TEACHING-LEARNING FACILITIES AND STUDENTS' PERFORMANCE IN CHEMISTRY IN SELECTED SECONDARY SCHOOLS IN KASESE MUNICIPALITY.

CLIVE MAATE

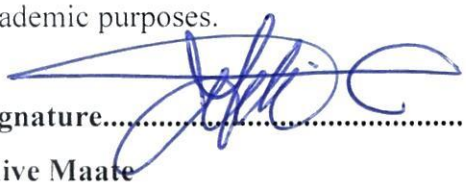
2016/PhD/024/PS

A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY OF MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY

APRIL 2023

DECLARATION

I, Clive Maate, hereby declare that the material provided in this thesis is entirely original and has never been submitted to another college or university for an award of any type in any field of study. It is also not a copy of any similar published work of another researcher for academic purposes.



Signature..... **Date**.....01/04/2023.....

Clive Maate

2016/PhD/024/PS

APPROVAL

I approve that this work is original and is up to the standard for the award of the degree of Doctor philosophy in educational planning and administration of Mbarara University of science and technolo

Signature..... **Date** ..1st /**April /2023.**

Associate Professor Adrian Mwesigye (PhD)

Supervisor

DEDICATION

This scholarly work is dedicated to my father retired Evangelist Samuel Katomera Mumbere and my mother Estheri Biira Mbahimba (Late) for their tireless efforts to see me rising to greater horizons; All my brothers, sisters, relatives and friends for bearing with the long hours of non-communication during my period of study and may God bless them abundantly. I will continue with my personal education motto "The hard way is the only way to go".

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LIST OF ABBREVIATIONS AND ACRONYMS

BOM Board of Management

CCE Co-operative Class Experiment

CVI Content Validity Index

DEO District Education Officer

GAO General Accounting Officers

KCE Kenya Certificate of Education

LoGs Local Governments

NYCC New York Comprehensive Centre

NPE National Policy on Education

NTCE National Technical Certificate of Education

MEO Municipal Education Officer

MDGS Millennium Development Goals

MoES Ministry of Education and Sports

MUST Mbarara University of Science and Technology

SESEMAT Secondary Science and Mathematics

SDGs Sustainable Development Goals

SPSS Statistical Package for Social Scientists

STR Students' Teacher Ratio

SWUF South Western Uganda Field

UACE Uganda Advanced Certificate of Education

REC Research Ethics Committee

ROU Republic of Uganda

USE Universal Secondary Education

UPE Universal Secondary Education

UK United King Dom

UCE Uganda Certificate of Education

UNCST Uganda National Council for Science and Technology

UNESCO Uganda National Education Scientific Culture Organisations

UNEB Uganda National Examination Board

UNEC Uganda National Examination Council

WAEC West African Examination Council

ABSTRACT

The low performance in chemistry subject at the ordinary secondary school level has been a matter of concern for educationists and several studies have been conducted with little emphasis on establishing the relationship between teaching-learning facilities and students' performance in chemistry. This study was guided by three objectives; to establish the effect of Teaching-Learning Facilities on students' performance in chemistry subjects in selected secondary schools in Kasese Municipality, to analyse the correlation between Teaching methods and students' performance in Chemistry subjects in selected secondary schools in Kasese Municipality, and to establish the effect of primary school background knowledge on students' Performance in chemistry in selected secondary schools in Kasese Municipality. A descriptive survey design using both quantitative and qualitative methods was employed where 325 participants responded to the self-administered questionnaire and 38 key informants responded to a semi-structured interview schedule. The response rate was 97.3%. Quantitative data were analysed using SPSS version 26 where descriptive inferential statistics and Bayesian statistics were significant in establishing the relationship between teaching-learning facilities and students' academic performance in chemistry subject. These results are in agreement with ecological system theory since teaching-learning facilities account for 33.5% when the f-ratio is 6.671, teaching methods account for 25.7%, other general factors account for 18.9%, students' background knowledge from primary school accounts for 33.4%, students attitudes 24.8% and combining the variables identified in the questionnaire all accounts for 75.3% while other variables not mentioned like school governance, parents household income, government policies and others account for the remaining 24.7%. Recommendations further studies should be done to establish the quality of science laboratories and the frequency of practical lessons in secondary schools. SeSamat program should be extended to primary schools since primary background accounts for 33.4%. This implies that salaries for primary school teachers should be enhanced.

CHAPTER ONE: INTRODUCTION

Introduction Overview

This study investigated the relationship between teaching-learning facilities and students' academic performance in Chemistry in selected secondary schools of Kasese Municipality. Teaching and learning facilities were perceived as the independent variable and student performance as the dependent variable. This chapter presented the background to the study, the statement of the problem, the purpose of the study, the specific objectives of the study, the research questions, the scope of the study, the significance, justification and conceptual framework.

Background of the study

The background of the study contained historical, theoretical, conceptual and contextual perspectives. The historical perspective showed the past and present overview of the variables, the theoretical perspective showed the theories employed in the study, the conceptual perspective gave the definitions of the key variables including their constructs or indicators and the contextual perspective showed the problem on the ground, which prompted the study.

Teaching-learning facilities and students' performance in chemistry is an old wish that is discussed in different countries; varies drastically. The physical conditions of high school buildings across the United States vary severely. While many schools boast state-of-the-art facilities, many others are unattractive, unhealthy, and even unsafe. Several reports show that over 53% of school facilities in the United States require improvements to be considered satisfactory. Likewise, the American Society of Civil Engineers (ASCE) gave a grade of "D" to the nation's schools due to their overall dilapidated conditions. At a minimum, much work

is needed to simply provide learning environments that are safe and comfortable for American children (Ford & Alsup, 2017; Jackson & Johnson, 2021). The teaching-learning facilities in the United States require huge amounts of dollars to improve them for schools to operate efficiently (Jackson & Johnson, 2021). The school facilities are interchangeably mentioned as teaching-learning facilities which are identified as predictors of students' performance in school (Ford & Alsup, 2017). These teaching-learning facilities directly affect the chemistry teaching-learning process. The specific learning facilities will affect the target subject such as chemistry, biology, physics and any other subject that may require laboratory facilities and textbooks.

The wave for global quality assurance policy that is originating from European Union has shown that both primary and secondary schools are fundamental to human resource development. The introduction and emphasis on STEM in Europe have allocated funds to enable more girls in the STEM sector to increase girls in the digital revolution in industries (Brett, 2021). It is further explained that by 2018 women in STEM 41% of scientists and Engineers. The European Union has provided finances to further improve women's education into a professional to pursue higher education and remove all burials, In this situation, teaching-learning facilities are provided to the women and girls so that they may freely utilize these resources for purpose of understanding. Chemistry in these science-oriented learning is a significant subject. A combination of chemistry and any other science becomes a preliminary level to allow students to freely join science professionals like engineers, human medicine and surgery, and aeronautics, to mention but a few (HLS-EU Consortium, 2012). In the European state members, science is emphasized but barriers are identified ranging from students' attitudes, tuition fees, academic performance, and school facilities. Teaching-learning facilities are a prerequisite for academic performance as both subject content-leading project-based learning and task-based learning all require laboratory experiments and

textbooks with help of the teacher as a facilitator in the learning process. Akpinar and Yalcin, (2023) assort that in the 21st Century, all economic development projects require STEM and for any country to compete favourably, STEM must be emphasized in primary, secondary and universities.

