naaman, 2011), and develop their psychomotor skills (Abdullah, Mohamed & Ismail, 2013; Imaduddin, Tantayanon, Zuhaida & Hidayah, 2020). Laboratory activities also encourage students to be positive and stimulate their communication and collaboration skills (Chabalengula, Mumba, Hunter & Wilson, 2009). Teaching chemistry without laboratory work activities is seen as only the transfer of factual information and laws without any in-depth knowledge construction process (Layton, 1990).

Students can practice what they have learned when they are learning with practicals. Students can participate in group work, work together with their fellows, and generate knowledge and different skills (Tesfamariam et al., 2014). Also, students can be able to see, touch, smell, and taste the product of the experiment. This act can raise their interest in chemistry, and they become motivated in learning chemistry. The whole teaching process is kind of learner centered as it involved the active participation of students. On the other hand, the second way of treatment is teaching without chemistry practical in the classroom. Students were passive recipients of knowledge, mainly listened to the teacher and copied notes without knowing how to practically relate concepts.

Use of micro lab kits and students performance

Micro science equipment comes in small lunch-size boxes which are entire laboratories on their own. With the ‘box laboratory’, students become active as they observe, manipulate, analyse, reflect and process ideas to draw conclusions about chemical and natural phenomena. The exposure, nurturing, and development of such manipulative, process, and concept skills in such enabling environments cause permanent learning (Hanson, 2017).

Conducting small scale chemistry activities through the use of micro kits have been known to enhance students' conceptions not only in South Africa (Sebuyira, 2001) but also in Ghana (Hanson, 2014), Mozambique (Kombo, 2006), Tanzania (Mafumiko, 2008) and most of the Asian countries including Thailand, Japan, Taiwan and Indonesia (Tantayanon, 2016; Supasorn, 2015). When it was introduced to undergraduate students in a Ghanaian university who also had misconceptions about chemistry, it was found to enhance their cognition and academic performance (Hanson, 2014). Chemistry students who used them in hands-on activities made conceptual gains as they overcame their conceptual challenges in principles that guided the study of chemistry. In this way they were able to engage in a kind of reality as they observed the causes and effect of phenomena in different variables. These concrete illustrations enhanced their concept formation and subsequently, academic performance.

The micro activities enabled students to verbalise, discuss, and explain scientific processes, as they worked together. Thus, engaging students in context-based learning (CBL) activities with respect to the constructivist paradigm, using the micro chemistry equipment as a tool, was adopted in this study to affect students' attitudes and understanding of basic chemistry concepts.

Advantages of Using chemistry micro lab kit

The chemistry micro lab kit uses solid chemicals in quantities of a few milligrams and liquid chemicals in few drops using special low-cost apparatus.

Student-friendly

• The use of chemicals in small quantities reduces fumes and risk of accidents, acid burns, etc.
• The experiments are quick to perform, thus, saving time for performing more experiments.
• It develops the habit of conservation.

Teacher-friendly

• It promotes better student discipline in the laboratory.
• It is pedagogically sound. Teachers can ask the students to do more experiments during the saved time to help in better conceptual understanding.

The Importance of chemistry micro Lab kits on students performance

Engages Students: chemistry micro Lab kits allows students to actually perform experiments rather than just read about them. Instead of taking monotonous notes, they can observe and complete exciting experiments. Such hands-on learning often makes it easier to understand challenging theories and concepts. As a result, students can become more engaged in the subject matter they are studying and develop a deeper appreciation for the sciences.

Improves Information Retention: As previously stated, chemistry micro Lab kits allow students to directly engage with the subject matter they are studying. By actively engaging with their curriculum, students often exhibit better retention. While a student may have to read over challenging subject matter several times before they are able to retain the information, completing a single experiment and seeing the results first-hand can allow the information to stick with them much longer. Without proper science equipment for schools, such engagement and information retention would not be possible for many students.

Provides Students with Practice: Another reason why chemistry micro Lab kits is important in schools is that it allows students to practice performing experiments. You wouldn't expect someone to be able to successfully drive a car if they've only read about vehicles and never actually got in one to practice behind the wheel. The same is true for science. If students choose to go into a science-based profession someday, they will be expected to perform experiments and engage in hands-on processes. Making the switch from reading about the sciences to putting them in action would be very difficult without having completed a few experiments in school. As such, it is important to provide students with the chemistry micro Lab kits necessary to practice.

Use of field trips and students performance

A field trip, is a school-sanctioned excursion away from the classroom and other traditional study environments, to observe, interact with different settings, conducting basic research and/or experiencing new activities not readily found in school (Behrendt & Franklin, 2014). It is a form of experiential learning that allows students to experience concepts discussed in textbooks firsthand and pick up new knowledge through interaction. As such, it carries a slew of benefits.

A field trip may be called instructional trips, and school excursions (Behrendt & Franklin, 2014). According to Myers & Jones (2009), field trips for studying science is a major component of the educational programming for both young and adults. Academic trips can be an integral part of teaching and learning process. Education field trips provide access to the students by experiencing the connection between concepts being studied in the class and actual world situation. It is more natural and rememberable technique that enables students to participate with mutual understandings outside the classroom. Educational field trips are designed with specific learning objectives as other program components.

Moreover, field trips are designed very often for the purposes of education which have been experienced by students outside the classroom (Tal & Morag, 2009). It is also very clear from different studies that the field trips are arranged for some objectives like: to provide personal experiences to the students, to promote interest and motivational factors regarding the subjects of science, to create interrelationships, to provide strong presentation and observation skills among students studying subjects of science, and to enhance social interactions (Behrendt & Franklin, 2014). In educational trips, students are taken to unique locations. Each student can learn through personal experiences. The connections are created between the theory and learning through experiences with previous first-hand experiences as well as learning from the institution (Lei, 2010).

Another important thing in field trip organization is that it helps to fill the gap between education and hands-on- experiences (Behrendt & Franklin 2013; Rennie, 2007). Science students through field tours fasten their learning skills to inspect and perceive theories in science by using five senses. Learners developed a positive attitude towards learning, motivating in doing practical works, and they can connect the educational concepts of learning at classroom level with the experience of field trips (Hudak, 2003). Field trips developed interest, curiosity, and motivation among students regarding the questions as well as answers, and discuss their experiences in group. When science students go on a trip, the location of field trips not only affects the students' learning but also enables them to gain knowledge about their environment, and communities through traveling from the school to the field trip (Behrendt & Franklin, 2013).

According to Knutson & CAISE (2016), field trips in education are important in learning for sharing social experiences with others and provide the basis for science students to sum up and highlight novelty in things and it provides a foundation to identify the learning experience from study tour related to science. Among the many potential outcomes, the trips have been provided many opportunities to students for doing new experiences which can enhance interest and association in science and its results must be affective and science students are satisfied with more positive and pleasant feelings towards science learning. Students got a chance to explore their skills and personality in meaningful way through these kinds of schools' trips.

The process of learning through field trips is affected by many parameters like the structure of the trip, content knowledge, and interests of the science learners during the journey, the social dimensions of the visit, and students' sharing learning experiences during the field trips (Knutson & CAISE, 2016). According to Gormez (2014), Sociocultural theory has described that successful learning occurs in social environments. In the theory regarding sociocultural, the Zone of Proximal Development (ZPD) considered most important to understand concepts.

The engagement of students through real-life experiences, physical objects, and other people with learning enables them to understand clearly (Vygotsky, 1987). According to Frost (2007), students had been interactive with each other during trips and they share their knowledge. Students learn more when they view all those elements with their five senses rather than what they are explained in the conventional process of education. They can realize that printed text is also real in the world. Educational field trips facilitate students as entertainment, motivator, and opportunities to discover new things and thoughts. Students can learn better in fun and activity-based teaching. Field trips serve the students to learn with the combination of fun and enjoyment and with realization what they already know through their books. Field trips explore for the students that they can evaluate the learning and its implementations in real-life situations.

Educational field trips also encourage students to learn in a team, collaboration, and in community as students experience trips in the form of groups. Students explore new venues and an environment for learning. This method takes a great deal to work with energy and expose the new horizons that students' value in relation to science (Frost, 2007). Science subject involves with

creative learning process to solve problems, make connection among concepts, conduct experiments, draw hypothesis, make conclusion, paramount of extending present knowledge of science (Stephens, 2009).

Impact of field trips on student's performance

Academic Impact: A well-organized field trip is a foremost example of knowledge transfer. The new layers of thought acquired by students through observation, interaction, and the narrative provided by guides and lecturers, can be applied to day-to-day scenarios, and this includes reaction papers and quizzes. Therefore, it helps them improve the retention of knowledge.

Promotes Hands-On Learning: Although connectivity in today's digital age has largely bridged the information gaps between students and subject matter not found in the classroom, experiencing new concepts or activities firsthand brings forth knowledge that is not fully encapsulated by non-tactile media. As learners get to engage with subjects in various ways, potentially assigning sensory interactions to each, which can serve as mental markers.

Lessons can also be presented in different modalities, with the instructors not restricted to the confines of textbooks and digital media. For instance, interactive science museums can be organized into sections that students can visit in a particular order to simulate the concepts discussed in class. Teachers or guest lecturers play an active role as they direct the experience in its entirety, accounting for the important points to take note of and ideas to ponder on, somewhat akin to the manner in which tour guides disseminate information.

Reinforces Cultural Growth and Personal Development: Museums are one of the primary destinations of field trips and for good reason. Each painting and installation is a portal to a specific time, location, and set of socioeconomic conditions, any of which potentially influencing how a piece was rendered in an artist's mind. This line of thought serves as a lens through which artworks are viewed and analyzed. Students may not know of this or might not know how to apply this had they not gone to a museum or a gallery for their field trip.

Increases Student Engagement: Any new concept might not register in the minds of students if they do not find it engaging, relatable, or applicable to their lifestyles. With this, field trips break the barrier of apathy by allowing students to freely interact with subjects like significant objects, places, personalities, and processes. The excursions also sharpen students' observation and perception skills as they engage in sensory-based learning (Nabors et al., 2009) and gain a deeper understanding of the subject matter.

In addition, abstract classroom concepts can be viewed from a more holistic perspective (Berer, 2016). Unstructured ideas can take form through the lectures that accompany the points of interest in a visited site. This is particularly helpful to students who have trouble keeping up with the classroom discussions since they have tactile or relatable examples to go with the lectures. They would also recognize how certain concepts function in real life.

Speeds Up Succeeding Lectures: Field trips carry bulks of information that teachers can leverage as reference points during lectures (Kelly, 2019). Rather than fleshing out new bodies of knowledge, which takes a lot of time and effort, they can simply refer to relevant segments of the excursion and add more context to what the students experienced. Learners can likewise use the reference points when reviewing lessons as opposed to reading entire chapters.

Despite the number of excursions gradually decreasing (Greene et al., 2013), field trips hold more than enough educational value to be retained in school curricula. Studies and surveys have proven that a well-planned trip results in positive academic and developmental outcomes that students can leverage inside and outside of the classroom (Greene et al., 2013; Behrendt & Franklin, 2014; Whitesell, 2015). As a means of hands-on learning, the trips help students improve their observational skills, develop an affinity for art and culture, and be more engaged in their studies.

Theoretical Framework

Jean Piaget's Theory of Cognitive Development (1896-1980)

Jean Piaget (1896-1980), a Swiss psychologist, is best known for his pioneering work on the development of intelligence in children. His studies have had a major impact on the fields of psychology and education. In his work Piaget identified the child's four stages of mental growth.

In the Sensorimotor Stage, occurring from birth to age 2, the child is concerned with gaining motor control and learning about physical objects. In the Preoperational Stage, from ages 2 to 7, the child is preoccupied with verbal skills. At this point the child can name objects and reason intuitively. In the Concrete Operational Stage, from ages 7 to 11, the child begins to deal with abstract concepts such as numbers and relationships. Finally, in the Formal Operational Stage, ages from adolescence to adulthood, the child begins to reason logically and systematically.

From his observation of children, Piaget understood that children were creating ideas. They were not limited to receiving knowledge from parents or teachers; they actively constructed their own knowledge. Piaget's work provides the foundation on which constructionist theories are based. Constructionists believe that knowledge is constructed and learning occurs when children create products or artifacts. They assert that learners are more likely to be engaged in learning when these artifacts are personally relevant and meaningful (Constructivism, n.d.).

An important implication of Piaget's theory is adaptation of instruction to the learner's developmental level. The content of instruction needs to be consistent with the developmental level of the learner. The teacher's role is to facilitate learning by providing a variety of experiences. "Discovery Learning" provides opportunities for learners to explore and experiment, thereby encouraging new understandings (Kafia & Resnick, 1996). Opportunities that allow students of differing cognitive levels to work together often encourage less mature students to advance to a more mature understanding (Crossland, 2016). One further implication for instruction is the use of concrete "hands on" experiences to help children learn. Additional suggestions include:

- Provide concrete props and visual aids, such as models and/or time line;
- Use familiar examples to facilitate learning more complex ideas, such as story problems in math;
- Allow opportunities to classify and group information with increasing complexity; use outlines and hierarchies to facilitate assimilating new information with previous knowledge; and
- Present problems that require logical analytic thinking; the use of tools such as "brain teasers" is encouraged.

Huitt and Hummel (1998) asserted that only 35% of high school graduates in industrialized countries obtain formal operations and many people do not think formally during adulthood. This is significant in terms of developing instruction and performance support tools for students who are chronologically adults, but may be limited in their understanding of abstract concepts. For both adolescent and adult learners, it is important to use these instructional strategies:

- Use visual aids and models;
- Provide opportunities to discuss social, political, and cultural issues; and
- Teach broad concepts rather than facts, and to situate these in a context meaningful and relevant to the learner.

Table 1: Teaching Students Beginning to Use Formal Operations (Adolescence)

Principles	Application
Continue to use many of the teaching strategies and materials appropriate for students at the concrete operational stage.	-Use visual aids such as charts and illustrations, as well a simple but somewhat more sophisticated graphs and diagrams. -Use well-organized materials that offer step by step explanations.
Give students an opportunity to explore many hypothetical questions.	-Provide students opportunities to discuss social issues. -Provide consideration of hypothetical "other worlds."
Encourage students to explain how they solve problems.	-Ask students to work in pairs with one student acting as the problem solver, thinking aloud while tackling a problem, with the other student acting as the listener, checking to see that all steps are mentioned and that everything seems logical.
Whenever possible, teach broad concepts, not just facts, using materials and ideas relevant to the students.	-Use lyrics from popular music to teach, so as to reflect on social problems, and so on.

Educational Implications of Piaget's Theory

Piaget's theories have had a major impact on the theory and practice of education (Case, 1998). First, the theories focused attention on the idea of developmentally appropriate education—an education with environments, curriculum, materials, and instruction that are suitable for students in terms of their physical and cognitive abilities and their social and emotional needs (Elkind,

1989). In addition, several major approaches to curriculum and instruction are explicitly based on Piagetian theory (Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikart, 1984), and this theory has been influential in constructivist models of learning (Berk, 2001) summarizes the main teaching implications drawn from Piaget as follows:

A focus on the process of children's thinking, not just its products. In addition to checking the correctness of children's answers, teachers must understand the processes children use to get to the answer. Appropriate learning experiences build on children's current level of cognitive functioning, and only when teachers appreciate children's methods of arriving at particular conclusions are they in a position to provide such experiences.