In Africa, agenda 2063 emphasize inclusive and quality education for purpose of improving the quality of the human resource. It is further suggested that harmonization of the curriculum is crucial for education. This explains why six universities with specialized professions are established across Africa.

African Union Commission proposed 2008 the creation of the Pan African University (PAU). The PAU involves the promotion, networking and development of programs and research centres within selected existing high-quality universities in the five geographic sub-regions, namely Northern, Western, Eastern, Central Northern and Southern Africa. Each sub-region will host a thematic component of the PAU which will be committed to selecting and networking high-quality centres developing similar programs and serve as a coordinating hub for those institutions (Lom, 2011; African Union, 2022).

Kenya's Jomo Kenyatta University of Agriculture and Technology has basic sciences, technology and innovation for East Africa, and in west Africa, the University of Ibadan in Nigeria is hosting life and Earth sciences. In Central Africa, the University of Yaounde 2 in Cameroon was chosen to host an institute of humanities, social sciences and good governance. North Africa finally settled on water, energy and climate change institute in Annaba in Algeria after the withdrawal of Libya (Lom, 2011). The South African Cape Peninsula the University of Technology (CPUT) won the opportunity to host the PAU Institute for Space Sciences, which is the fifth node of the PAU programs, representing the Southern Africa region (Space in Africa, 2019). The PAU in its advertisement to recruit

students in Masters and Doctoral programmes, science courses were most called for to signify that STEM should be emphasized in every member state.

The president of Uganda has set a "presidential initiative project" to support science and technology in the country was disclosed in 2009 at Makerere University (CEDAT.Mak.Univ, 2009). The president directed the ministry of education to include 25 billion in the budget for five years. Science and innovation require chemistry as a leading subject for all science combinations important for children in secondary and primary schools.

The challenge is striking the balance between teaching-learning facilities and student's performance in chemistry subject

Historical Perspective

The missionaries brought formal education to train children how to write and read emphasizing doctrine as a major concern to transform Africans from their traditional way of living (Ukessays, 2018). Education was always meant to prepare students for reading and numeracy to support the colonial administration by training clerks and interpreters (Anguma, Jurua & Asiimwe, 2012). Later, things like industrialization and globalization surpassed this purpose. The education system underwent numerous improvements during the industrial age in Africa, including but not limited to the addition of new topics, the building of school buildings, and the formation of school facilities including libraries, science laboratories, and other co-curricular facilities. Such changes were made to help students perform better so that they might excel and specialize in different fields (UKessays, 2018).

In the late nineteenth century, missionaries from Europe brought schooling to Uganda, primarily through the Church Missionary Society, the White Fathers, the Mill Hill Fathers, and the Comboni Missionaries (Pawlikova-Vilhanova, 2011). Before they became clerks and

other city workers, they initially educated the sons and daughters of chiefs (Anguma, Jurua & Assimwe, 2012). These church schools were the forerunners of modern, church-founded primary schools. According to the Education Policy Review Report (1989), the majority of youngsters attended unfunded tiny rural schools known as Church Schools (Government White Paper, 1992).

Regrettably, the colonial authority provided minimal financial assistance for the missions' educational activity to refute the premise made above (Akomolafe, 2016). However, the colonial authority was not entirely divorced from the administration of the schools' finances. Governments were primarily focused on providing funding to support the operation of the mission schools (Akomolafe, 2016). A panel headed by E. B. Castle was established by the Ugandan government in 1963, and it recommended combining primary and junior secondary schools. It prioritized quality at the primary level in addition to quantitative growth. The Castle Commission emphasized the importance of increasing girls' educational opportunities. In 1977, the government established a new commission with Senteza Kajubi as its chairperson to reform Uganda's educational system. However, due to the liberation war of 1978–1979, neither the findings nor the recommendations of the aforementioned Kajubi Commission were published (Mwesigye & Kitigaan, n.d). The commission was then accomplished in 1989 under the same chairperson Professor William Senteza Kajubi.

As a result, save from a few policy changes, Uganda's educational system has been structured following the 1963 Castle Commission Report on Education in Uganda. As a result, according to Juuko and Kabonesa (2007), the current system of education in Uganda has been in place since the time of the missions, but especially since 1965, when the recommendations of the aforementioned Castle Education Commission Report on Education were implemented. This illustrates how antiquated the system is and how urgently it needs to be

revised and updated. High demand for secondary education resulted from the adoption and execution of Universal Primary Education (UPE) in Uganda in 1997 as a means of achieving the second of the eight Millennium Development Goals (MDGs) (Uganda Education Statistical Abstract, 2009). Although much has been done to increase enrolment and access to secondary school education, the World Bank's report on education in African nations reveals that academic performance in Uganda has been very low for the previous decades of years and appears to be influenced by the quality of school infrastructural facilities. A crisis of high school dropouts and poor performance has hampered academic performance in the majority of secondary schools in Uganda (UNESCO, 2008).

Theoretical Perspective

The study was inspired by the ecological system theory of Bronfenbrenner the American Psychologist (Hofkitchner & Schafranek, 2011). The explicit presentation of a child's ecological environment to be a complex system with subsystems helps educators to understand the connections between teaching-learning environments and secondary school students' performance in Chemistry (German, 2015). The ecological System theory aims to elaborate on the qualities, rules, and laws that are inherent in all types of "systems, regardless of a particular sort, the nature of the parts, interaction, relations, or "forces" between them (Anderson, 2016). The ecological system theory stresses the five sub-systems that define the child's relationship with his environment; microsystem, exosystem, macrosystem, and chronosystem (Indira, 2004). In addition, the system is defined as a set of interconnected elements with ordered interactions. According to the systems theory, for learning to occur, teaching and learning facilities and their performance should be controlled appropriately (Andreae, 2011).

To achieve better academic performance, secondary school management must make sure that all components, including parental support, infrastructure, and teacher quality and quantity, are equally supported. This was something that is emphasized by the systems theory. The theory emphasises the importance of meeting the varied demands of the many functional sectors of the school to support teaching and learning. This results from the idea that a school is a system in and of itself, with subsystems like teaching and learning facilities. These amenities include classroom buildings, libraries, science laboratories and student academic resources. When these facilities are in use, several interactions between internal and external factors create a complicated interplay. A little change in one factor might have a significant impact on other factors (Leithwood & Schools, 2010). School laboratories are of benefit to learners and they must be seen as one cohesive system in which the adaptation is enhanced (Atubin, 2015; Akomolafe, 2016). The establishment of such educational facilities should treat everyone equally by offering enabling environment necessary to acquire the facilities that individuals should take advantage of educational chances and improve their school examination results. The national policies may remain rigid to provide enabling both political and economic environments in which educational institutions would thrive. The absence of ecological niche results in extinction or migration. However, in terms of education teachers' well-being and parents' well-being may equally influence learners' ecological environment. The ecological systems theory explicitly presents an understanding that several factors influence learners' academic performance in any of the subjects, especially subjects. The ecological system theory explicitly presents five major systems that interact to form an ecological system that all co-contribute to the prosperity of its members in the ecosystem. Ecosystem refers to the interacting system that encompasses a community and its nonliving, physical environment. The ecosystem services include important environmental services but are not limited to cleaning air to breathe, clean water to drink, and fertile soils in which to

grow crops, which ecosystems provide (Solomon, Berg & Martin, 2011). The five systems: microsystems, mesosystem, exosystem, macrosystem and chronosystem allow the learner to interact within an ecosystem (Ryan & Paquette, 2001). An ecological niche is the totality of an organism's adaptations, its use of resources, and the lifestyle into which it is fitted in its community. How the organism uses the resources in its environment and how it relates with other organisms within the ecosystem is dependent on the adaptation and factors influencing adaptation.

The microsystem has components like a child's home, family, community, school, culture, body, brain, emotional system, behaviour and spiritual or religion. The physical body of the learners influences her/ his activeness or participation in learning. For instance, a sickly child may not participate in organizing scientific experiments hence if he /she cannot use all her/his senses then the possibility of failing is high. The VARK model of learning styles suggests that there are four main types of learners: visual, auditory, reading/writing, and kinesthetic exist in the school setting hence all individuals must be inclusively planned for by the teacher (Munna & Kalam, 2022).

The body is supported by parents as they provide meals and other scholastic materials. The healthy mind in a healthy body is true with ecological system theory because good nutrition nourishes the body and health growth experienced. The child has got direct conduct with family, parents, teachers, neighbours, church, and other learners and his learning is greatly influenced by the interactions within this system known as the microsystem. At home, these members of the ecological system often interact with an individual more frequently than when comparing the mesosystem.

The mesosystem comprises extended relatives of the family, and school teachers that may not directly interact with learners. Society, community and family sometimes appear in both mesosystem and microsystem because they are wide in complexity (Ryan & Paquette, 2001). In the microsystem, the relationship has two directions impact the learner influences the activities of a teacher and the teacher influences the life of the learner. In the mesosystem, one organism influences more organisms in the ecosystem. Bronfenbrenner calls such interactions as bi-directional influences. For instance, the parent's belief may affect the behaviour or aspiration of the child. If the parents think that chemistry is hard, the child can also believe that chemistry is hard.

In the mesosystem, churches, schools, the child's teacher and parents can interact to plan for the child's learning experience at schools. The role of teachers in guiding the parents and learners remains significant for education. The poor relationship between parents and teachers can easily affect the child's education. However, this is not always true for everyone. This is why it is in the second closest system of the child's world.

Exosystem the child does not directly interact with the system. For instance, a parent's workplace can affect the well-being of the child. If the workplace is unfriendly and the parent is forced not to come home or not to get funds to pay for his/her children then they will be affected by the workplace. A transfer of station of work like one working and living with his family in Kasese and he is made to transfer to Gulu. His children will indirectly be affected as he will be forced to leave them behind.

The macrosystem involves the belief and culture of the parents like; previously girls were not allowed to study science because their education prepared them into good mothers (Anguma, Jurua & Asiimwe, 2012). Schools like Gayaza High school and Namagunga College were for girls while Budo and Namilyango were for boys. Cultural beliefs sometimes influence the

decision of the child or behaviour. Early marriages sometimes are associated with cultural beliefs. Children are affected by their parent's culture and customs and performance in class can be easily compromised by such beliefs (Ryan, 2001).

Chronosystem this system encompasses dimensions of time and space such as their relation to the child's environment. Elements in the system can be external like timing parents' death time when the child needs him/her most in terms of support at school. The issues like inflation and financial crisis countrywide like high prices of food, and other basic needs.

This environment is not under the mandate of the parents or child but they exist.

Bronfenbrenner sees instability and unpredictability within the microsystem which includes family, school, and community (Ryan & Paquette, 2001). It is from the background of the stable family that the child begins to associate with other children's people and groups where learning is taking place. It is therefore significant to think of the family. The interaction between the teachers and parents may have a lasting effect on the child's educational achievement in school. Parents interact with teachers under a mesosystem which makes the environment friendly for the child to learn. Their interaction is not directly in the first layer of the model but in the second layer of the ecological systems.

Systems theory emphasises on learner's ecological environment that has a home, community, neighbours, culture, parents, churches, other schools, and other variables allowing an organism to establish an ecological niche, learning outcome is expected to be high as factors influencing performance being abundant (Ryan & Paquette, 2001). Science teaching and learning in classrooms to boost the efficacy of Science instruction and promote students' learning (Anderman & Sinatra, 2012). Creating a learning environment for students that fosters their comprehension of science by co-constructing and negotiating ideas through meaningful peer and teacher interactions is the most crucial aspect of science teaching and

learning. The main components of the learning environment that have a significant impact on how secondary school learners construct their knowledge of chemistry as being the nature, quality, and frequency of Chemistry practical lessons (Mupa & Chinooneka, 2015). learning science takes from ecological systems theory with postulations that social contexts, such as whether a school is single-gender or mixed-gender in nature, have a significant impact on how pupils create their knowledge.

Education according to Vygotsky, society determines what is of interest to the learners (Hazma, 2019). The learner's achievement is influenced by his/her ability to find the solution to the problem. It is accepted that several trials or experiments establishing solution brightness the understanding and makes learners more knowledgeable than when solutions are given. The Vygotsky argument that learning happens when there is meaningful interaction between society and the environment is well-detailed in the ecological system theory. That is how people learn and the nature of knowledge is here explained. Each learner constructs meaning individually as he/she interacts with the environment. This explains why all learners in class do not achieve equally. This opens another epistemological view that knowledge is not independent of the learner it is the learner who creates knowledge. The meaning attached to nature and its changes is the learning the participant will have as his/her knowledge.

In the teaching of science subjects, the concepts and acronym of STEM originating from Science, Technology, Engineering and mathematics aim at encouraging students to further discoveries in the scientific world (Akran & Asiroglu, 2018). There is a significant relationship between the sciences (Biology, Physics, Chemistry and Mathematics), technology, Engineering and mathematics. However, English is pertinent in that English in interpreting the instruction, activities science major concepts in STEM has origin in western

culture (Hassan, Ali, Salum, Elmoge & Amour, 2015). In Zanzibar students failing chemistry and other science subject were attributed to low levels in the English language as a medium of instruction for science subjects. While knowledge is not owned by any individual, teachers are facilitators and fellow travellers in education. The role of teachers is significant even when technology has presented a plethora of open resource materials (OECD, 2012). Poor education achievement also imposes a cost on society. An economy with a low-skilled human resource may always fail to maximize its comparative advantage with other countries. This explains why Germany is the 1st economically viable country in Europe with its highly qualified human resource.

Systems theory recognizes the social aspects of learning, including the classroom and learning community, where students use both individual and social processes to make sense of the environment. The focus of learning activities can be divided into two categories: student-centred teaching and laboratory-centred teaching. Since the students themselves are at the centre of learning activities, teacher-centred instruction is not very effective. Students can develop understanding through exercises including doing experiments (in classes) and conversing with classmates about the outcomes (Umar, Fugu & Aliyu, 2018). For students to develop new knowledge and concepts, laboratory-centred instruction's type, quality, and frequency are essential. Students get the chance to understand the technique and abilities that are facilitating conceptual improvements that could result in improved performance in Chemistry during these laboratory activities. Therefore, the study would show that there is a causal link between teaching and learning environments and students' Chemistry performance at selected secondary schools in the Kasese municipality.