Recognition of the crucial role of children's self-initiated, active involvement in learning activities. In a Piagetian classroom the presentation of ready-made knowledge is deemphasized, and children are encouraged to discover for themselves through spontaneous interaction with the environment. Therefore, instead of teaching didactically, teachers provide a rich variety of activities that permit children to act directly on the physical world.

A deemphasis on practices aimed at making children adultlike in their thinking. Piaget referred to the question "How can we speed up development?" as "the American question." Among the many countries he visited, psychologists and educators in the United States seemed most interested in what techniques could be used to accelerate children's progress through the stages. Piagetian-based educational programs accept his firm belief that premature teaching could be worse than no teaching at all, because it leads to superficial acceptance of adult formulas rather than true cognitive understanding (May & Kundert, 1997).

Acceptance of individual differences in developmental progress. Piaget's theory assumes that all children go through the same developmental sequence but that they do so at different rates. Therefore, teachers must make a special effort to arrange classroom activities for individuals and small groups of children rather than for the total class group. In addition, because individual differences are expected, assessment of children's educational progress should be made in terms of each child's own previous course of development, not in terms of normative standards provided by the performances of same-age peers.

Gagne's theory of instruction. (Gagne's nine events of instruction)

Gagne (1985) in Gagne, et al (2005) contended that instruction must consider the whole set of external factors such as environment, resources and management of learning activities which interact with internal conditions such as state of mind that the learner brings to the learning task, previously learned capabilities, and personal goals of the individual learner. Gagne's internal factors that other instructional designers did not consider are highly important set of factors that can affect academic performance of learners in one way or another. This is indicated by Reiser et al (2007) who comment: "Gagne's description of the various types of learning outcomes and the events of instruction remain cornerstones of instructional design practices. In his research, Gagne stipulated that instruction may be conceived as a deliberately arranged set of external events designed to support internal learning processes.

Gagne "described which instructional events were particularly crucial for which type of outcome, and discussed circumstances under which particular events could be excluded" (Ibid.). This implies that the events of instruction are not sequential and must not be followed in order of appearing but teachers may use them in a particular point and time, depending on classroom setting, nature of the topic, nature of the learners and many other variables that differentiate learning situations. Gagne's events of instruction involve nine activities namely Gaining attention, informing the learner of the objective, stimulating recall of prior learning, presenting the stimulus, providing learning guidance, eliciting performance, providing feedback, assessing performance and enhancing retention and transfer (Hanson and Asante, 2014; Ahmed, 2011; Gagne, et al 2005; Reiser and Dempsey, 2007; Joyce and Weil, 1996 & Tuckman and Monetti (2011). The Nine Events of Instruction are further elaborated in the light of existing theoretical framework:

Gaining Attention: Attention is defined by Slavin (2009 p. 160,) as "active focus on certain stimuli to the exclusion of others." Learner's attention in the teaching/ learning transaction is very important ingredient for effective learning, yet it is a limited resource. In order for effective learning to take place, students must give up actively attending to other stimuli, shifting their priorities so that other stimuli are screened out. Some basic ways of commanding attention of the learners include the use of novelty as is often done with animation, a demonstration or some unexpected events (Gagne, et al, 2005). Slavin (2009, p. 160 suggests that additional ways to gain

students attention in class include usage of cues that indicate "this is important" by raising or lowering voice to signal that critical information is about to be imparted, application of gestures, repetition and body position, introducing lesson with demonstration in order to engage students' curiosity and informing the learners that what follows is important.

Informing the learner of the objective: Objectives tell students what final performance is expected, a state which provides expectancy and curiosity among the learners. Gagne et al (2005) has it that "presenting students with learning objectives communicates an expectation of the knowledge and/ or skills they are expected to perform." It also argued that "students cannot tell when they have accomplished a learning task and experience the satisfaction of that accomplishment unless they know what final performance is expected of them" (Slavin, 2011). Therefore, this calls upon teachers in the instructional processes to clearly state specific objectives that their learners are intended to meet.

Stimulating recall of prior learning: Prior learning is the fundamental pillar of the idea of "from known to unknown." Tuckman and Monetti (2011) contend that "it is the old information and the new information combined that enables an attentive, expectant student to achieve mastery of a task." Slavin (2011) maintains that "new learning invariably builds on prior learning" and maintains that the success of new learning will depend on three factors: whether the necessary prior learning has already taken place, the student knows what prior learning to try to remember and apply and that the student can remember the necessary prior learning.

Presenting the stimulus: Stimulus (stimuli in plural) is an environmental condition that activates the senses. The senses of the learners must be activated for effective learning to take place (Slavin, 2009). It is "an activity or information that presents the content of what has to be learned" (Reiser et al. 2007). In an attempt to present the stimulus, "the teacher must determine what new stimulus information is required by an objective and how to present that new stimulus information so that students can perceive and retain it (Tuckman & Monetti, 2011).

Providing learning guidance: Guidance is an important practice that affects students' life and particularly their academic performance. Nyaga, Oundo and Kamoyo (2014) argue that guidance

and counselling services contribute to better growth of students' academic competence. They call for educational institutions to strengthen these services for holistic development of students and provide adequate physical and human resources that are crucial in promoting the provision of guidance and counselling services. Furthermore, they argue that employment of adequate numbers of professionally well-trained persons for guidance and counselling is of prime importance if guidance and counselling services need to excel in schools. Tuckman and Monetti (2011) have it that "to properly combine old and new information and to make it possible for the result to be entered into long-term memory, students must be given help or guidance." They also advise that teachers must plan the technique they will use to guide the learners in a given task and how they will present these techniques. "The essence of learning guidance is to provide support for learners in making connection between what they know and what is being learned" (Gagne, et al (2005).

Eliciting performance: This has to do with "opportunity to practice or otherwise perform what has been learned" (Reiser et al, 2007). "People learn to do well what they practice (Kauchak & Eggen, 2008). This suggests that students need to demonstrate to themselves and to their teachers that the new learning has occurred (Tuckman and Monetti, 2011). This is in harmony with Thorndike's law of exercise which states that if one exercises, the effect increases (Schunk, 2004). The teacher therefore, needs to elicit the learners to practice what has been taught in class in order to increase permanence in learning.

Providing Feedback: According to Kauchak and Eggen (2008), feedback means information about existing understanding that we use to enhance future understanding." He also postulates that feedback that follows performance closely in time affects behaviour far more than delayed feedbacks. This suggests that teachers need to give immediate feedback on what students have performed. Slavin (2009) views feedback in a mutual perspective when it refers to both information students receive on their performance and information teachers receive on the effect of their instruction. Effective instruction is therefore enhanced by feedback.

Assessing Performance: Evaluation is an act of paramount importance in the teaching-learning transaction. "No period of practical teaching is complete without some form of evaluation" (Farrant 1999). Assessment is "an opportunity to demonstrate what has been learned" (Reiser et

al, 2007). According to Hammill (1986) assessment is the act of acquiring and analyzing information about students for some stated purposes, usually for diagnosis of specific problems and for planning instructional programs. Purposes for assessing students include screening students to find those who need special assistance, to diagnose their problems, to identify their instructional needs, to document their progress in special programs and to provide information for use in research projects.

Enhancing Retention and Transfer: At this stage of Gagne's nine instructional events, learning knowledge and skills have been learned and what follows is to enhance retention and transfer of learning. While retention is all about preventing forgetting and enhancing the learner's ability to recall the knowledge or skills at the appropriate time, transfer of learning sets some variety of new tasks for the learner, tasks that require the application of what has been learned in situations that differ substantially from those used for the learning itself (Gagne, et al (2005). This suggests that ability to recall is not enough. What is needed is ability to transfer ability to perform similar tasks while learning can take place without teaching, effective learning is a result of effective instructional design. Unless teachers design their instructional activities properly, effective learning will be minimal or may not take place at all. Therefore, Gagne's nine events of instruction need to be incorporated in the process of instructional design and actual teaching.

Empirical review

Ehirim, Iwuchukwu, and Okenyi (2020) investigated the availability and use of instructional resources in the teaching and learning of chemistry in senior secondary schools in Imo state's Owerri Municipal Council Area. Five schools were chosen using a basic random selection procedure, and 20% of the students were employed to provide a sample size of 168 chemistry students; nevertheless, all 32 chemistry professors were used because it was a reasonable quantity. The study used a descriptive survey approach, and the data was analyzed using a mean rating system. Many educational materials are accessible, but they are not being used effectively, according to the research. In the teaching and learning of chemistry, chemistry teachers do not appropriately innovate instructional materials

Lawal, Rumah, and Amadi (2020) looked into the use of instructional materials in teaching chemistry in Katsina's senior secondary schools. The research sample was selected using a random sampling procedure, which resulted in a total of twenty-four (24) chemistry teachers and three hundred and seventy (370) pupils. Both descriptive and inferential statistics were used to analyze the data collected. According to the findings, there is no substantial difference in the availability of instructional materials for teaching chemistry in senior secondary schools in Katsina metropolis. Ibe (2021) maintained that there was a significant difference in mean scores in a comparative study of secondary school Chemistry students taught with improvised instructional material and those taught with standard improvised instructional material in favour of those taught with improvised instructional material. He further opined that in as much that improvised instructional material improves academic retention of secondary school Chemistry students when compared with standard instructional material, that there is a significant different in academic retention of male and female Chemistry students who were taught with improvised instr2uctional material and standard instructional material in favour of male students .

In a comparative study carried out by Okwuduba and Okigbo (2018), the researchers observed that there was a significant difference when students were taught with cooperative learning strategy and think pair learning strategy in favour of those taught with think pair share learning strategy. The authors maintained that think pair share learning strategy enhances students' academic retention in Chemistry than cooperative learning strategy in Ogidi education zone. The above comparative studies reviewed were done outside the present scope of study. However, the researchers wish to investigate the comparative effect of teaching with improvised instructional materials and standard instructional materials on secondary school students' academic retention in Chemistry.

Ajayi, (2021) carried out a study to investigate whether three-dimensional puzzle-based instructional strategy could improve senior secondary students' engagement and academic performance in chemistry. A sample of 143 Senior Secondary 2 Students from 4 senior secondary schools in Makurdi Local Government Area of Benue State, Nigeria was used. The study adopted non-equivalent quasi-experimental research design. The instruments used for data collection were Chemistry Engagement Questionnaire (CEQ) and Chemistry Performance Test (CPT) with the

reliability values of 0.89 and 0.93 using Cronbach Alpha and Kuder-Richardson respectively. Four research questions and four null hypotheses guided the study. The research questions were answered using Mean and Standard Deviation scores while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance.

The study revealed that there is significant difference in the mean engagement and academic performance scores between students taught Chemistry using three dimensional puzzle-based instructional strategy and those taught using discussion method in favour of three-dimensional puzzle-based strategy [F(1,138) =2204.094, p<0.05], [F(1,138) =102.075, p<0.05]. It is found that there is no significant difference in the mean engagement and academic performance scores between male and female students taught Chemistry using three-dimensional puzzle-based strategy [F(1,67) = .402, P>0.050], [F(1,67) = .172, P>0.050]. It was recommended that three-dimensional puzzle-based instructional strategy should be adopted while teaching chemistry since it has been proved to be a viable option in enhancing students' engagement and academic performance for regardless of gender.

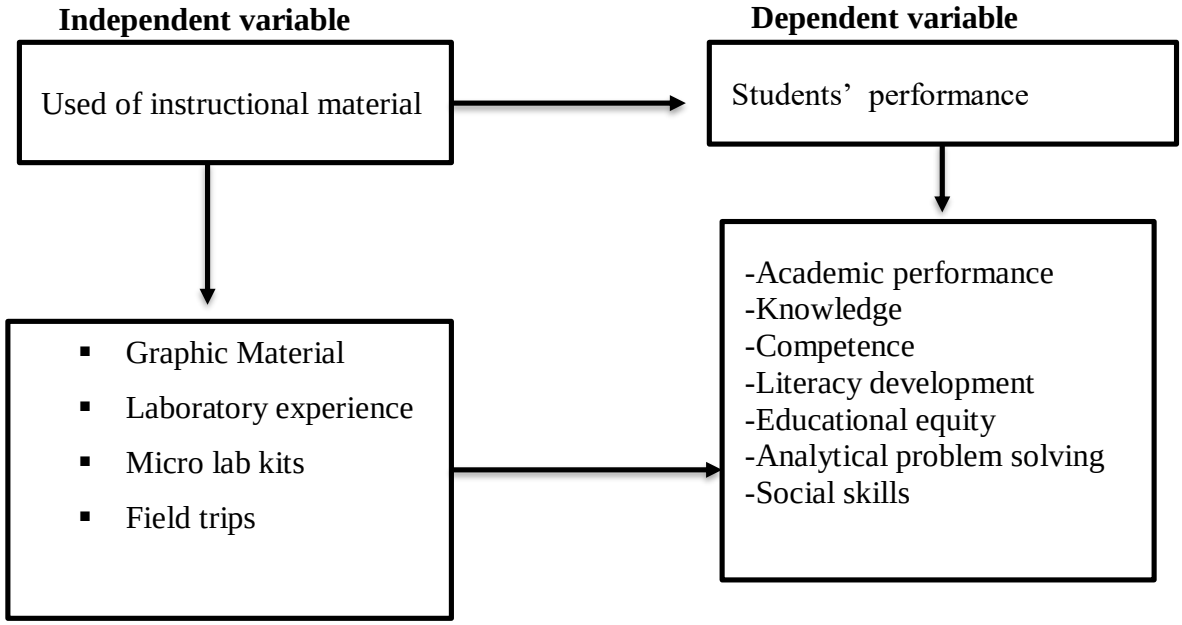
A study out by Samuel et al., (2020) which aimed at investigating the effects of videotape instructional package on students' achievement and retention of chemistry concepts, two hypotheses were tested. A total of 100 chemistry students from randomly selected schools divided into two groups were taught some concepts of chemistry using videotape package and traditional teaching methods. One of the groups formed the experimental group and the other formed the control group. The experimental group was taught chemistry using videotape package while the control group was taught the same concepts in chemistry using the traditional teaching method. The treatment lasted for four weeks for both groups. Pretest, post-test experimental- control group design was employed in carrying out the study. Pretest was first administered to determine, the level of equivalence of the two groups with respect to their prior knowledge of the concepts of chemistry and were found to be equivalent. After the treatment, a post-test was administered to both groups to evaluate the effect of treatment on students' performance. A post-test was administered, after four weeks to determine the retention of the concept of chemistry by experimental group. Data gathered were analyzed and tested at 0.05 level of significance. The results of the findings revealed that the use of videotape instructional package for learning

chemistry significantly improved achievement of students compared to the traditional method. The use of videotape instructional package enhanced retention of the concepts of chemistry among the students and When videotape instructional package is used in chemistry teaching, students learn faster and retain more concepts.