Conceptual Perspective

The availability of teaching-learning facilities and physical facilities in secondary schools does not adequately much with the current demand as school enrollment has drastically increased in several countries (Achary & Maharjan, 2017). Teaching-Learning facilities mean areas dedicated for use by students, faculty, or administrative or maintenance personnel for clinical purposes, research activities, libraries, classrooms, offices, auditoriums, dining areas, student activities, or other related purposes necessary for, and appropriate to, the conduct of comprehensive programs of education. Such a term includes interim facilities but does not include off-site improvements or living quarters (Ilomo & Mlavi, 2018). Specifically, for chemistry and other science subjects the following are significant; science textbooks, laboratory equipment, laboratory guide handouts, and consumables within the laboratories for a practical purpose (Abdulla, 2017). Students' performance in chemistry subject has been researched by several researchers and they indicate factors such as; student-related factors, teacher-related factors, societal factors, the government infrastructural problem, the language problem, examination board-related variables, curriculum-related variables, test-related variables, textbooks-related variables, and home related variable (Barineka, 2012). Performance is an outcome of learning; hence ways of learning determine outcome or performance. Performance in science subjects is an outcome of how the subjects were learnt. An assessment reveals evidence of learning a particular subject when it comes to diagnostic, formative and summative assessment.

Assessment serves several purposes as most teachers use quizzes, tests, mid-term examinations, and end-of-term examinations to assess students' performance in a particular subject and finally their summative performance to qualify them for the next level in the academic ladders. Tests like multiple choice do not give feedback to the teacher since their

lack critical thinking of the learner. Therefore, teachers are advised to use several kinds of assessment to measure and predict learners' performance that includes both cognitive and behaviour. The diagnostic assessment uses short answers or multiple choice to measure the current knowledge of the learner. Formative assessments include continuous assessment tests (CAT), oral questions that provide feedback during the learning process and dialogue-based discussions that remain ungraded. Summative assessments use measures such as tests, quizzes, and other graded course activities that are used to measure students' deep understanding or performance. They are cumulative and often reveal what students have learned at the end of a unit or the end of a course. Also, Behavioral skills are significant predictors of students' academic success; therefore, parents and educators need to be constantly observing and monitoring students in early grades to ensure that their social and behavioural skills are developing appropriately. The pedagogical content knowledge (PCK) is important during assessment like when teaching about chemical bonding in chemistry (Dulmen, Visser, Coenders, Pepin & Mckenney, 2022).

This conceptual framework was influenced by ideas about instruction, learning environments, and student performance in Chemistry in Uganda. The teaching-learning facilities provide a suitable environment for students to perform well in chemistry (Atibuni, 2015). The teaching-learning facilities in this study serve as independent factors, while student performance serves as the dependent variable. Facilities for teaching and learning include library textbooks, laboratories and others infrastructures that are likely to encourage students to actively participate in the learning process (Akomolafe et al., 2016). Student-related teaching-learning amenities improve their overall performance in practical subjects, particularly Chemistry (Ogembo, Otanga, & Yaki, 2015). There is a strong likelihood that the learner will perform fairly in science or practical disciplines like Chemistry if they can obtain the necessary prerequisites (Ogembo et al., 2015). The prerequisite for science subjects is science

textbooks, laboratory equipment, and laboratory staff (teaching and non-teaching), and all these are supported by qualified teachers serving in attractive working conditions. Students' progress in grades, their involvement in that particular science subject's class, and their capacity to apply what they learn in school to other facets of their lives are all considered when evaluating their performance (Akomolafe et al., 2016). Students' performance in chemistry refers to the ability of a student being able to perform such prerequisite activities that makes a science student academically sound. For instance, able to read measurements in the laboratory, record measurements, identify colours of substances used in the laboratory, handle properly apparatus used in the laboratory and others. Performance is an outcome of learning; hence ways of learning determine outcome or performance when discussing performance we indirectly consider teaching methods and teachers' approaches/strategies in the facilitative learning process. Academic performance in science subjects is an outcome of how the subjects were learnt. The academic performance grades attained from examination measure academic performance while grades attained from practical examination measures students' performance (Chikendu, 2022). At the senior four and senior six ends of course examinations both subject competencies and academic performances are tested (Dulmen, Visser, Coenders, Pepin & Mckenney, 2022). In this study, we use student performance rather than academic performance as the outcome of students' performance in chemistry.

According to Limon and Development (2016), learning is a complicated process that constantly evaluates the physical circumstances of the school as well as the motivation of the pupils. These internal and external resources interact to enable a student to experience holistic learning (Corcoran, 2011). There was not a single variable that operated in isolation, thus educators should consider each variable crucial in ensuring the process continued without interruption. The school building must be seen as an equal participant in this process of teaching-learning. Therefore, stakeholders need to be aware of the various ways in which the

state of the school infrastructure affects students' ability to learn. The term "physical facilities" refers to the school plant, which includes the buildings, classrooms, libraries, laboratories, restrooms, offices, and other components and infrastructures that are likely to inspire kids to study. Physical facilities are important for students' successful learning and academic performance. The primary factor influencing academic accomplishment in the educational system is amenities. They include, among other things, school buildings, classrooms, libraries, laboratories, and recreational equipment (Akomolafe, 2016).

Chemistry is regarded as the experimental science that is most useful. For instance, in Kenya, admission to medical and agricultural professional programs requires a solid secondary school education and a passing mark in chemistry (Mwangi, 2016). Poor performance in the topic means fewer students can enter such professions, and a shortage of professionals causes the country to have inadequate health care and food insecurity as the community is left to be destroyed by poverty. Poor performance in the topic means fewer students can enter such professions, and a shortage of professionals causes the country to have inadequate health care and food poverty. Academic performance can be thought of as the degree to which a learner acts or completes a piece of work, as well as how successfully or poorly he or she completes the task or activities included in a learning process (Akomolafe, 2016). However, poor performance can be viewed as falling short of the required academic performance (Umar et al., 2018). When performance is superb, the desired standards are not met. It was further made clear that having access to these resources is crucial for the educational system to be effective at providing instruction and supervision. The lack of basic amenities like classrooms, office space, workshops, recreational facilities, laboratories, libraries, etc. that secondary schools endure is an exact reflection of the conditions in the educational system. The specific teaching-learning facilities for chemistry are chemistry textbooks, science laboratories, laboratory technicians or laboratory assistants whose role is to help the

chemistry teachers in preparing equipment and other requisites for practical lessons to be effectively given to the learners. The laboratory technician further helps learners to utilize the laboratory in the absence of the chemistry teacher (Townsend, 2012). Some secondary schools do not have laboratory technicians and laboratory equipment is only in lab stores.

The lack of adequate teaching-learning facilities undermines the use of the five human senses; seeing, touching, smelling, hearing and testing. The aspect of teaching using visual aids, and audio where the teacher or other students talk and others listen are very important when considering the Vygotsky VARK model emphasises the importance of science laboratory in secondary schools (Sreenidhi & Helena, 2017). The chemistry science laboratory facilitates the observation and kinesthetic that contribute to the construction of imageries that increase understanding of the subject matter (Alber, 2014). High school learning combinations of science like PCM, BCM, and PCB all require chemistry as a binding subject to make science a reality in professionalism (Mwangi, 2016). Food science will greatly require knowledge of chemistry and medicine will require chemistry hence life knowledge is about chemistry and chemistry is about life science. The laboratories are fundamental in the teaching of chemistry. Scaffolding in teaching science is defined as a strategy provided by the teacher to create support that aids the learners to enhance their understanding of new concepts and knowledge. Instructional scaffolding is a process through which a teacher adds support for students to enhance learning and aid in the mastery of tasks. The teacher does this by systematically building on students' experiences and knowledge as they are learning new skills (Vanderbilt University, 2022).

However, most laboratory types of equipment are expensive for private secondary schools to acquire them yet the Uganda government has provided a policy of compulsory science subjects at the ordinary level (UNESCO, 2017). The lack of equipped science laboratories in the country creates doubt about compulsory science subject policy implementation (Muhumuza, 2017). The role of science laboratories has been identified by several scholars as they indicate that chemistry is a practical subject that requires teachers to teach in science laboratories (Mwangi, 2016). This study established the relationship between teaching/learning facilities and performance in Chemistry at O' level in Kasese Municipality, Kasese District. The data collected in chapter four below shows that teaching-learning facilities mentioned in the research tool are not conclusive but other variables still exist that account for the 31% remaining.

The persistent low academic performance in chemistry subjects as reflected in the Uganda certificate of examination (UCE) has created a plethora of arguments in search of the cause and solution for the problem. The majority of facilities, such as science laboratories and libraries, are deficient in the schools in Kasese municipality, just like in any other portion of the Rwenzori region. Even the current science laboratories lack the necessary supplies of tools and chemicals to make it easier to teach and study practical courses, especially Chemistry (Montserrat Lara et al., 2013). As chemistry became a required subject for the UCE in the 2000s, the demand for Ugandan schools to establish well-equipped laboratories increased (Kule, 2018). The government has been hesitant to provide funds in the form of laboratory equipment to these schools, and the price of laboratory equipment has remained high (Baluku & Kasujja, 2020). It appears that secondary schools in Kasese municipality and the Rwenzori region have been performing worse than average in science classes, particularly in Chemistry.

A detailed examination of student performance in Kasese District appears to point out the lack of suitable physical facilities and a supportive learning environment that may inspire secondary students to excel in science subjects, notably Chemistry subject (Baphtale, 2015). Records from Kasese District show that children in schools with well-stocked laboratories and libraries do better than their peers in science classes, including Chemistry (Kule, 2018). It appears that when these resources are insufficient, students' attitudes toward learning deteriorate (Baluku & Kasujja, 2020). To determine the most effective interventions to boost performance in the research area, this study set out to determine the relationship between teaching and learning facilities and students' performance in Chemistry in selected secondary schools of Kasese Municipality.

The availability of computers in schools can easily be used for the teaching of chemistry in class. The challenge to using a computer when it comes to e-libraries and remote laboratories is the electricity supply. Secondary schools in Kasese all have electricity supplies hence the above-mentioned situation would not be an excuse. The availability of adequate computer pieces to a recommendable compute to learners is needed to be established. In 2009, the ratio of 5.3:1 was students to the computer with 97% supplied with the internet. Previous studies show that the utilization of ICT contributes to 14.9% of the performance of students (Baluku & Kasujja, 2020). It is further established that 55.7% of teachers in Kasese are having expertise in ICT hence it is possible to introduce remote laboratories. With the rapid advancement of technology and the prevalent use of the Internet in education, science practical work in the form of a web-based laboratory or remote laboratory (RL) has recently been adopted in cloud computing (Tho &Yeung, 2016). The remote laboratory system designed can be accessed at any time by the learners and teachers. For instance, online laboratory practical lessons (Bast, 2021) reduce anxiety and increase space for learners to observe and record measurements. Critical thinking in science laboratories and other science

and technology is enhanced by practical lessons (Atubin, 2015; West, 2015). The instructional facilities in teaching-learning chemistry range from textbooks, science laboratories, and laboratory apparatuses categorized into several groups according to use and application, without the oversight of human resources. In the world of economics, labour remains important among the factors of production because labour combines other factors in the production process. Teaching and support staff combine science facilities and facilitate learning. The laboratory attendant is significant in preparing; guiding learners to clean the equipment after use and overseeing the storage quality of the equipment for the next use.

The teaching methods, where teachers use teacher-centred approaches like lecture methods with a lot of lesson notes given to the learners do not influence academic performance. Gone are days when textbooks were not seen in school libraries that teachers used to hold on to the written notes acquired from friends or from previous schools they attended from a particular class. The open resource materials both lesson notes, textbooks (ebooks), laboratory practical guidebooks, and practical lessons specific to particular experiments are available. The requirement is to establish a computer laboratory and expose learners to the learning materials. Smartphones have equally increased the availability of open resource materials as the ministry of education and sports allows the use of ICT in school and smartphones are part of the learning facilities in science.

Statement of the Problem

Students' poor performance in chemistry has been a point of debate both at the local and national levels in Uganda. In 2018, almost 50% of the 330,721 candidates that sat for UCE failed chemistry and Physics subjects as shown in appendix L attached. The overall performance was 46.5% in chemistry while in 2019 overall pass was ranked at 54.6% (The Independent, 2020). The worst subject done in the 2018 Uganda Certificate Examination was chemistry subject (Serugo, 2019). The reports mentioned by the Independent newspaper (The Independent, 2020) and Geoffrey Serugo (Serugo, 2019) show that chemistry was worst done in the year 2018 without showing the possible cause for such a failure. In the parliamentary watch, it was also mentioned that textbooks of science subjects only teach knowledge without teaching competencies in science subjects (Parliament, 2021). The contradictory argument between teaching approaches and teaching-learning facilities remains a topic for research for students of administration and planning in Ugandan education institutions. While secondary education was introduced in 1905 in most central parts of Uganda, the first secondary, "Saad Memorial secondary school" in Kasese was established in 1974. The second secondary school Rwenzori High Secondary school was established in 1980, followed by a few others in the 1980s where teaching-learning facilities may still be held responsible for the poor performance in science subjects, especially chemistry. Based on existing literature and the historical background of education in In Kasese, the researcher was motivated to delve into research to find out the relationship between teaching-learning facilities and students' performance in chemistry from selected secondary schools in Kasese Municipality.

Chemistry has a crucial role in the development of a country (Mwangi, 2016; Nandugwa, 2018). The United Nation's plan (SDG 2030) promotes quality education where science, technology and innovation (STI) will be enhanced with emphasis on STEM at the secondary level of education (UNESCO, 2018).

The SESAMAT project was introduced in Uganda with the target to enhance teaching skills and students' performance in secondary science and mathematics. Secondary school Science has got subjects like Chemistry, Biology, Physics, Computer and Mathematics. These science subjects prepare students to study STEM which is Science, technology engineering and mathematics that STI become the outcome. As the government was injecting public funds into secondary schools in the name of "Universal secondary education", students are frequently failing as reflected in 2018 as shown in appendix 12. Students who passed division 1 were 27,812 (8.4%) while those who failed were 42,334 (12.8%). The situation is reflective of what is happening in schools and calls for further investigations to avert the problem. When it comes to Kasese where secondary education is less than five decades, performance is very low. In the same year 2018, students who fail chemistry were 61.2% and only 38.7% passed as shown in appendix 4.

Purpose of the Study

The major purpose of this study was to examine the relationship between teaching-learning facilities and students' performance in Chemistry in selected secondary schools of Kasese Municipality. This study anticipates establishing the relationship between teaching-learning facilities and students' performance in chemistry so that policymakers can get the reference for them to plan for the public to trust the government.