Another study carried by Omwirhiren (2015) with the aim to determine how academic achievement and retention in chemistry is enhanced using the two instructional methods among SSII students and ascertained the differential performance of male and female students in chemistry with a view of improving student performance in chemistry. The study adopted a non-equivalent pretest, posttest control quasi-experimental design. A total of one hundred and eighteen senior secondary school II students in intact classes were chosen from three schools in Gboko Local Government Area of Benue State using purposive random sampling. The ages of the students ranged between 16-17 years. Data were collected using a 30- item multiple choice Chemistry Achievement Test (CAT), in organic chemistry. Students were assigned to a treatment and a control group. Three hypotheses were generated and tested which were tested at 0.05 level of significance.

The data obtained were analyzed using descriptive statistics, t-test, spearman's correlation coefficient and analysis of variance (ANOVA). There was significant difference in students performance when discussion and lecture strategies were used to teach chemistry (Fcal = 4.65 > Fcrit = 3.85 at $P < 0.05$). There was significant difference in the retention ability of students exposed to discussion and lecture method (rcal = 0.9786 > 0.2353 at $P < 0.05$). There was significant difference in the performance of male and female students in the two groups (tcal = 3.621 > tcrit = 2.000 at $P < 0.05$). The overall results showed that discussion instructional strategy significantly improved students' performance in chemistry better than the lecture instructional strategy. The study concluded that discussion enhanced better achievement and productivity than the lecture method. It was recommended that discussion method should be use to teach organic chemistry in Nigerian Senior Secondary Schools.

Figure 2:Conceptual Framework



Source: researcher 2023

The conceptual framework was design based of the review of literature and theories use in this study.

CHAPTER THREE: RESEARCH METHODOLOGY

Research Design

A descriptive survey design was employed for this study, and a regression prediction design was used to gather data. Using descriptive design designs and regression analysis, you can predict results and elucidate the effect of independent variables on the dependent variable. Researchers use the regression test to predict the effect of two or more variables or sets of scores (Creswell, 2012). According to Mbua (2003), a research design is a strategy that details information on a certain issue and should be gathered and processed. It is a broad framework that describes the steps that will be taken to collect the data needed to respond to the research question or hypothesis. Amin (2005) claims that a research design outlines the steps the researcher will take, from writing or creating the hypothesis to the final data analysis. Data is gathered using a quantitative approach to ascertain whether and how strongly the two variables affect each other (pedagogic supervision and teaching and learning process). At the end of this research, quantitative data was collected and analyzed, and the findings were generalized to the entire study population. With prediction design, researchers aim to predict outcomes by employing specific factors as predictors rather than merely associating variables. Therefore, prediction studies are valuable because they aid in predicting or anticipating future behaviour. For instance, the recruitment and retention of many teachers in an educational.

Area of Study

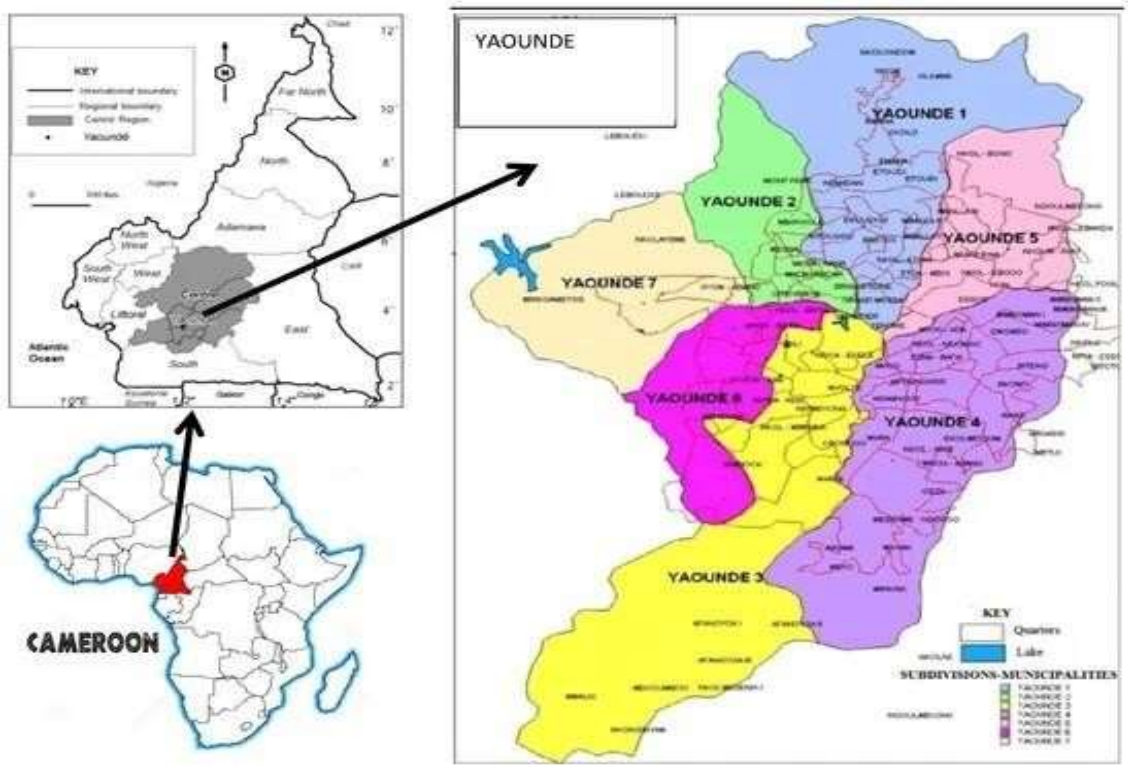
A research area is a physical site that is the locality, topography, and history where the research project is being conducted. This study was conducted in the Mfoundi Municipality of the Centre Region of Cameroon. The Mfoundi Municipality was purposively sampled. Mfoundi division is a department of Centre region in Cameroon. The department covers an area of 297 km2 and as of 2005 had a total population of 1,881,876. The department forms the Yaoundé capital and greater area. The department was created following Decree No. 74/193 of the March 11, 1974 separating it from the department of Méfou (today itself divided into Méfou-et-Afamba and Méfou-et-Akono).

The department has only one urban community: However, each of the 7 current boroughs has an urban borough council, elected headed by an urban borough mayor. The urban community covering the entire department makes it a community with a special status.

The department has 7 arrondissements:

1. Yaoundé I (Nlongkak)
2. Yaoundé II (Tsinga)
3. Yaoundé III (Efoulan)
4. Yaoundé IV (Kondengui)
5. Yaounde V (Essos)
6. Yaoundé VI (Biyem-Assi)
7. Yaoundé VII (Nkolbisson)

Figure 3: Map of Mfoundi Division



Source: Yaoundé urban council (CUY/2007)

Population of Study

According to Amin (2005), a population is the totality of all the components relevant to certain research. When concluding a sampling study, the researcher is interested in the entirety or aggregate of things or people with one or more traits in common (Amin, 2005). Asiamah et al. (2017) believe that population members must share at least one common attribute. This characteristic qualifies participants as population members.

Target Population

The researcher intends to generalize the findings to this population. The target population, often known as the parent population, may not always be reachable to the researcher (Amin, 2005). For Asiamah et al. (2017), the set of people or participants with particular traits of interest and relevance is referred to as the target population, and it is the portion of the general population that remains after it has been refined. The researcher must therefore identify and exclude members of the general population who might not be able to share experiences and ideas in sufficient clarity and depth from the target population. The targeted population in the study are the upper-sixth students offering chemistry in selected high schools in the Mfoundi division.

Accessible population

This is the population from which the sample is actually drawn (Amin,2005). Asiamah et al. (2017) corroborate this by postulating that after eliminating every member of the target population who might or might not engage in the study or who cannot be reached during that time, the accessible population is then reached. The last group of participants is the one from whom data is gathered by polling either the entire group or a sample taken from it. If a sample is to be taken from it, it serves as the sampling frame. People eligible to engage in the study but unable to participate or would not be available at the time of data collection are referred to as the accessible population. The accessible population of this study is drawn from seven (05) schools where students of the English sub-system of education were targeted. The researcher, therefore, had access to 492 students drawn from the seven (05) schools, as seen below.

Table 2: Accessible population of the study

SN	Schools	Population
1.	G.B.H.S Emana Yaounde	105
2.	English High School Yaoundé	88
3.	Pi And Ju Anglo-Saxon International College Yaounde	68
4.	CHUO Bilingual Comprehensive College Carriere Yaounde	18
5.	G.B.H.S Mendong Yaounde	75
6.	Total	492

Source: Division of personnel, divisional delegation of secondary education 2023

The table above shows the accessible population, which is 492 in the targeted seven schools.

Sampling of the study

The sample of this research work was drawn from the accessible population of 492 students of the English- system of education from the five schools the researcher had access. A good sample is one that statistically represents the target population and is sizable enough to provide an answer to the research issue. Amin (2005) views a sample as a portion of the population whose results can be generalized to the entire population. The author adds that a sample can also be considered representative of a population. Majid (2018) corroborates this by asserting that because the community of interest typically consists of too many people for any research endeavour to involve as participants, sampling is a crucial tool for research investigations.

In the study area, 5 secondary schools were randomly selected for data collection, and in each school, the sample size was determined using stratified sample technique select students who filled the questionnaires. The population that was studied comprised of both sexes regardless of age, literacy levels and also included persons with disabilities who are stakeholders in education provision. The total number of respondents were 285.

Sample size

The sample size was determined using Krejcie & Morgan table (1970), which constituted 285 students drawn from five schools representing the seven sub-divisions in Mfoundi. They were drawn in such a way that all students should be represented. The sample size for each school was obtained using the formulas below

$$\text{Sample size} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

Z= is the Z-score
e= is the margin of error
N=is the population size
P= is the population proportion
The sample sizes were obtained to be as follows in the table below:

Table 3: sample size of students per schools

SN	Schools	Population	Sample size
1.	G.B.H.S Emana Yaounde	105	80
2.	English High School Yaoundé	88	70
3.	Pi And Ju Anglo-Saxon International College Yaounde	68	56
4.	CHUO Bilingual Comprehensive College Carriere Yaounde	18	16
5.	G.B.H.S Mendong Yaounde	75	63
6.	Total	492	285

Source: The researcher 2023

Sampling technique

Every research involves, to some degree or another, a sampling process. Sampling is one of the most important steps in research; it will lead to valid results when carefully done. Sampling is a process of selecting representative portions of a population that permits the researcher to make utterances or generalizations concerning the said population. It can also be the process of selecting elements from a population so that the sampled elements selected represent the population. Sampling is involved when any choice is made about studying some people, objects, situations, or events rather than others. A good sample should be representative of the population from which it was extracted. Regardless of the sampling approach, the researcher should be able to describe the characteristics and relate them to the population (Amin,2005).

Sampling techniques refer to the various strategies a researcher uses to draw out a sample from the parent population of the study (Amin, 2005). There are two main sampling techniques; probability and non-probability techniques. The sampling technique suitable for this study is probability sampling, in which all the elements of the population have some probability of being selected. Probability sampling will provide a base for the researcher to generalize about the population.

The type of probability sampling technique employed in this research is simple random sampling (SRS). Amin (2005) opined that a simple random sample is a sample obtained from the population in such a way that samples of the same size have equal chances of being selected. The researcher proceeded through this method by selecting the accessible population comprising seven government bilingual high schools in Mfoundi. This was done through the random number method, in which Amin (2005) says if there are numbers that identify the elements of the population, then the random number method will be appropriate. The researcher proceeded as follows; The numbers 01,02,03…..11 were attributed to all the government bilingual high schools

in the Mfoundi division on folded pieces of paper in a basket. The researcher pleaded with two neighbours who randomly selected 2 and 3 schools each from the basket. These five schools were selected to represent the five schools used in the accessible population.

Through this technique, no school or students was left out, ensuring the representativeness of all government bilingual high schools in the Mfoundi division.

Instrument for Data collection

An instrument is any tool that has been methodically built to collect data and should be gathered accurately. The questionnaire is the tool utilized to gather data for this investigation. According to Amin's definition from 2005, a questionnaire is a professionally crafted tool used to gather data in line with the research questions and hypothesis requirements. He continues by saying that a questionnaire can be considered a self-report tool used to collect data on factors of interest in research. A questionnaire is a useful tool for gathering survey data, providing structured, frequently numerical data, being able to be administered without the researcher's presence, and frequently being comparatively simple to analyze, as Cohen et al. (2007) reiterated. It is a tool for gathering data with specific questions that the respondent must answer and then return to the researcher. There are two different kinds of questionnaires: closed and open-ended. The type of study is the only factor influencing the questionnaire selection. This study will use closed-ended questions, including Likert-style rating scales and dichotomous questions. These closed questions are simple to code and take little time to complete.

According to Creswell (2009), a questionnaire takes a quantitative approach to measure perceptions and provides data upon which generalizations can be made on the views of a given population on a particular phenomenon. This study's self-administered questionnaire was preferred, given that the targeted respondents could read and express themselves effectively. The researcher used a self-administered questionnaire to capture the students views on the use of instructional material on the teaching and learning of chemistry and it impact on student’s performance in some secondary schools in Mfoundi Division. It is a rigorous instrument prepared by the researcher about the research problem under investigation, which is to be used to collect

information from respondents. It consists of a carefully selected set of questions or statements requiring respondents' answers.

The collection of the research-developed questionnaire titled the use of instructional material on students' academic performance has two parts; A and B. Part A contains information on the personal data of the respondents, while part B contains twenty (20) statements built in four clusters A, B, C, and D. Cluster A of the questionnaire focused on the use of Graphic Material in the learning of chemistry. Cluster B of the questionnaire hinged on the use of Laboratory experience in the learning of chemistry. Cluster C of the questionnaire concentrated on the use of Micro lab kits in the learning of chemistry. Finally, Cluster D of the questionnaire addressed the use of Field trips in the learning of chemistry. This enables us to obtain information on the dependent variable, which is the actual problem.

Table 4 : Variables and statements

Variables	**Statements**
Use of graphic materials	1, 2,3, 4, 5
Use of laboratory experiences	6, 7, 8, 9, 10
Use of micro lab kits	11, 12, 13, 14, 15
Use of field trips	16, 17, 18, 19, 20

All the five-cluster had 5 (five) statements each, all relating to the research questions that guided the study. The response format for clusters A to B is based on a four-point scale of strongly agree (SA), Agree (A), Disagree (D) and strongly disagree (SD). In other words, the higher the aggregate scores on the rating scale, the more positive the response of the subjects and the lower the score, respondents indicated their level of agreement by ticking (√) on the rating scale.

Table 5: Questionnaire options and corresponding weights on the Likert scale

Option	Weight
Strongly Agree (SA)	4 Points
Agree (A)	3 Points
Disagree(D)	2 Points
Strongly Disagree (SD)	1 Point

The Table above shows how the questionnaire was weighted with the various options, from 4 points for SA to 1 point for SD.

Validation of the Instrument of data Collection

According to Amin ME (2005), Validation refers to the accuracy of the instrument in measuring what the researcher intends to measure. Validity refers to the measurement instrument and the level to which it saves the purpose of it design. The validity of the instrument can be affirmed with the reason that the questions were simple, understandable and easy for the respondents to answer. Face validity was adopted this was done by giving the initial draft of the questions to expert rates and were kindly requested to examine the adequacy of the statement relevance and suitability of language, structuring and sequencing of ideas and appropriateness of the instrument.

The comments and observations of these experts were used for modifications of the instrument. They modified some of the research questions and improved on the clarity of the questionnaire statements and the clarity of the response scale format of strongly Agree (SA), Agree (A), Disagree (D) and strongly Disagree (SD). Their comments were incorporated in the revised version of the questionnaire statements. Our method of distributing questionnaires to the respondent was face-to-face distribution. We later collected the questionnaire in on week. This was to give room for the respondents to take their time in filling the questionnaires without any inconvenience.

Face Validity

The questionnaire was carefully studied by specialists in instrument development and the supervisor in charge of the dissertation for examination and screening in case of any error. Some were adjusted, and maintained and others were disqualified.

Content Validity

The content validities of the instruments were determined by experts (lecturers/ researchers). These experts carefully reviewed all the items of the instruments and judgments concerning how well the items represent the intended content area. Their judgments were based on whether all the variables had items which adequately represent them in the right proportions. The items were meticulously scrutinized by four judges who ticked either Yes/No for each of the items, based on their expert view on whether the items are measuring the intended variables. A tick on (Yes) represented a content valid item while (No) represented an invalid item. The formula below was used in calculating the content validity index (CVI) for each of the items and the whole instrument.

$$\mathbf{CVI} = \frac{\textbf{Number of items declared valid by judges}}{\textbf{Total number of items}}$$

Table 6: Indices of content validity index (*Researcher survey 2022)*

S/N	Variable	No of items	No of Judges	Yes	No	CVI
1	Graphic Material	5	4	4		1.0
2	Laboratory experience	5	4	2	2	0.50
3	Micro lab kits	5	4	3	2	0.75
4	Field trips	5	4	4		1.0
	Overall content validity index					0.81

The content validity index was 0.81 indicating that the content relevant variance of the instrument was 81%.

Reliability of the research instrument

According to Yin (2003), reliability evaluates the quality of research and shows the collision of variation from the measurement of the results. Reliability refers to the consistency of a measure. A test is considered reliable if the same result repeatedly is produced. The purpose of reliability is to minimize the errors and biases in a research work. Reliability presents that the operations of the study, such as the data collection procedures can be repeated with the same result. Reliability of the research can be improved by taking some measurements to reduce the chances of errors that may lead towards inappropriate results. Questionnaire for empirical data collection are done at the same time for avoiding different results. The questionnaires are distributed only within the domain of interested group such as lecturers instead of the general population. To facilitate responding, the goal and the objective of the study is also included at the start of questionnaires.

The Cronbach's alpha was used to calculate the reliability of the instrument from the data collected from the pre-test with 20 participants and the reliability was obtained as presented below:

Table 7: Indices of internal consistency (*Researcher survey 2022)*

S/N	Variable	N	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
1	Graphic Material	5	0.86	0.97
2	Laboratory experience	5	0.88	0.97
3	Micro lab kits	5	0.86	0.97
4	Field trips	5	0.75	0.81
	Total	20	0.84	0.93

The internal consistency estimate was 0.84 indicating that the instrument was 84% reliable to collect data repeatedly.

Pilot Study

The researcher then conducted a pilot test in a school which did not constitute part of the sample. We did a pilot study because we wanted to develop and test the adequacy of the research instrument. The teachers responded and the internal consistency of the clusters were determined using Cronbach alpha which gave us a reliability of .84. The coefficient for the clusters was high enough for the study to realize the instrument because it reveals a complete understanding of the content of the questionnaire. This procedure ensures the content validity if the instrument. It might also give advance warning about where the main research project could fail, where research protocols may not be followed, or whether proposed methods or instruments are inappropriate or too complicated.

Methods of data collection

The researcher took authorization of research from the Dean of the Faculty of Science of Education from the University of Yaounde 1. He first of all went to the Centre Regional Delegation for Secondary Education of Mfoundi Division, where he carried out documentary research on statistics of teachers in the division. he went to the schools and obtain permission from the principals. The permission was granted. As far as the questionnaire administered were concern, they were distributed to all the students of the schools' concern and was collected after with a research confirmation signed by the principals of the respective schools. During the exercise, the researcher permitted the students to ask questions were necessary. At the end, most of the copies were collected. This gave a return rate of 90%.

The return rate of the instrument

The return rate indicates the number of questionnaires that were received at the end of the research after the questionnaires were administered to respondents. A total number of 300 questionnaires were administered to upper sixth student studying chemistry. Of the 300 questionnaires 270 participants responded to the questionnaire resulting to a 90% rate. This response rate was quite good and representative in addition.

$$R = \frac{\sum RQ}{\sum AQ} \times \%$$

Where;

R= Return rate

∑RQ= Sum of questionnaires returned

∑AQ=Sum of questionnaires administered

% = Percentage expressed as a hundred

The rate of return of questionnaires for this study was calculated as follows;

Total number of questionnaires administered = 300

Total number of questionnaires returned= 270

Therefore, return rate is = 300⁄270 * 100 = 90%

Methods of data analysis

This study made use of a method of data analysis by which each hypothesis is taken and material to answer or provide a test is provided. Consequently, A regression method was used. Data were presented using tables and descriptive statistics like percentages, frequencies, and means were used. Correlation as well as the statistically more advanced method of multiple regression analyses was used in data analyses.

A regression method was the main method used in this study. Regression methods form the backbone of much of the analyses in research. In general, these methods are used to estimate associations between variables, especially when one or more of these are variables are continuous. To answer the research question on how the independent variables, affect the dependent variables, a standard multiple regression analysis was conducted on the data in SPSS. The multiple regression analyses attempt to find out whether independent variables are able to predict the dependent variable and which of those independent variables is the strongest predictor of the dependent variable, in this case, teachers' effectiveness, and is, therefore, the most suitable analysis tool for the current research (Pallant, 2005).

The Extraneous Variable

The extraneous variable is any variable that if not controlled, can affect the experimental research outcome or result. In this study, the extraneous variable are the facilities for supervision, the behaviour of the supervisor, and rewards.

Expected Results

After having tested our variables, we expect to see whether Graphic Material, Laboratory experience, Micro lab kits and Field trips will have an influence on students performance in chemistry

The null hypotheses for this study are thus restated with the corresponding statistical tests:

- **H_{O1}:**The use of Graphic Material in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.
- **H_{O2}:** Laboratory experience in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.
- **H_{O3}:** The use of micro lab kits in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.
- **H_{O4}:**The use of field trips in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

The statistical analysis used to test the hypothesis was the simple linear regression. The simple linear regression analysis as the statistics statistical method used to test all the four hypotheses of this study and level of significance adopted for the analysis is $P \leq 0.05$. This level of significance formed the basis for retaining or rejecting the four null hypotheses.

CHAPTER FOUR: PRESENTATION OF RESULTS AND DISCUSSION

The purpose of this study was to assess the impact of the use instructional materials on students' performance in chemistry of some high schools in the Mfoundi Division, and this was further divided into four specific objectives as stated as follows: Examine the effects of Graphic Material on secondary school students' academic achievement in Chemistry. Explore the effects of laboratory experience on secondary school students' academic achievement in Chemistry. Investigate the effects of using micro lab kits on secondary school students' academic achievement in Chemistry. Examine the effects of field trips on secondary school student's academic achievement in Chemistry.

Gender of Respondents

The figure bellow present the frequency distribution of the participants and the results revealed that most participants were female (**f= 160, %= 59**) while male were less represented as compare to female (**f =110, %=41).** This indicates that females constitute the majority of the upper-sixth biology students.

Figure 4: Frequency distribution of the participants by gender

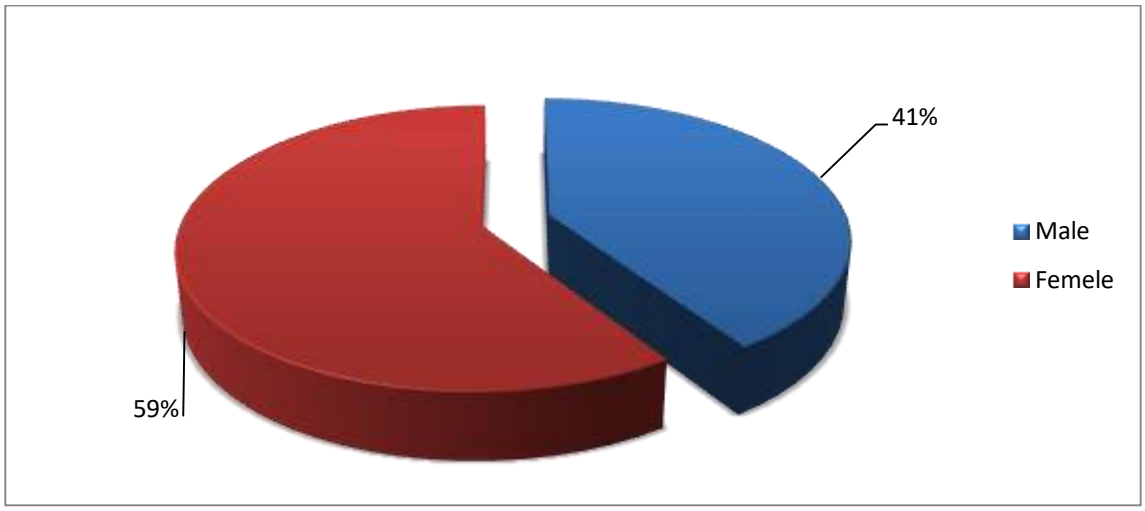
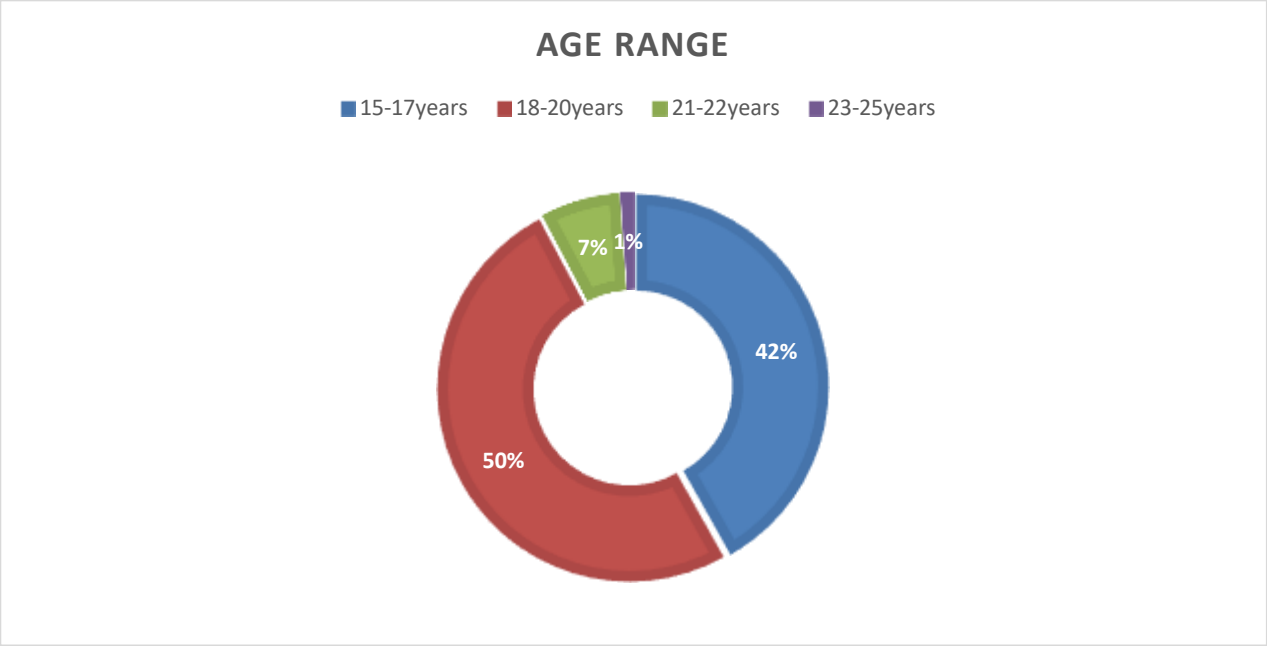


Figure 5: Frequency distribution of participants by age

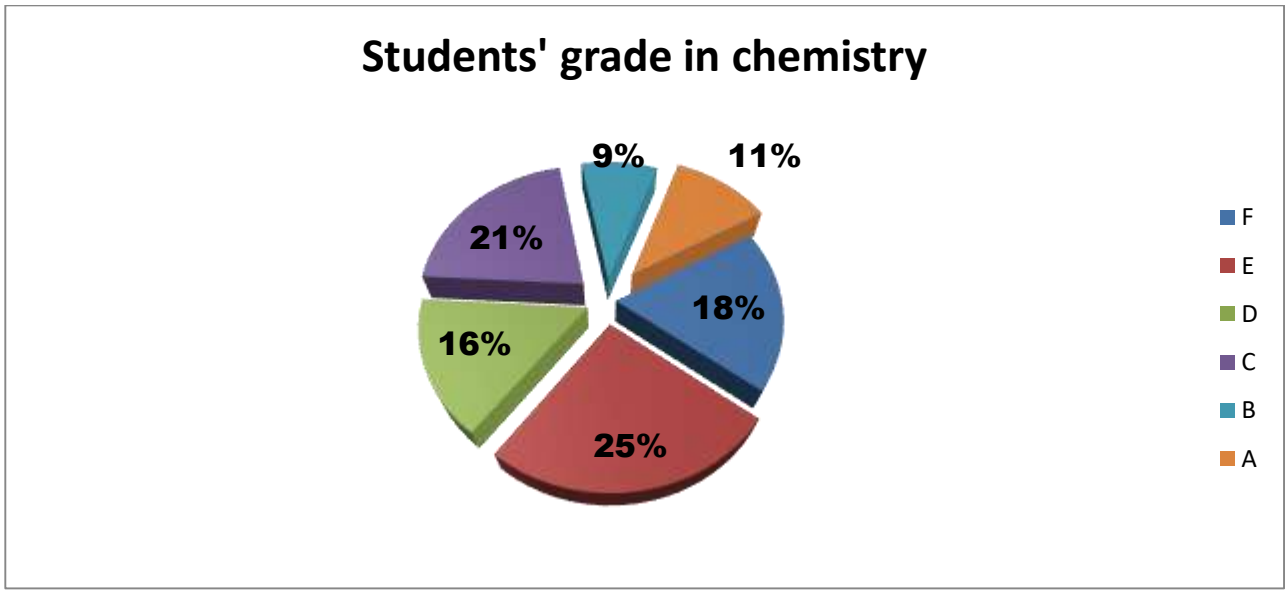


The respondents were asked to indicate their age group and the findings are as stipulated in the figure above. The findings reveal that most respondents were found to be in the age group 18-20 years and above **(f=136, %=50),** followed by the age group 15-17 years **(f=113, %=42)** and the age group 23-25years had the least number of respondents (**f=3, %=1**). These results showed that the majority of the participants were very young which could be an advantage to the use of the instructional material.