Objectives of the study

1. To establish the effect of Teaching-Learning Facilities on students' performance in chemistry subjects in selected secondary schools in Kasese Municipality

2. To analyse the correlation between Teaching methods and students' performance in Chemistry subjects in selected secondary schools in Kasese Municipality

3. To establish the effect of primary school background knowledge on students' Performance in chemistry in selected secondary schools in Kasese Municipality.

Research questions

1. What is the effect of teaching-learning facilities on the student's performance in chemistry subjects in selected secondary schools in Kasese Municipality?

2. What is the relationship between Teaching-Learning Facilities and students 'performance in chemistry subjects in selected secondary schools in Kasese Municipality

3. What is the effect of primary school background knowledge on the student's performance in chemistry subjects in selected secondary schools in Kasese Municipality

Scope of the Study

Content Scope

The study was limited to teaching-learning facilities and students' performance in Chemistry in selected secondary schools. The parameters used to measure the independent variable in this study were teaching-learning facilities, teaching methods, and other school facilities that improve student performance, while the parameters used to measure the dependent variable

were student performance at the Uganda National Examinations Board, student attendance, discussions and seminars, tests and continuous assessments, and student performance.

The study's goals of determining the impact of teaching-learning facilities on students' performance in chemistry in particular secondary schools, determine the factors that affect chemistry performance in particular secondary schools and examined the relationship between teaching facilities and students' academic performance in chemistry in particular secondary schools were further achieved. For this goal, the researcher focused on several distinct characteristics, such as student attitudes, personality traits, and intrinsic and extrinsic motivation.

Geographical Scope

The study was conducted in Kasese municipality; Kasese District took selected secondary schools. The study involved both private and government grant-aided secondary schools. Taking these schools aimed at giving a clear comparison for the study to come up with clear information. Further, Kasese municipality secondary schools have improved teacher learning facilities as compared to schools outside the municipality yet the performance in Chemistry among these schools has been low as compared to other schools in the whole District and this accounts for why the Municipality, particularly both Secondary schools have been chosen.

According to BID NOTICE (2019/2020), the municipality is located in southwestern Uganda in Kasese District near the Democratic Republic of Congo border at 0012'S and 0026N longitude; 290 42'E and 300 18'E latitudes with a totally dry land area of 3,389.8 SqKm, open water 409.7 SqKm and Swamp 68.8 SqKm. It is partially hilly and flat land with mostly dry seasons. It is a heavily populated area with so many schools from primary to tertiary level and at the secondary level, the majority being privately owned schools.

Time Scope

The study was conducted for a period of 6 years, from 2016 to 2022. This time frame was chosen because secondary schools in Kasese municipality have consistently had low performance over the past few years, despite the government of Uganda's support and acquisition of school facilities to help secondary schools with good Chemistry performance. However, low performance has persisted over years, so this period would help determine or research what the previous causes of the low performance have been.

Justification

The researcher chose to carry out the study on the area of teaching and learning facilities and students' performance in Chemistry in selected secondary schools of Kasese municipality, Kasese District because many studies have been linked to teaching and learning facilities on the general performance of students in Chemistry. Yet there has not been any study carried out on teaching-learning facilities and students' performance in Chemistry in Kasese Municipality. This study was therefore extremely important at this time since it examined the relationship between teaching, learning, and learning facilities, student performance in Chemistry, and the proposal of benchmark policy recommendations to reverse the increasing situation.

Significant of the Study

Based on the results, teachers will modify their lessons to focus on using the right school resources to improve student performance in chemistry and improved learning.

Students are expected to gain from this study because they will be better able to grasp how lacking teaching and learning resources in secondary schools can negatively influence their academic achievement in Chemistry.

Additionally, it is intended that teachers will acknowledge through this study how much better Chemistry teaching and learning would be for both students and teachers if there were proper teaching and learning facilities available.

Additionally, the school administration would use the study's conclusions and suggestions to address the issue of insufficient infrastructure provision in our secondary schools. Through this study, they will gain a better understanding of the impact that inadequate teaching and learning environments have on the effectiveness of our instructors' work and the academic success of Chemistry students.

Parents would benefit from it because it would help them understand how poor teaching and learning environments affect children's and teachers' academic and professional performance.

Parents could assist school administrators in identifying long-term solutions to the issue of inadequate teaching and learning facilities in schools by using the study's results and recommendations.

The study would be beneficial to society because it would encourage instructors to work more and generate better pupils for the community when there is appropriate access to Chemistry teaching and learning resources in schools.

Conceptual Framework

A conceptual framework is a representation of the relationship you expect to see between your variables or the characteristics or properties that you want to study. Conceptual frameworks can be written or visual and are generally developed based on a literature review of existing studies about your topic (). The source of the conceptual framework is within the limits of the ecological system theory. The choice of applying one of the following moderators, confounder, intervening, or extraneous variables depends on theoretical grounds with considerable literature support rather than driven by ambition or requirement to make this study complex (Memon et al, 2019). Confounding variables are those that affect other variables in a way that produces spurious or distorted associations between two variables. They confound the "true" relationship between two variables. Moderating variables Changes the relationship between dependent and independent variables by strengthening or weakening the intervening variable's effect (Eady, 2023). The intervening variables are also known as a mediator or mediating variable, which explains the process through which two variables are related, while a moderating, or moderator, variable affects the strength and direction of that relationship (Eady, 2023).

The knowledge gained during the pilot study and final data collection guided the discussion and helped the researcher to formulate this conceptual framework graphically. The type of interaction with experts in the same field and the key informants in the relevant field of study was a useful technique to brainstorm and identify the potential moderators that were included in the questionnaire as well as in the conceptual framework as moderators. The independent variable and dependent variable as stated in the topic was influenced by the teaching methods and background knowledge of the learner in the centre of research. The teachers, head teachers and municipal education office remained as key informants since most of them were

even parents of the same students in the question of why chemistry is the worst performed subject at senior four.

According to the conceptual framework in figure 1 above, the study was concerned with teaching-learning facilities and students' performance in Chemistry in secondary schools. Some of the variables directly relate to each other while others may not correlate. Additionally, this conceptual framework was founded on the facts that the Independent variable was based on teaching-learning facilities that affect performance, and as a variable was measured by the parameters based on the teaching–learning facilities that include textbooks and laboratory apparatuses while moderating factors include teaching methods, laboratory assistants, teachers expertise, learners attitude, and learners background knowledge from primary schools. The independent variables are based on the student's performance in chemistry and are measured in the parameters of students' daily attendance, tests and continuous assessment tests. The student's performance in Uganda's national examinations reveals students' performance, academic performance and teachers' input as a major facilitator in the teaching-learning process. The dependent variable is based on the student's performance in chemistry and is based on the student's performance in chemistry. The availability of teaching-learning facilities is likely to increase the influence performance of students in chemistry when all other factors remain adequate. Several additional variables may not affect both the independent and the dependent variables to achieve improved student performance in chemistry, such as type of school (public or private secondary schools, gender, and location of the school in a rural or urban area. The teacher of chemistry is professionally expected to have all the requirements to motivate learners to gain skills and knowledge to directly influence students' interest in the subject matter taught to bring about performance outcomes and the learning process. Students learn when they are actively motivated to participate in the teaching-learning process and the opportunity to manipulate

teaching-learning activities. The nature of teaching-learning facilities can lead to positive or negative outcomes which are large to be appreciated as academic performance. The major purpose of this study was to investigate the effect of teaching-learning facilities on students' performance in selected secondary schools in Kasese Municipality. A moderating variable influences the effect of an independent variable and a dependent variable. It is used to measure the impact of an additional variable on the dependent-independent variable relationship.