Student Performance at the Regional Mock

The figure below represents the frequency distribution of student performance at the chemistry regional mock. The results of the analysis shows that the overall performance of the students at the regional mock was good as the majority of them passed the mock that is 82% passed. The results specifically revealed that the majority of the participants had an E grade (25%), followed by those who had D grade with a 21% passed. The results showed that very few had A and B grades. From the results above it can be clearly deduced that instructional materials has a positive effect on chemistry students' performance in school.

Figure 6: Chemistry students' performance at the regional mock.



Result Based on Research Questions

This section will present the results of the analysis based on the research questions. Four research questions were formulated for this study as presented below:

Student's use of Graphic materials

Table 8: Student's use of Graphic materials

Items		Strongly disagree	Disagree	Agree	Strongly Agree
I1	I find it easy to use the various graphic materials	13	51	142	64
I2	I know to extract quality information from pictures and charts to better understand chemistry lessons.	12	60	142	56
I3	I know how to read chemistry textbooks and make summary for better comprehension.	8	36	147	79
I4	I use periodic table with no difficulty to make my summaries.	16	61	93	100
I5	I am acquainted with the various laboratory equipment like glassware, pipettes, clamp stand etc.	25	17	113	115

Table 8.0 above represents the descriptive analysis of the Student's ability to use the various types of instructional material. Five items were developed in order to respond to the question on the

effects of graphic material and student academic performance. The results of the analysis revealed that for items one (I1), the majority of the participant affirmed (142) that they find it easy to use the various types of chemistry graphic materials during learning period. The results also revealed that for item two (I2) most participants agree 142(%) that they knew how to extract quality information from pictures and charts to better understand chemistry lessons. For item three (I3) the majority agree 147(%) that they knew how to read chemistry textbooks and make summary for better understanding. The result of the analysis revealed that for I4 most participants 100(%) strongly agree that they could use periodic table with no difficulty to make their short notes. Finally, item five (I5) revealed that most participants strongly agreed 115(%) that they were acquainted with the various laboratory equipment such as glassware, pipette, clamp stand etc. Based on the responses a good number of them asserted that they were able to use the various types of chemistry instructional materials and that have an effect on their performance.

Laboratory experience in the teaching and learning of chemistry

Table 9: Use of laboratory

Items		Strongly disagree	Disagree	Agree	Strongly Agree
I1	The school has all the necessary lab manual	25	51	101	93
I2	My school provides us with the necessary laboratory equipment for effective practical lessons	14	30	130	96
I3	We have a well-furnished lab in our school with the various types of instructional materials for chemistry	68	75	83	44
I4	I find it easy to access the various types of reagents in the chemistry lab.	25	93	117	35
I5	The various types of reagents recommended by the Government are cheap and easy to get in the bookshops around.	72	93	82	23

Table 9 above represents the descriptive analysis of the access to chemistry instructional material. Five items were developed in order to respond to the question on the effects of students' access to chemistry instructional materials and student academic performance. The results of the analysis

revealed that for items one (I1), the majority of the participant asserted (101) that The school has all the necessary lab manual. The results also revealed that for item two (I2) most participants agree 130(%) that their school provides them with the necessary laboratory equipment for effective laboratory practical lessons. For item three (I3) the majority agree 83(%) that they had a well-furnished library in our school with the various types of instructional materials in chemistry on the other hand a good number (75) of participants disagree about their school having a well-furnished library. The result of the analysis revealed further that for item four (I4) most participants 117(%) agree that they find it easy to access the various types of chemistry instructional materials. Finally, item five (I5) revealed that most participants disagreed 93(%) that the various types of instructional material recommended by the Government were cheap and easy to get in the bookshops around. Based on the responses a good number of them asserted that they had access to the various types of chemistry instructional materials and that have an effect on their performance.

The use of micro lab kits

Table 10: The use of micro lab kits and students' academic engagement

Items		**Strongly disagree**	**Disagree**	**Agree**	**Strongly Agree**
I1	The regular use of the use of micro lab kits makes learning real and improve understanding	7	9	113	141
I2	The use of micro lab kits make chemistry lessons easy for me	7	19	159	85
I3	The use of micro lab kits make learning chemistry lessons interesting to me	4	29	145	92
I4	The use of micro lab kits help me to understand difficult chemistry concepts easily.	4	34	151	81
I5	The use of micro lab kits materials have boosted my interest for chemistry	11	34	137	88

Table 10 above represents the descriptive analysis of the Instructional materials and students' academic engagement. Five items were developed in order to respond to the question on the effects of students' academic engagement and their academic performance. The results of the analysis revealed that for items one (I1), the majority of the participant strongly affirmed (141) that the use

of micro lab kits make learning real and improve their understanding. The results also revealed that for item two (I2) most participants agree 159(%) that the use of micro lab kits make chemistry lessons easy for them. For item three (I3) the majority agree 145(%) that the use of micro lab kits make learning chemistry lessons interesting for them. The result of the analysis revealed that for Q4 most participants 151(%) agree that the use of all the categories of the use of micro lab kits in teaching chemistry has increased their passion for the subject. Finally item five (I5) revealed that most participants agreed 137(%) that the use of micro lab kits has promote their appetite for learning. Based on the responses a good number of them asserted that the use of micro lab kits has increase their engagement for the chemistry lessons and that have positive effect on their performance.

Field trips and the use of field trips in teaching

Table 11: Field trips and the use of field trips in teaching

Items		**Strongly disagree**	**Disagree**	**Agree**	**Strongly Agree**
I1	The use of Field trips enable me to understand chemistry lessons better.	12	51	137	70
I2	Field trips provided for practical stimulate learning.	3	21	145	101
I3	I understand my chemistry lessons better when after going for Field trips.	10	49	142	69
I4	Learning has become very easy and effective because of Field trips	19	31	135	85
I5	The use of Field trips in teaching chemistry has improve my ability to understand the subject..	8	21	164	77

Table 11 above represents the descriptive analysis of the types of instructional materials and the use of field trips in teaching . Five items were developed in order to respond to the question on the effects of the use of field trips in teaching and their academic performance. The results of the analysis revealed that for items one (I1), the majority of the participant affirmed (137) that the use of pictures and charts enable them to understand chemistry lessons much easier. The results also revealed that for item two (I2) most participants agreed 145(%) that the Field trips provided for practical stimulate learning effectively. For item three (I3) the majority agree 142(%) that they understand their chemistry lessons better when Field trips are used in knowledge acquisition. The

result of the analysis revealed that for I4 most participants 135(%) agree that Learning's has become very easy and effective after Field trips to explain some chemistry concepts. Finally, item five (I5) revealed that most participants agreed 164(%) that Field trips in teaching chemistry has improve my ability to understand the subject. Based on the responses a good number of them asserted that the instructional materials have increased their retention of chemistry lessons and that have a positive effect on their performance.

Hypothesis testing

A hypothesis is a predicted answer to a research question or problem. In social science research, there are two types of hypotheses; the Alternative hypothesis (sometimes called secondary hypothesis) denoted Ha which represents the hypothesis that the researcher wants to verify and the statistical or null hypothesis denoted Ho. These hypotheses are generally formulated in terms of independent and dependent variables. During this research project, four research hypotheses were formulated as follows:

H_{A1}: The use of Graphic Material in teaching has a statistically significant effect on secondary school students' academic achievement in Chemistry.

H_{O1}: The use of Graphic Material in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

H_{A2}: Laboratory experience in teaching statistically significantly affects secondary school students' academic achievement in Chemistry.

H_{O2}: Laboratory experience in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

H_{A3}: The use of micro lab kits in teaching has statistically significant effects on secondary school students' academic achievement in Chemistry.

H_{O3}: The use of micro lab kits in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

H_{A4}: The use of field trips in teaching statistically significantly affects secondary school students' academic achievement in Chemistry.

H_{O4}: The use of field trips in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

Verification of research hypothesis 1 (RHo1)

H_{A1}: The use of Graphic Material in teaching has a statistically significant effect on secondary school students' academic achievement in Chemistry.

H_{O1}: The use of Graphic Material in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

The result is presented as follows:

Table 12: Model Summary Rho1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.254[a]	.065	.061	1.546

a. Predictors: (Constant), students' use of Graphic materials

The independent variable studied, explain that students' performance in chemistry is influence by 6.5% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates that Student's ability to use the various types of chemistry of graphic materials has a very weak influence on their academic performance and 93.5% of their academic performance is influence by other factors.). Also, there is a very weak positive relationship (r=0.254, SE=1.546) between the criterion and the predictor variables.

Table 13 ANOVA[a] of RH1

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	44.220	1	44.220	18.504	.000[b]
	Residual	640.465	268	2.390		
	Total	684.685	269			

a. Dependent Variable: students' performance at the regional mock

b. Predictors: (Constant), students ability to use graphic materials

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as (F(1, 268)=18.504, P <0.05. The P-value obtained indicated that were was a statistically significant influence of Student's ability to use the various types of chemistry graphic material over their academic performance. The result above reveals that the students' ability to use the graphic material is a strong predictor of students' performance in chemistry because they are linearly related.

Table 14 : Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.243	.551		-.441	.659
	The use of Graphic Material in teaching	.773	.180	.254	4.302	.000

a. Dependent Variable: students' performance at the regional mock

The simple linear regression model indicates that the independent variable (students' ability to use the graphic material) had a positive β coefficient. According to the regression equation established, students' ability to use graphic material at a constant of zero, students' performance in chemistry will be 0.254. The findings also reveal that every unit increase in students' ability to use the instructional material will lead to a 0.773 increase in students' performance in chemistry. At 5% level of significance and 95% level of confidence students' ability to use of graphic material had a 0.000 level of significance, which means it has a significance influence in students' performance in chemistry.

Verification of research hypothesis 2 (RHo2)

H_{A2}: Laboratory experience in teaching statistically significantly affects secondary school students' academic achievement in Chemistry.

H_{O2}: Laboratory experience in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

Table 15: Model Summary RHo2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.244[a]	.059	.056	1.550

a. Predictors: (Constant), Laboratory experience

The independent variable studied, explain that students' performance in chemistry is influence by 5.9% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates that Students' Laboratory experience has a very weak influence on their academic performance

and 94.1% of their academic performance is influence by other factors. Also, there is a very weak positive relationship (r=0.244, SE=1.550) between the criterion and the predictor variables.

Table 16: ANOVA[a] Rho2

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.676	1	40.676	16.927	.000[b]
	Residual	644.009	268	2.403		
	Total	684.685	269			

a. Dependent Variable: students' performance at the regional mock
b. Predictors: (Constant), Laboratory experience

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as (F (1, 268) =16.927, P <0.05. The P-value obtained indicated that were was a statistically significant influence of Students' Laboratory experience to chemistry over their academic performance. The result above reveals that the students' Laboratory experience is a strong predictor of students' performance in chemistry because they are linearly related.

Table 17: Coefficients[a] Rho2

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.230	.462		.498	.619
	Access to instructional materials	.700	.170	.244	4.114	.000

a. Dependent Variable: students' performance

The simple linear regression model indicates that the independent variable (Students' Laboratory experience) had a positive β coefficient. According to the regression equation established, Students' Laboratory experience at a constant of zero, students' performance in chemistry will be .230. The findings also reveal that every unit increase in students' laboratory experience will lead to a 0.700 increase in students' performance in chemistry. At 5% level of significance and 95% level of confidence students' ability to use the instructional material had a 0.000 level of significance, which means it has a significance influence in students' performance in chemistry.

Verification of research hypothesis 3 (RHo3)

H_{A3}: The use of micro lab kits in teaching has statistically significant effects on secondary school students' academic achievement in Chemistry.

H_{O3}: The use of micro lab kits in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

Table 18 : Model Summary Rho3

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.166[a]	.028	.024	1.576

a. Predictors: (Constant), the use of micro lab kits

The independent variable studied, explain that students' performance in chemistry is influence by 2.8% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates the use of micro lab kits have a very weak influence on their academic performance and 97.2% of their academic performance is influence by other factors.). Also, there is a very weak positive relationship (r=0.166, SE=1.576) between the criterion and the predictor variables.

Table 19 :ANOVA[a] Rho3

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.845	1	18.845	7.585	.006[b]
	Residual	665.840	268	2.484		
	Total	684.685	269			

a. Dependent Variable: students' performance

b. Predictors: (Constant), use of micro lab kits and students engagement

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as (F (1, 268)=7.585, P <0.05. The P-value obtained indicated that were was a statistically significant influence of the use of micro lab kits . The result above reveals that the students' academic engagement is a strong predictor of students' performance in chemistry because they are linearly related.

Table 20 : Coefficients[a] Rho3

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.467	.598		.781	.436
	instructional material and students' engagement	.505	.183	.166	2.754	.006

a. Dependent Variable: students' performance

The simple linear regression model indicates that the independent variable (The use of micro lab kits) had a positive β coefficient. According to the regression equation established, The use of micro lab kits at a constant of zero, students' performance in chemistry will be .467. The findings also reveal that every unit increase in the use of micro lab kits will lead to a 0.505 increase in students' performance in chemistry. At 5% level of significance and 95% level of confidence The use of micro lab kits had a 0.006 level of significance, which means it has a significance influence in students' performance in chemistry.

Verification of research hypothesis 4 (RHo4)

H_{A4}: The use of field trips in teaching statistically significantly affects secondary school students' academic achievement in Chemistry.

H_{O4}: The use of field trips in teaching has no statistically significant effects on secondary school students' academic achievement in Chemistry.

Table 21 : Model Summary Rho4

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.237[a]	.056	.053	1.553

a. Predictors: (Constant), the use of field trips in teaching

The independent variable studied, explain that students' performance in chemistry is influence by 5.6% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates that the use of field trips in teaching has a very weak influence on their academic performance and 94.4% of their academic performance is influence by other factors.). Also, there is a very weak positive relationship (r=0.237, SE=1.553) between the criterion and the predictor variables.

Table 22: ANOVA[a] Rho4

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	38.517	1	38.517	15.975	.000[b]
	Residual	646.168	268	2.411		
	Total	684.685	269			

a. Dependent Variable: students' performance at the regional mock

b. Predictors: (Constant), the use of field trips in teaching

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as ($F(1, 268)=15.975$, $P <0.05$. The P-value obtained indicated that were was a statistically significant influence the use of field trips in teaching over their academic performance. The result above reveals that the use of field trips in teaching is a strong predictor of students' performance in chemistry because they are linearly related.

Table 23.0 : Coefficients[a] Rho3

Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	Sig.
		B	**Std. Error**	**Beta**		
1	(Constant)	-.309	.608		-.507	.612
	the use of field trips in teaching	.776	.194	.237	3.997	.000

a. Dependent Variable: students' performance

The simple linear regression model indicates that the independent variable (the use of field trips in teaching) had a positive β coefficient. According to the regression equation established, the use of field trips in teaching at a constant of zero, students' performance in chemistry will be -0.309. The findings also reveal that every unit increase in the use of field trips in teaching will lead to a 0.261 increase in students' performance in chemistry. At 5% level of significance and 95% level of confidence the use of field trips in teaching had a 0.002 level of significance, which means it has a significance influence in students' performance in chemistry.

Summary of Findings

The following implications were made based on the findings of the study

Table 24: Implementation of findings of all the objectives

Variable	Pearson correlation	R square	Unstandardized Beta values	Significance	Decision
The use of Graphic Material	0.254	0.065	0.773	.000	The use of graphic material had a significant effect on the students' performance in chemistry
Laboratory experience	0.244	0.059	0.700	0.000	Laboratory experience had a significant effect on the students' performance in chemistry
The use of micro lab kits in teaching	0.166	0.028	0.505	0.006	The use of micro lab kits in teaching had a significant effect on the students' performance in chemistry
The use of field trips in teaching	0.237	0.056	0.776	0.000	The use of field trips in teaching had a significant effect on the students' performance in chemistry

CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This section presents the Discussion, conclusion and recommendations arrived at according to the researcher's findings and based on the data collected through the questionnaires. This work focused on assessing the influence of instructional materials on students' performance in chemistry in some selected secondary high schools in Mfoundi Division. The discussions are related to the literature reviewed and the results obtained from the findings. The study aimed at achieving the following objectives:

- Examine the effects of Graphic Material on secondary school students' academic achievement in Chemistry.
- Explore the effects of laboratory experience on secondary school students' academic achievement in Chemistry.
- Investigate the effects of using micro lab kits on secondary school students' academic achievement in Chemistry.
- Examine the effects of field trips on secondary school student's academic achievement in Chemistry

Discussion

Student's use of Graphic materials

The results of the analysis revealed that the majority of the participant affirmed (142) that they find it easy to use the various types of chemistry graphic materials during learning period. Most participants agree 142(%) that they knew how to extract quality information from pictures and charts to better understand chemistry lessons. Majority agree 147(%) that they knew how to read chemistry textbooks and make summary for better understanding. 100(%) of the participants strongly agree that they could use periodic table with no difficulty to make their short notes. Finally, most participants strongly agreed 115(%) that they were acquainted with the various laboratory equipment such as glassware, pipette, clamp stand etc. Based on the responses a good number of them asserted that they were able to use the various types of chemistry instructional materials and that have an effect on their performance.

The independent variable studied, explain that students' performance in chemistry is influence by 6.5% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates that Student's ability to use the various types of chemistry of graphic materials has a very weak

influence on their academic performance and 93.5% of their academic performance is influence by other factors. Also, there is a very weak positive relationship (r=0.254, SE=1.546) between the criterion and the predictor variables. The P-value obtained indicated that there was a statistically significant influence of Student's ability to use the various types of chemistry graphic material over their academic performance. The result above reveals that the students' ability to use the graphic material is a strong predictor of students' performance in chemistry because they are linearly related.

This study is supporting the idea of Ajayi and Angura (2017) who argued that one of the innovative teaching methods in which diagrams are used as the central focus is the Collaborative Concept Mapping Instructional Strategy which involves interactions during concept mapping process to create a shared understanding of previously studied concepts and construct knowledge. This method is a collaborative way of sharing ideas in which a group of students comes together to brainstorm, generate a pool of concepts or facts, which when put together, they eventually come up with a map that represents the thought of the group

Laboratory experience in the teaching and learning of chemistry

The majority of the participant asserted (101) that the school has all the necessary lab manual. The results also revealed that most participants agree 130(%) that their school provides them with the necessary laboratory equipment for effective laboratory practical lessons. The majority agree 83(%) that they had a well-furnished library in our school with the various types of instructional materials in chemistry on the other hand a good number (75) of participants disagree about their school having a well-furnished library. The result revealed further that most participants 117(%) agree that they find it easy to access the various types of chemistry instructional materials. Finally, most participants disagreed 93(%) that the various types of instructional material recommended by the Government were cheap and easy to get in the bookshops around. Based on the responses a good number of them asserted that they had access to the various types of chemistry instructional materials and that have an effect on their performance.

The independent variable studied, explain that students' performance in chemistry is influence by 5.9% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates that Students' Laboratory experience has a very weak influence on their academic performance

and 94.1% of their academic performance is influence by other factors. Also, there is a very weak positive relationship (r=0.244, SE=1.550) between the criterion and the predictor variables.

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as ($F(1, 268) = 16.927$, $P < 0.05$. The P-value obtained indicated that there was a statistically significant influence of Students' Laboratory experience to chemistry over their academic performance. The result above reveals that the students' Laboratory experience is a strong predictor of students' performance in chemistry because they are linearly related.

The study is also in lined with the work of many researchers in chemistry education. The laboratory learning environment provides unique learning opportunities and is effective in helping students construct their knowledge (Gupta, Hill, Valenzuela & Johnson, 2017; Lunetta, Hofstein & Clough, 2007), develop logical skills through inquiry (Dkeidek, Mamlok-Naaman & Hofstein, 2012; Hofstein & Mamlok-Naaman, 2011), and develop their psychomotor skills (Abdullah, Mohamed & Ismail, 2013; Imaduddin, Tantayanon, Zuhaida & Hidayah, 2020). Laboratory activities also encourage students to be positive and stimulate their communication and collaboration skills (Chabalengula, Mumba, Hunter & Wilson, 2009). Teaching chemistry without laboratory work activities is seen as only the transfer of factual information and laws without any in-depth knowledge construction process (Layton, 1990).

Students can practice what they have learned when they are learning with practicals. Students can participate in group work, work together with their fellows, and generate knowledge and different skills (Tesfamariam et al., 2014). Also, students can be able to see, touch, smell, and taste the product of the experiment. This act can raise their interest in chemistry, and they become motivated in learning chemistry. The whole teaching process is kind of learner centered as it involved the active participation of students. On the other hand, the second way of treatment is teaching without chemistry practical in the classroom. Students were passive recipients of knowledge, mainly listened to the teacher and copied notes without knowing how to practically relate concepts.

The use of micro lab kits

The results of the analysis revealed that majority of the participant strongly affirmed (141) that the use of micro lab kits make learning real and improve their understanding. The results also revealed

that most participants agree 159(%) that the use of micro lab kits make chemistry lessons easy for them. The majority agree 145(%) that the use of micro lab kits make learning chemistry lessons interesting for them. The result of the analysis revealed that for most participants 151(%) agree that the use of all the categories of the use of micro lab kits in teaching chemistry has increased their passion for the subject. Finally, most participants agreed 137(%) that the use of micro lab kits has promote their appetite for learning. Based on the responses a good number of them asserted that the use of micro lab kits has increase their engagement for the chemistry lessons and that have positive effect on their performance.

The independent variable studied, explain that students' performance in chemistry is influence by 2.8% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates the use of micro lab kits have a very weak influence on their academic performance and 97.2% of their academic performance is influence by other factors. Also, there is a very weak positive relationship (r=0.166, SE=1.576) between the criterion and the predictor variables.

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as ($F(1, 268) = 7.585$, $P < 0.05$. The P-value obtained indicated that the was a statistically significant influence of the use of micro lab kits. The result above reveals that the students' academic engagement is a strong predictor of students' performance in chemistry because they are linearly related.

Conducting small scale chemistry activities through the use of micro kits have been known to enhance students' conceptions not only in South Africa (Sebuyira, 2001) but also in Ghana (Hanson, 2014), Mozambique (Kombo, 2006), Tanzania (Mafumiko, 2008) and most of the Asian countries including Thailand, Japan, Taiwan and Indonesia (Tantayanon, 2016; Supasorn, 2015). When it was introduced to undergraduate students in a Ghanaian university who also had misconceptions about chemistry, it was found to enhance their cognition and academic performance (Hanson, 2014). Chemistry students who used them in hands-on activities made conceptual gains as they overcame their conceptual challenges in principles that guided the study of chemistry. In this way they were able to engage in a kind of reality as they observed the causes and effect of phenomena in different variables. These concrete illustrations enhanced their concept formation and subsequently, academic performance.

Field trips and the use of field trips in teaching

The results of the analysis revealed that majority of the participant affirmed (137) that the use of pictures and charts enable them to understand chemistry lessons much easier. The results also revealed that most participants agreed 145(%) that the Field trips provided for practical stimulate learning effectively. For item three (I3) the majority agree 142(%) that they understand their chemistry lessons better when Field trips are used in knowledge acquisition. The result of the analysis revealed that 135(%) participants agree that Learning's has become very easy and effective after Field trips to explain some chemistry concepts. Finally, most participants agreed 164(%) that Field trips in teaching chemistry has improve my ability to understand the subject. Based on the responses a good number of them asserted that the instructional materials have increased their retention of chemistry lessons and that have a positive effect on their performance. The independent variable studied, explain that students' performance in chemistry is influence by 5.6% by the independent variable, as represented by the R^2 in the table 7.0 above. This indicates that the use of field trips in teaching has a very weak influence on their academic performance and 94.4% of their academic performance is influence by other factors. Also, there is a very weak positive relationship (r=0.237, SE=1.553) between the criterion and the predictor variables.

The analysis of variance (ANOVA) was used to check the significant level. A significant regression equation was obtained as ($F(1, 268) = 15.975$, $P < 0.05$. The P-value obtained indicated that where was a statistically significant influence the use of field trips in teaching over their academic performance. The result above reveals that the use of field trips in teaching is a strong predictor of students' performance in chemistry because they are linearly related.

The process of learning through field trips is affected by many parameters like the structure of the trip, content knowledge, and interests of the science learners during the journey, the social dimensions of the visit, and students' sharing learning experiences during the field trips (Knutson & CAISE, 2016). According to Gormez (2014), Sociocultural theory has described that successful learning occurs in social environments. In the theory regarding sociocultural, the Zone of Proximal Development (ZPD) considered most important to understand concepts.

The engagement of students through real-life experiences, physical objects, and other people with learning enables them to understand clearly (Vygotsky, 1987). According to Frost (2007), students had been interactive with each other during trips and they share their knowledge. Students learn

more when they view all those elements with their five senses rather than what they are explained in the conventional process of education. They can realize that printed text is also real in the world. Educational field trips facilitate students as entertainment, motivator, and opportunities to discover new things and thoughts. Students can learn better in fun and activity-based teaching. Field trips serve the students to learn with the combination of fun and enjoyment and with realization what they already know through their books. Field trips explore for the students that they can evaluate the learning and its implementations in real-life situations.

Educational field trips also encourage students to learn in a team, collaboration, and in community as students experience trips in the form of groups. Students explore new venues and an environment for learning. This method takes a great deal to work with energy and expose the new horizons that students' value in relation to science (Frost, 2007). Science subject involves with creative learning process to solve problems, make connection among concepts, conduct experiments, draw hypothesis, make conclusion, paramount of extending present knowledge of science (Stephens, 2009).

Conclusion

Considering a number of findings made from this study, it is concluded generally that; teaching Chemistry with graphic materia has pronounced positive effect on the students' academic Achievements.

The study is also in lined with the work of many researchers in chemistry education. The laboratory learning environment provides unique learning opportunities and is effective in helping students construct their knowledge (Gupta, Hill, Valenzuela & Johnson, 2017; Lunetta, Hofstein & Clough, 2007), develop logical skills through inquiry (Dkeidek, Mamlok-Naaman & Hofstein, 2012; Hofstein & Mamlok-Naaman, 2011), and develop their psychomotor skills (Abdullah, Mohamed & Ismail, 2013; Imaduddin, Tantayanon, Zuhaida & Hidayah, 2020). Laboratory activities also encourage students to be positive and stimulate their communication and collaboration skills (Chabalengula, Mumba, Hunter & Wilson, 2009). Teaching chemistry without laboratory work activities is seen as only the transfer of factual information and laws without any in-depth knowledge construction process (Layton, 1990).

Students can practice what they have learned when they are learning with practical. Students can participate in group work, work together with their fellows, and generate knowledge and different skills (Tesfamariam et al., 2014). Also, students can be able to see, touch, smell, and taste the product of the experiment. This act can raise their interest in chemistry, and they become motivated in learning chemistry. The whole teaching process is kind of learner centered as it involved the active participation of students. On the other hand, the second way of treatment is teaching without chemistry practical in the classroom. Students were passive recipients of knowledge, mainly listened to the teacher and copied notes without knowing how to practically relate concepts.

Conducting small scale chemistry activities through the use of micro kits have been known to enhance students' conceptions. Chemistry students who used them in hands-on activities made conceptual gains as they overcame their conceptual challenges in principles that guided the study of chemistry. In this way they were able to engage in a kind of reality as they observed the causes and effect of phenomena in different variables. These concrete illustrations enhanced their concept formation and subsequently, academic performance.

The process of learning through field trips is affected by many parameters like the structure of the trip, content knowledge, and interests of the science learners during the journey, the social dimensions of the visit, and students' sharing learning experiences during the field trips (Knutson & CAISE, 2016). According to Gormez (2014), Sociocultural theory has described that successful learning occurs in social environments. In the theory regarding sociocultural, the Zone of Proximal Development (ZPD) considered most important to understand concepts.

The engagement of students through real-life experiences, physical objects, and other people with learning enables them to understand clearly (Vygotsky, 1987). According to Frost (2007), students had been interactive with each other during trips and they share their knowledge. Students learn more when they view all those elements with their five senses rather than what they are explained in the conventional process of education. They can realize that printed text is also real in the world. Educational field trips facilitate students as entertainment, motivator, and opportunities to discover new things and thoughts. Students can learn better in fun and activity-based teaching. Field trips

serve the students to learn with the combination of fun and enjoyment and with realization what they already know through their books. Field trips explore for the students that they can evaluate the learning and its implementations in real-life situations.

Educational field trips also encourage students to learn in a team, collaboration, and in community as students experience trips in the form of groups. Students explore new venues and an environment for learning. This method takes a great deal to work with energy and expose the new horizons that students' value in relation to science (Frost, 2007). Science subject involves with creative learning process to solve problems, make connection among concepts, conduct experiments, draw hypothesis, make conclusion, paramount of extending present knowledge of science (Stephens, 2009).

Recommendations

Based on the findings and conclusions from this study, the following recommendations were made: The government of Cameroon should ensure that, the increase of subjects in the schools should commensurate with the number of instructional materials allocated for each subject. This will pave ways for students to reach their highest possible academic achievement. The government of Cameroon should come up with a policy on provision of instruction materials in secondary schools to allow teaching/learning process take place easily. Students should always try their best to make use of available instructional materials where necessary to make their learning more interesting.

Secondly, the teaching of chemistry in secondary school should make use of the various types of instructional materials that students will effectively understand and learn the concept taught. It should be practical as the use of multiple types instructional materials play greater role in students 'achievement. It is suggested that regular meaningful workshop on instructional material usage for science student be conducted to improve and update their competence in learning.

REFERENCES

Abdulqudus M. (2015), Experimental methods of teaching business studies: Practical Approaches Beyond Lecturing. International Journal of Core Engineering & Management (IJCEM) vol.

Adesoji, F. A., & Raimi, S. M. (2004). Effects of enhanced laboratory instructional technique on senior secondary students' attitude towards chemistry in Oyo township, Oyo State, Nigeria. Journal of Science Education and Technology, 13(3), 377-385.

Ajayi, O.V. &Angura, T.M. (2017). Improving Senior Secondary Students' Retention, I Electrolysis Using Collaborative Concept Mapping Instructional Strategy, Greener Journal of Educational Research 7(6), 087- 092

Aksela, M. (2005). Supporting meaningful chemistry learning and higher-order thinking through computer-assisted inquiry: A design research approach. Helsinki: University of Helsinki.