In conclusion, this chapter dealt with the background study by highlighting the need for carrying out this research. The theoretical framework of the study was systematically conceptualized in which the real research problem was identified and underpinned. The study also brought out the real salient variables from which the three research objectives were derived to solve the research problem contextually or conceptually.

Conceptual Framework

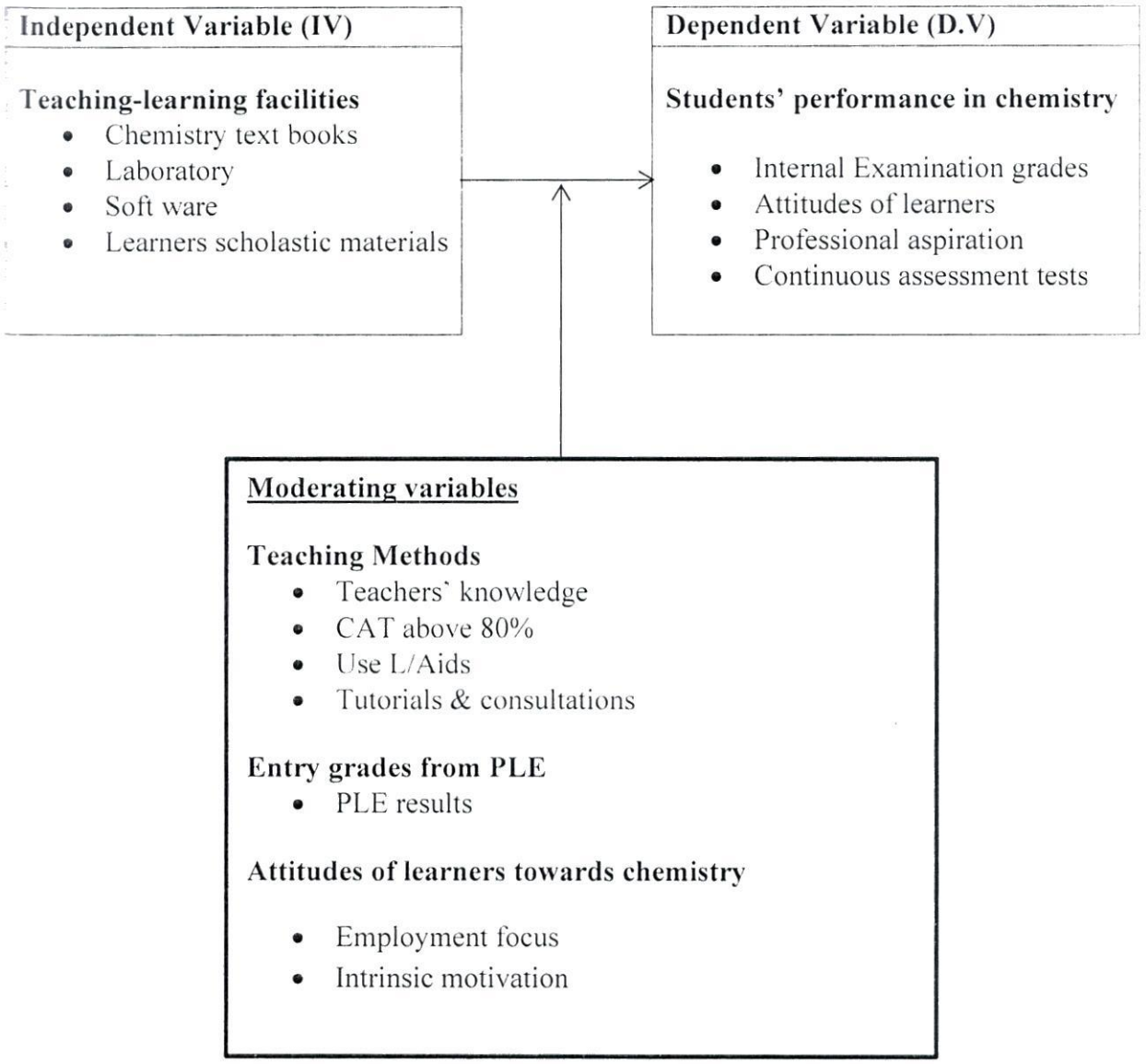


Figure 1: Conceptual Framework

Source: The ecological systems theory; field experts and literature review (Memon, Hwa, Ramayah, Ting, Chuah & Cham, 2019).

CHAPTER TWO: LITERATURE REVIEW

Introduction

This chapter provides an overview of the literature related to the study. The review is examined under Teaching-Learning Facilities, Teaching methods, factors affecting the teaching-learning of chemistry and students' academic performance in chemistry in low secondary Schools. The researcher consulted existing literature on the teaching of basic science currently known as STEM (Science, Technology, Engineering and Mathematics) to establish the link between the existing literature on the chemistry subject under investigation. STEM is expected to be an interdisciplinary approach covering pre-primary school, primary school, secondary school, university, and tertiary institutions of higher education (Akran & Asiroglu, 2018). Research shows that primary school teachers have got both positive and negative perceptions of the implementation of STEM Education. The persistent failure of students in chemistry was revealed in the 2018 Uganda Certificate Examination (UCE) results where 46.5% of students passed and 53.5% of the registered candidates failed with F-grade at the ordinary level. This situation motivates researchers to delve into depth to study the causes and effects of poor performance in secondary school chemistry subject. The researcher has systematically consulted textbooks, scholarly articles, blogs, and newspapers written by experienced scholars and educators in the field of science and humanities.

Theoretical Review

The teaching-learning process involves a complex system that has got teachers, learners, support staff, parents, and facilities all interacting within the environment. The centre of the system is the learner or a child as an organism in the ecological system (German, 2015; Indira, 2004). Bronfenbrenner's ecological system theory views the child's development as a complex system of relationships affected by several levels of the surrounding environment from immediate settings of family and school to broader cultural values, laws and customs. The ecological system theory provides an understanding of the structure and behaviour of an organisation, an institution, a community and a nation including its simple and complex set-up of interactions between its members (German, 2015). Related Literature draws an understanding between a selection of concepts as defined by different authors and how they become relevant when considering cognitive processes in human beings. Learning is a process through which an individual adopts knowledge and skills meticulously or unknowingly given an ecological environment through which adaptation is facilitated.

This study is hitched on ecological system theory which was proposed by Urie Bronfenbrenner an American psychologist who viewed a child's development from home to school. He was so critical that previous theories on child development in unfamiliar laboratory environments were ecologically invalid (Guy-Evans, 2020). Bronfenbrenner divided the person's environment into five different systems: the microsystem (parents, siblings, teachers and school peers), the mesosystem (for instance the parents' relationship build to communicate with teachers indirectly supports the child's learning at school), the exosystem (involves environment outside a child's environment like parents workplace or parents economic status these affect a child's well-being indirectly at school), the macrosystem (this focuses on how cultural elements affect a child's development, such as

socioeconomic status, wealth, poverty, and ethnicity), and the chronosystem (This system consists of all of the environmental changes that occur over the lifetime which influence development, including major life transitions, and historical events). The child's learning is influenced by complex ecological environments where parents' and teachers' well-being accounts a lot for the child's learning at school and home.