Alkan, F. (2019). Examining the instructional materials' motivation of prospective chemistry teachers in the laboratory. SHS Web of Conferences, 66, 01006.

Amadioha S.W (2020) the importance of instructional materials in our schools an overview: Rivers State University of Science and Technology.

An Unpublished Thesis submitted to the School of Postgraduate Studies, NnamdiAzikiwe University, Awka.

Anike, M. (2020). A Study on Role of Diagrams in the Evaluation of Learning Outcomes of Secondary students in life science.

Arop, B. A., Umanah, F. I., & Effiong, O. E. (2019). Effect of instructional materials on the teaching and learning of basic science in junior secondary schools in Cross River State, Nigeria. Global Journal of Educational Research, 14(1), 67.

Aydin-Günbatar, S., & Demirdöğen, B. (2017). Chemistry Teaching Method Course for Secondary-Science Teacher Training. In A. J. Sickel & S. B. Witzig (Eds.), Designing and Teaching the Secondary-Science Methods Course (pp. 129–148). Sense Publishers.

Babalola, V.T. &Abdullahi, H.A. (2016). School administration and instructional Supervision of Secondary school Chemistry for students' academic Achievement Issues in ScientificResearch 1(3), 27-36.

Barak, M. and Hussein-Farraj, R. (2013). Integrating model-based learning and Animations for enhancing students' understanding of proteins structure and function.Res. Sci. Edu., (43), 619-636.

Barr, D. A. (2008). The leaky pipeline: Factors associated with early decline in interest in premedical studies among underrepresented minority undergraduate students. Academic Medicine, 83(5), 503-511.

Basit, T. (2003). Manual or electronic? The role of coding in qualitative data analysis. Educational Research, 45(2), 143–154.

Behrendt, M., & Franklin, T. (2014, January 8). A review of research on school field trips and their value in education. International Journal of Environmental and Science Education, 9 (3), 235-245.

Behrendt, M., & Franklin, T. (2014). A Review of Research on School Field Trips and Their Value in Education.

Bennett, J., Hogarth, S., & Lubben, F. (2003). A systematic review of the effects of context-based and science-technology-society (STS) approaches in the teaching of secondary science. EPPI- Centre and University of York.

Berer, S. (2016, January 9). The benefits of learning through field trips.

Bilgin, A. K., Yurukel, F. N., & Yigit, N. (2017). The effect of a developed REACT strategy on the conceptual understanding of students: 'Particulate nature of matter'. Journal of Turkish Science Education, 14(2), 65-81.

Bilgin, I., & Geban, O. (2006). The effect of cooperative learning approach based on conceptual change condition on students' understanding of chemical concepts. Journal of Science Education and Technology, 15(1), 31-46.

Bowler, L., & Large, A. (2008). Design-based research for LIS. Library & Information Science Research, 30(1), 39–46.

Braun, V., Clarke, V., & Weate, P. (2016). Using thematic analysis in sport and exercise research. In Routledge handbook of qualitative research in sport and exercise (pp. 213– 227). Routledge.

Broman, K., & Parchmann, I. (2014). Students' application of chemical concepts when solving chemistry problems in different contexts. Chemistry Education Research and Practice, 15(1), 516-529.

Buhatwa, J. A. (2014). The effect of laboratories in secondary schools on students' performance in science subjects [Doctoral dissertation, The Open University of Tanzania].

Canan, N. (2017). Use of graphic organizers in secondary Chemistry lessons, The Eurasia Proceedings of Educational & Social Sciences (7), 72-75

Chikendu, R.C., Obikezie, M.C.& Eke. J.A. (2021). Co-operative group learning strategy on secondary school student's achievement and retention in chemistry. GIS Business 16 (2) 127-138

Chikendu,R.C., Obikezie, M.C & Abumchukwu, A.A (2021). Challenge of effective teaching of chemistry in the secondary schools in Enugu state. International Journal of Research 8 (10) 106-117

Choppin, J., Roth McDuffie, A., Drake, C., & Davis, J. (2020). The role of instructional materials in the relationship between the official curriculum and the enacted curriculum. Mathematical Thinking and Learning, 1–26.

Cirenza, C. F., Diller, T. E., & Williams, C. B. (2018). Hands-On Workshops to Assist in Students' Conceptual Understanding of Heat Transfer. Journal of Heat Transfer, 140(9).

Cohen, L., Manion, L., & Morrison, K. (2007). Research methods in education (6th edn). Routledge.

Coll, R. (2014). Investigating first year chemistry learning difficulties in the South Pacific. Retrieved September 2017, from Chemistry web site:

Creswell, J. W. (2008). Educational research: Planning, conducting and evaluating quantitative and qualitative research. Upper Saddle River, NJ: Merril. Creswell, JW (2009). Research Design. Qualitative, and Mixed-Methods Approaches, 570–590.

Creswell, J. W. (2014a). Research design: Qualitative, quantitative, and mixed-methods approaches (4th ed). SAGE Publications.

Creswell, J. W. (2014b). Research design: Qualitative, quantitative, and mixed-methods approaches (4th edn). SAGE Publications.

Demircioglu, G., Ayas, A., & Demircioglu, H. (2005). Conceptual change achieved through a new teaching program on acids and bases. Chemistry Education Research and Practice, 6(1), 36- 51.

Dike, R.C. (2013). Impact of substituting standard materials with local materials on chemistry achievement and interest of senior secondary school students in Imo state Nigeria.

Ekpo J. (1992), safety education for senior secondary school chemistry students. Journal of science teachers association of Nigeria 27, (No. 9);104-109.

Enderly, P.J. & Leanne, R.B. (2016). Students lab manual for argument-driven Inquiry in Chemistry.

Engida, T. (2012). Development of low-cost educational materials for chemistry. Africa Journal of Chemistry Education. 2(1) 51-53.

Etiubon, R. U., & Udoh, N. M. (2017). Effects of practical activities and manual on science students' academic performance on slubility in Uruan local education authority of Akwa Ibom State. Journal of Education and Practice, 8(3), 202-209.

Etiubon, R.U. (2011). Employing technological resources to enhance students' Achievement in Chemistry. Journal of Education, 4(1), 230-239.

Etiubon, R.U. &Udoh, N.M. (2017). Effects of Practical Activities and Manual on Science Students' Academic Achievement on Solubility in Uruan LEA of AkwaIbom State. Journal of Education and Practice (3), 202-209.

Ezeliora, E.A., Ibe , N.F & Obikezie, M.C (2021). Comparative effect of teaching with improvised instructional material and standard instructional material on secondary school students' academic achievement in chemistry. International Journal of Research in Educati2on and Sustainable Development 1(8)27-40

Fani, T., & Ghaemi, F. (2011). Implications of Vygotsky's zone of proximal development (ZPD) in teacher education: ZPTD and self-scaffolding. Procedia-Social and Behavioral Sciences, 29, 1549–1554.

Fechner, S. (2009). Effects of context-oriented learning on student interest and achievement in chemistry education. Berlin: Logos Verlag Berlin GmbH.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). How to design and evaluate research in education. McGraw Hill.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410–8415.

Glassman, M. (2001). Dewey and Vygotsky: Society, experience, and inquiry in educational practice. Educational Researcher, 30(4), 3–14.

Gormez, I. (2014). The Effect of Field Trip Oriented Instruction on Ninth Grade Students' Achievement in Animal

Greene, J., Kisida, B., & Bowen, D. (2013, September 16). The educational value of field trips. The Journal, 14 (1).

Hallinen, J. (2011). STEM education curriculum. http://www.britannica.com/topic/STEM-education

Hanson, R. (2014). Using small scale chemistry equipment for the study of some organic chemistry topics- a case study in an undergraduate class in Ghana. Journal of Education and Practice, 5(18), 59-64.

Hanson, R. (2016). Using an embedded conceptual strategy to enhance students' understanding of Le Chatelier's summation of some stress factors on equilibrium position. International Journal for Cross Discilinary Subjects in Education (IJCDSE), 7(3), 2889-2899.

Hanson, R. (2017). Assessing the potential of worksheets as a tool for revealing teacher trainees' conceptions about chemical bonds. In C. A. Shoniregun, & G. A. Akmayeva (Ed.), CICE-2017 Proceedings (pp. 648-653). Mississauga, Canada: Infonomics Society.

Hanson, R., & Acquah, S. (2014). Investigating undergraduate chemistry teacher trainees' understanding of laboratory safety. Advances in Scientific and Technological Research, 1(1), 56-64.

Hayat, M., Hasan, R., Ali, S. I., & Kaleem, M. (2017). Active learning and student engagement using Activity-Based Learning. 2017 International Conference on Infocom Technologies and Unmanned Systems (Trends and Future Directions) (ICTUS), 201–204.

Hodson, D. (1990). A critical look at practical work in school science. School Science Review, 71(256), 33-40.

Hofstein, A., & Mamlok-Naaman, R. (2007). The laboratory in science education. The state of the art. Chemistry Education Research & Practice, 8(2), 105-107.

Hofstein, A., Eilkis, I., & Bybee, R. (2011). Societal issues and their importance for contemporary science education- A pedagogical justification and the state-of-the-art in Israel, Germany, and the USA. International Journal of Science and Mathematics Education, 9, 1459-1484.

Holstermann, N., Grube, D., & Bögeholz, S. (2010). Hands-on activities and their influence on students' interest. Research in Science Education, 40(5), 743–757.

Ibe, F.N. (2021). Comparative effect of teaching with improvised instructional material and standard instructional material on secondary school students' academic achievement and retention. [Unpublished dissertation Department of Science Education] Chukwuemeka Odumegwu Ojukwu University Uli Campus.

Ibe, N., Obikezie, M., Awka, & Chikendu, R. (2021). Effect of Improvised Instructional Materials on Chemistry Students' Academic Retention in Secondary School. International Journal of Research in Education and Sustainable Development, 19–31.

Ibrahim A. (2012). The role of the laboratory in the teaching of chemistry in Nigeria. Poster paper presented at Kano State Polytechnic.

Idika, M. 1. (2021). Effect of Visualized Case-Based Learning Strategy on Students' Academic Achievement in Chemistry in Ibadan Metropolis, Nigeria, African Journal of Teacher Education 10(1), 106-126

Ikwuanusi, E.N. (2011). Teachers' role in improvisation and effective instruction of junior basic science curriculum for students acquisition of self-reliance skills. Ibadan: Hern Publishers, Plc.

Jackson, K., Garrison, A., Wilson, J., Gibbons, L., & Shahan, E. (2013). Exploring Relationships between Setting up Complex Tasks and Opportunities to Learn in Concluding Whole-Class Discussions in Middle-Grades Mathematics Instruction. Journal for Research in Mathematics Education, 44(4), 646–682.

Jensen, J. L., & Lawson, A. (2011). Effects of Collaborative Group Composition and Inquiry Instruction on Reasoning Gains and Achievement in Undergraduate Biology. CBE—Life Sciences Education, 10(1), 64–73.

Justi, R., Gilbert, J. K., & Ferreira, P. F. (2014). The application of a 'model of modelling' to illustrate the importance of metavisualisation in respect of the three types of representation.

Kakure (2016), The Role of Chemistry in national Development; Journal of the Science Teachers Association of Nigeria 21, (No. 2); 7 – 17.

Kanellopoulou, E.-M., & Darra, M. (2018). The Planning of Teaching in the Context of Lesson Study: Research Findings. International Education Studies, 11(2), 67.

Kelly, M. (2019). Field trips: Pros and cons.

Khalil, M. K., & Elkhider, I. A. (2016). Applying learning theories and instructional design models for effective instruction. Advances in Physiology Education, 40(2), 147–156.

Khoiriyah, U., Roberts, C., Jorm, C., & Van der Vleuten, C. P. M. (2015). Enhancing students' learning in problem-based learning: Validation of a self-assessment scale for active learning and critical thinking. BMC Medical Education, 15(1), 140.

Kirman Bilgin, A., & Yigit, N. (2017). The investigation of students' responses to revelation of the relation between 'physical and chemical change' concepts and contexts. YYU Journal of Education Faculty, 4(1), 289-319.

Knutson, K., & CAISE. (2016). Field Trips Are Valuable Learning Experiences.

Ko, J., Sammons, P., CfBT Education Trust (Great Britain), Hong Kong Institute of Education (China), & University of Oxford (England), D. of E. (2013). Effective Teaching: A Review of Research and Evidence.

Koballa, T. R., & Glynn, S. M. (2007). Attitudinal and motivational constructs. In S. K. Abell, & N. G. Lederma (Eds.), Handbook of research on science education. Englewood Cliffs, NJ: Erlbaum Publishers.

Köller, H. G., Olufsen, M., Stojanovska, M., & Petrusevski, V. (2015). Practical work in chemistry and its goals and effects. Chemistry in Action, 106, 37-50.

Kombo, K. E. (2006). Implementation of microscience kits in a teacher training program through distance education. Enschede: University of Twente.

Korau, Y. (2006). Educational crisis facing Nigerian secondary schools and possible solutions. Ibadan, Nigeria: University of Ibadan, Faculty of Education.

Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.

Kristen, K.B., Malinda, W.G., Monica, D. & Kendra, M. (2017). Pedagogical Methods and Technology Used in Chemistry Secondary Education. Modern Chemistry &Application, 5(3), 223-226.

Lardi (2016), Laboratory Planning and Layout. Journal of Pure and Applied Science, 6 (No. 9); 206 – 213.

Lei, S. A. (2010). Field trips in college physics and ecology courses: Revisiting benefits and drawbacks. Journal of Instructional Psychology, 37(1), 42-48.

Locaylocay, J. R. (2006). Changes in college students' conceptions of chemical equilibrium. Amsterdam: Vrije Universiteit Printers.

Lui, A. (2012). Teaching in the Zone: An introduction to working within the Zone of Proximal Development (ZPD) to drive effective early childhood instruction. Children’s Progress, 1–10.

Machumu, H. (2011). The Growing Impetus of Community Secondary Schools in Tanzania: Quality concern is debatable.

Mafumiko, F. (2006). Micro-Scale Chemistry Experiments as a Catalyst for Improving the Chemistry Curriculum in Tanzania. Unpublished PhD Thesis, University of Twente, The Netherlands.

Mafumiko, F. M. (2008). The potential of micro-scale chemistry experimentation in enhancing teaching and learning of secondary chemistry: Experiences from Tanzanian classrooms. NUE Journal of International Cooperation 3, 63-79.

Mberekpe, A.C. (2013). Effects of students' improvised instructional materials on senior secondary school students' achievement in biology. Department of Science Education, Faculty of Education, University of Nigeria Nsukka.

Mertens, D. M. (2010). Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods (3rd ed). Sage.

Montgomery County Public Schools (2020). Fiscal Year 2020: Please provide a report on all field trips taken last year by school.

Muleta, T., & Seid, M. (2016). Factors affecting implementation of practical activities in science education in some selected secondary and preparatory schools of Afar region. African Journal of Chemical Education, 6(2), 123-142.

Mwangi, J. T. O. (2016). Effect of chemistry practicals on students' performance in chemistry in public secondary schools of Machakos and Nairobi counties in Kenya [Doctoral dissertation, University of Nairobi].

Myer, B., & Jones, L. (2018). Effective Use of Field Trips in Educational Programming: A Three Stage Approach.

Nabors, M.L., Edwards, L.C., & Murray, R.K. (2009). Making the case for field trips: What research tells us and what site coordinators have to say. Education, 129 (4), 661-667.

Navaneedhan, C. G. (2015). Visual, auditory and kinesthetic approach to enhance the information processing ability in teaching learning teaching chemistry. International Educational E-Journal, 4, 61-66.

Nbina, J. B., & Mmaduka, O. A. (2014). Enhancing chemistry teaching in secondary schools: An alternative teaching approach. AFRREV STECH: An International Journal of Science and Technology, 3(2), 127–135.

Nnoli, J.N. (2014). Teaching chemistry for creativity.the effect of the use of improvised organic reagents on students' achievement in chemistry.In Z.C. Njoku (Ed), 55th Annual Conference Proceedings of STAN (265-270). Ibadan: Hern, Publisher Plc.

Nworgu, B.G. (2015). Educational Research: Basic Issues and Methodology. Nsukka, University Trust Publishers.

O-saki, K. (2007). "Science and Mathematics Teacher Preparation in Tanzania: Lessons from Teacher Improvement Projects in Tanzania, 1965-2006. International Education Cooperation, 2(1), 51–64.

Obikezie Maxwell C., Eke Joy A. & Abumchukwu Angela A. Comparative effects of Teaching...

Obikezie, M.C & Abumchukwu, A.A (2021). Assessment of contemporary issues in development of chemistry teaching among secondary school chemistry teaching in Anambra state Nigeria. Unizik Journal of Educational Research and Policy Studies 7(3) 142-165

Obikezie, M.C., Abumchukwu, A.A & Chikendu, R.E (2021). Effect of contextual teaching-learning approach on studentss retention in chemistry in secondary schools in Anambra state. International Journal of Trends in Scientific Research and Development (IJTSRD) 5(3)404-408

Odigie, J.I (2011). Women in Biology Education; their improvisation ability in non- conducive working environment in AdeniranOgunsanya College of Education, Lagos. Annual Conference of Science Teachers Association of Nigeria, 46, 280-288. HEBN Plc.

Okendu, J.N., 2012.The Influence of instructional process and supervision on academic performance of secondary school students of River State, Nigeria. Journal of Academic Research International,.2(3).

Okoye, A. C. (2013). Teachers' knowledge of the content and activities of Basic Science Curriculum: Implications for MDGs. Proceedings of 54th STANAnnual Conference.

Okwuduba, E.N. & Okigbo, E2.C. (2018). Effect of teaching methods on students' academic performance in chemistry in Nigeria: Meta- analytic review. Bulgarian Journal of Science and Education Policy, 12(2), 418-434.

Olayinka A.B (2016) Effect of Instructional Materials on Secondary Schools Students' Academic Achievement in Social Studies in Ekiti State, Nigeria. World Journal of Education Vol. 6 No. 1 Sciedu Press.

Olubu, O. M. (2015). Effects of laboratory learning environment on students' learning outcomes in secondary school chemistry. International Journal of Arts & Sciences, 8(2), 507.

Omar, N., Mohammed, M. M. &Paimin, A.N. (2014). Dimension of Learning Styles an Students' Academic

Onajite G.O, Olaniyi O.N, Oyerinde D.O, Onyesom M., Aina M.A (2019), Teachers Utilization of Instructional Materials for Effective teaching of Business Studies in Junior Secondary Schools in Delta State. Mediterranean Journal of Social Sciences Vol. 10 No. 6.

Onasanya, S.A., &Adegbija, A. (2012). Practical handbook on instructional media (2nd Ed.). Nigeria: Graphon Publishers, Ilorin.

Oriade, T.L. (2008). An empirical study of the use of instructional materials in biology curriculum implementation: Unpublished M. Sc project Bauchi state university.

Ozmen, H., Demircioglu, H., & Demircioglu, G. (2009). The effect of conceptual change texts accompanied with animations in overcoming 11th grade students' alternative conceptions of chemical bonding. Computers and Education, 52(3), 681-695.

Pavešić, B. J. (2008). Science achievement, gender differences, and experimental work in classes in Slovenia as evident in TIMSS studies. Studies in Educational Evaluation, 34(2), 94-104.

Peetz, C. (2019). Inequities discovered in student field trips.

Pirttimaa, M., Husu, J., & Metsärinne, M. (2017). Uncovering procedural knowledge in craft, design, and technology education: A case of hands-on activities in electronics. International Journal of Technology and Design Education, 27(2), 215–231.

Prince, M. (2004). Does Active Learning Work? A Review of the Research. Journal of Engineering Education, 93(3), 223–231.

Prins, G. T., Bulte, A. M. W., & Pilot, A. (2018). Designing context-based teaching materials by transforming authentic scientific modelling practices in chemistry. International Journal of Science Education, 40(10), 1108–1135.

Rahman, T., & Spafford, H. (2009) Value of field trips for student learning in the biological sciences. In Teaching and Learning for Global Graduates. Proceedings of the 18th Annual Teaching Learning Forum, 29-30 January 2009. Perth: Curtin University of Technology.

Raines, D. (2014). Virtual field trips: An online learning experience.

Reeves, R., & Rodrigue, E. (2016, June 8). Fewer field trips mean some students miss more than a day at the museum.

Reeves, T. C. (2000). Enhancing the worth of instructional technology research through "design experiments" and other development research strategies. International Perspectives on Instructional Technology Research for the 21st Century, 27, 1–15.

Rizk, L. (2011). Learning by doing: Toward an experiential approach to professional development. Cairo, Egypt.

Samuel,N.N.C & Obikezie M.C (2020). Effect of contextual teaching-learning approach on students' achievement in chemistry in secondary schools in Anambra state, Nigeria. International Journal of Innovative Research & Development 9(12) 97-101

Schwichow, M., Zimmerman, C., Croker, S., & Härtig, H. (2016). What students learn from hands-on activities: HANDS-ON VERSUS PAPER-AND-PENCIL. Journal of Research in Science Teaching, 53(7), 980–1002.

Sebuyira, M. (2001). A trial introduction of RADMASTE microchemistry kits in chemistry practical at the University of Witwatersrand. South Africa: University of Witwatersrand.

selected secondary schools in South-Western Nigeria. Eurasian Journal of Science Review, 36(3), 336-341.

Sevian, H., & Talanquer, V. (2014). Rethinking chemistry: A learning progression on chemical thinking. Chem. Educ. Res. Pract., 15(1), 10–23.

Shana, Z., & Abulibdeh, E. S. (2020). Science practical work and its impact on high students' academic achievement. JOTSE, 10(2), 199-215.

Shneiderman, B. (1998). Relate-create-donate: A teaching/learning philosophy for the cyber-generation. Computers & education, 31(1), 25-39.

Sikandar, A. (2016). John Dewey and his philosophy of education. Journal of Education and Educational Development, 2(2), 191–201.

Stammes, H., Henze, I., Barendsen, E., & de Vries, M. (2020). Bringing design practices to chemistry classrooms: Studying teachers' pedagogical ideas in the context of a professional learning community. International Journal of Science Education, 42(4), 526–546.

STAN (1970), Curriculum Development News – Letters No – 2 – Chemistry Syllabus.

Stolk, M. J., Bulte, A., De Jong, O., & Pilot, A. (2012). Evaluating a professional development framework to improve chemistry teachers ability to design context-based education. International Journal of Science Education, 34(10), 1487-1508.

Supasorn, S. (2015). Grade 12 students' conceptual understanding and mental models of galvanic calls before and after learnibg using small-scale experiments in conjunction with a model kit. Chemistry Education Research and Practice, 16, 393-407.

Tantayanon, S. (2016). Small scale organic chemistry: My experiences in Asia. 24th IUPAC International Conference on Chemistry Education (ICCE) 2016 (pp. 55-56). Kuching, Sarawak, Malaysia: KIMIA.

Tera, A. R. (2018). Space science in high school. Journal of STEM 6(4) 2-15 WAEC (2018).

Tesfamariam, G., Lykknes, A., & Kvittingen, L. (2014). Small-scale chemistry for a hands-on approach to chemistry practical work in secondary schools: Experiences from Ethiopia. African Journal of Chemical Education, 4(3), 48-94.

Tobin, K. (1990). Research in Science Laboratory Activities: In pursuit of better questions and answers to improve learning. School Science and Mathematics 90. 403 – 418.

Tortosa, M. (2012). The use of microcomputer-based laboratories in chemistry secondary education: Present state of the art and ideas for research-based practice. Chemistry Education Research and Practice, 13, 161-171.

Tukur, 2019) A Summary of Research in Science Education, 71; 277 – 284.

Udogu, M.-A. E., & Enukora, E. (2017). The Efficacy of Locally Improvised Materials and Home Activities on Students Achievement and Retention in Chemistry. International Digital Organization for Scientific Research, 2(3), 30–41.

URT. (2010). Education sector development programme (2010-15). The United Republic of Tanzania.

Valdez, A. V., Lomoljo, A., Dumrang, S. P., & Didatar, M. M. (2015). Developing critical thinking through activity-based and co-operative learning approach in teaching high-school chemistry. International Journal of Social Science and Humanity, 5(1), 139.

Vos, M. A. J., Taconis, R., Jochems, W. M. G., & Pilot, A. (2010). Teachers implementing context-based teaching materials: A framework for case-analysis in chemistry. Chem. Educ. Res. Pract., 11(3), 193–206.

WAEC. (2014). Chief Examiners' Report- Chemistry. Accra: West African Examinations Council. WAEC. (2015). Chief Examiner's Report- Chemistry. Accra: West African Examinations Council. Yara, P. O. (2009). Students' attitude towards mathematics and academic achievement in some

Wambugu, P. W., & Changeiywo, J. M. (2008). Effects of mastery learning approach on secondary school students' physics achievement. EURASIA Journal of Mathematics, Science and Technology Education, 4(3), 293-302.

Wang, C. X. (2021). CAFE: An Instructional Design Model to Assist K-12 Teachers to Teach Remotely during and beyond the Covid-19 Pandemic. TechTrends, 65(1), 8–16.

Wood, C. (2006). The development of creative problem solving in chemistry. Chemistry Education Research and Practice, 7(2), 96–113.

Yazachew, A. T. (2015). Effective strategies for teaching Chemistry, International Journal of Educational research and review 3(3), 78-84.

APPENDICES

REPUBLIQUE DU CAMEROUN
Paix-Travail-Patrie
****
UNIVERSITE DE YAOUNDÉ I
****
FACULTE DES SCIENCES DE L'EDUCATION
****
DEPARTEMENT DE CUERRICULAR ET EVALUATION
****

REPUBLIC OF CAMEROON
Peace-Work-Fatherland
****
UNIVERSITY OF YAOUNDE I
****
FACULTY OF EDUCATION
****
DEPARTMENT CURRICULUM AND EVALUATION
****

APPENDIX A: STUDENT QUESTIONNAIRE

My name is Eric, a Master's Degree student in the faculty of education, at the University of Yaounde 1. As part of my course requirements, I am undertaking a research project on the **Impact of Instructional Materials on the Performance of Advanced level Chemistry students in Mfoundi Division**

Kindly fill this questionnaire that would take approximately ten minutes of your time. The questionnaire consists of six (6) sections and is designed for academic purpose. Your answers will be treated with utmost confidentiality.

Instructions: Please answer all the questions in section I below by placing a tick in the box that correspond to your answer. Sections II to VI elicit your opinion according to the four-point Likert scale of strongly disagree (SD) =1, disagree (D) =2, agree (A) = 3 and strongly agree (SA) = 4

SECTION I: Respondents Demographic Details

1. **Gender**
   - ☐ Male
   - ☐ Female
2. **How old are you? 15-17years ☐ 18-20years ☐ 21-22years ☐ 23-25years ☐**
3. **Indicate the name of your school……..**

……

SECTION II: Student's ability to use the various types of instructional material.

	STATEMENTS	SA	A	D	SD
i	I find it easy to use the various types of instructional materials				
ii	I know to extract quality information from pictures and charts to better understand chemistry lessons.				

iii	I know how to read chemistry textbooks and make summary for better comprehension.				
iv	I use video lessons with no difficulty to make my summaries.				
v	I am acquainted with the various laboratory equipment like glassware, pipettes, clamp stand etc.				

SECTION III: access to chemistry instructional material

		SA	**A**	**D**	**SD**
i	My parents were able to buy most of the instructional materials for chemistry lessons.				
ii	My school provides us with the necessary laboratory equipment for effective practical lessons				
iii	We have a well-furnished library in our school with the various types of instructional materials for chemistry				
iv	I find it easy to access the various types of instructional materials in chemistry.				
v	The various types of instructional material recommended by the Government are cheap and easy to get in the bookshops around.				

SECTION IV: Instructional materials and students' academic engagement

		SA	**A**	**D**	**SD**
i	The regular use of Instructional materials make learning real and improve understanding				
ii	Instructional materials make chemistry lessons easy for me				
iii	Instructional materials make learning chemistry lessons interesting to me				
iv	Instructional materials help me to understand difficult chemistry concepts easily.				
v	The use of various instructional materials have boost my interest for chemistry				

SECTION V: Types of instructional materials and the use of field trips in teaching

		SA	**A**	**D**	**SD**
i	The use of pictures and charts enable me to understand chemistry lessons better.				
ii	The reagents, real object and other concrete materials provided for practical stimulate learning.				
iii	I understand my chemistry lessons better when handout are used in knowledge acquisition.				
iv	Learnings has become very easy and effective as computers, slides and photographs are used to explain some concepts.				

v	The use of all the categories of instructional materials in teaching chemistry has improve my ability to understand the subject..				

SECTION VI: Regional Mock Performance
Students 'grade in Chemistry

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ F

Thanks for your cooperation

Appendix B

REPUBLIQUE DU CAMEROUN
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****
DEPARTEMENT OF CURRICULUM AND EVALUATION
****

The Dean

N° _____/21/UY1/FSE/VDSSE

AUTHORISATION FOR RESEARCH

I the undersigned. **Professor BELA Cyrille Bienvenu,** Dean of the Faculty of Education, University of Yaoundé I, hereby certify that **NJOMENY YEMTE Eric,** Matricule **20V3121,** is a student in Masters II in the Faculty of Education, Department: *CURRICULUM AND EVALUATION*, Specialty: *DEVELOPER AND EVALUATOR OF CURRICULUM.*

The concerned is carrying out a research work in view of preparing a Master's Degree, under the supervision of **Pr. NDI Julius NSAMI.** His work is titled « ***The impact of instructional materials on the performance of advanced level chemistry students in Mfoundi Division*** **».**

I would be grateful if you provide him with every information that can be helpful in the realization of his research work.

This Authorization is to serve the concerned for whatever purpose it is intended for.

Done in Yaoundé..... 15 DEC 2021

For the Dean, by order

Le Vice-Doyen

Prof. Auguste OWONO.KOUMA