The teaching-learning facilities will be categorized into software and hardware both supported in an ecological environment as scaffoldings built to aid high performance in chemistry subject and other science subjects as mentioned; in STEM. An understanding of ecological system theory helps both teachers and policymakers not to focus on one aspect of the environment as all in determining high performance in chemistry and neglecting other aspects. Software teaching-learning facilities are in-built facilities within the professional handling of teaching chemistry. How knowledgeable and competent is a teacher? How competent is a head teacher in governing and supervising the teaching process? How technical is a policymaker communicating to the teaching fraternity? How is a teaching team composed of communication with the learners? The hardware involves learning aids like textbooks, science laboratory equipment; physical facilities such as apparatus, chemicals, and others that help the learner to interact with practical knowledge engaging all the five senses.

Teaching-Learning Facilities and Students' Academic Performance

Teaching-learning facilities are instructional materials that facilitate or help the teacher to deliver adequately a lesson to the learners. These instructional materials include but are not limited to models, pictures, diagrams and blackboard sketches, graphs, experiments, videos, and audio-recorded sounds (Bhatia & Bhatia 2004). Teaching-learning facilities include both material and non-material facilities. Material facilities may be known as hardware (computers, smartphones, tablets, textbooks, apparatus) while non-material as software (time

in terms of frequency of teaching, skills and knowledge generalized as teachers competencies) may explain facilities for quality education (Kibalirwandi & Mwesigye, 2018). Material or physical facilities, and human facilities make up the three components of a teaching facility. For both the extracurricular activities and the other school program activities, teaching facilities are necessary. Learning is a complicated activity that involves the interaction of students' motivation, physical facilities, instructional facilities, and abilities of teaching, according to (Akomolafe & Adesua, 2016). Thus, having teaching facilities available makes schools more effective because they are the fundamental resources that help kids perform well in school. Materials facilities, human resources like teachers and support staff, and physical facilities like labs, libraries, and classrooms are among the amenities that should be provided for teaching and learning.

Teaching-Learning facilities are detailed and categorized into facilities: system management facilities, learning environment, and infrastructure. System management facilities include e-learning facilities and management information systems (MIS). The learning environment includes classrooms, teaching aids (science laboratory), and libraries. The Infrastructures include hostels, transport and parking, and sports and game pitches (Ramli & Zain, 2018). Staff quarters are also included among teaching-learning facilities that aid teachers to live within the school promises. Teachers become more effective when they live within the school's premises (Akomolafe, 2016). School open ground, classrooms and furniture provide a physical environment for the teaching-learning environment (Baynon, 1997).

Print and non-print resources for learners include things like relevant textbooks, math sets, and charts, among other things that affect students' academic performance in chemistry subjects. Students can learn more effectively when pertinent facilities are made available to them (Achola, Gudo, & Odongo, 2016). Additionally, this improves pupil learning, which

helps them do better on exams (Achola, Gudo, & Odongo, 2016). There is a connection between the accessibility of facilities and student performance. Educational outcomes appeared to be influenced by both the quality of facilities and students' explicit possession of them (Owoeye & Olatunde Yara, 2011).

Library textbooks are major teaching-learning facilities that aid students' academic performance in chemistry (Hassan, Ali, Salum, Kassim, Elmoge & Amour, 2015). Chemistry textbooks and laboratories are key facilities to enhance teaching-learning of chemistry. Laboratory practical work is very important in the teaching and learning of chemistry in secondary schools. Several experiments and practical work have to be done in laboratories to assure a proper understanding of chemistry. In a chemistry laboratory, the most common and widely used equipment are those made of glass, with glassware. Laboratory facilities are classified in chemistry into Chemistry laboratory equipment that includes; Dry bath, centrifuge, thistle tube, Rectangular water bath, Bunsen burner, Water bath, Digital thermometer, Thermometers, pH meters and laboratory accessories including the following: Tripod stand, stop the clock, Test chambers, Laboratory stands, Laboratory clamps, Laboratory stoppers. The liquids are handled by the following equipment; Burette, laboratory pipette, Diluters, laboratory dispensers, peristaltic pump, and syringes. Laboratory Cooling Equipment – chillers, freezers, laboratory refrigerators etc.

Scientific teaching facilities in Ugandan secondary schools can be enhanced by improvisation (Ndirangu, Kathuri & Mungai, 2003). Studies carried performed in Uganda have revealed that secondary school scientific performance has frequently lagged behind the national average (Bwenvu, Adhiambo, & Anyone, 2020; Mudulia & Studies, 2012; Opolot-Okurut & Education, 2005). They went on to say that inadequate performance is partially attributed to rising student enrolment in schools without a corresponding rise in learning facilities

(Bwenvu et al., 2020). Cost-sharing in secondary schools has restricted the government's role to merely paying teachers' wages (Kabunga, Habiba, and Mnjokava, 2018). The parents invest in capital and buy instructional materials and because of the country's rising degree of poverty, parents have been unable to fulfil this responsibility efficiently (Kabunga, 2018). The potential applications of improvised science facilities for science instruction and learning affect performance.

Laboratory mixing equipment includes the following: mixers, shakers, and magnetic stirrers. Laboratory Filtration Equipment includes the following; laboratory filters, filter paper, filtration pump, extraction thimbles, filtration mesh, and Gooch crucible. Laboratory consumables include the following; filtering flasks, a plastic funnel, a distillation apparatus, a chromatography apparatus, a Petri dish, a volumetric flask, and boiling flasks. Laboratory Safety Equipment also includes; personal protective equipment, and general laboratory safety equipment. It is, therefore, necessary to examine the availability and utilization of these facilities in senior secondary schools (Hassan, 2015; Priyambodo & Wulaningrum, 2017).

The textbooks and the eight (8) categories of laboratory equipment mentioned above, require management leadership of the science teachers especially laboratory technicians, chemistry teachers and laboratory assistants who are charged with ensuring safety, compiling data and information on experiments, ensuring cleanliness in the laboratory and hard wares, and monitoring ongoing students research projects. There are several benefits involved with the availability of resources in schools for children to use. Learners are motivated and few missed school when they have engaging, meaningful, and relevant activities, teacher facilities assist enhance access and educational success (Okongo, 2015). For the teaching-learning process to be effective, these facilities should be accessible in schools in both quality and quantity. There is a positive correlation between instructional materials and learners'

achievement (Adalikwu & Iorkpilgh, 2013). This fore mentioned study was in cross river state in Nigeria where senior students were divided into experimental groups to be taught with instructional materials and the control group was taught without instructional materials in chemistry. Results revealed that there is a strong positive relationship between the use of instructional materials and students' academic performance.

In another region Kenya, a similar experiment found that there is a strong positive correlation between physical facilities and students' performance in his study on the impact of physical facilities on students' performance in the Kenya Certificate of Education. The facilities available for instructional facilities had an impact on students' performance on certificate exams (Musyoka, 2013). He concluded that the use of material resources has a substantial impact on students' accomplishment because they encourage the learning of abstract concepts and ideas and facilitate the learning of concrete ones.

The absence of practical chemistry lessons causes poor communication and observational abilities, which leads to students' poor performance (Atibuni, 2015). High-quality Chemistry practical lessons aid students' grasp of scientific principles and procedures which is significant in improving academic performance (Baluku & Kasujja, 2020). The schools are constrained with funds to invest in setting up and outfitting Chemistry labs in secondary schools (Akomolafe, 2016). Remote computing laboratories using cloud computing would reduce the cost of consumables in the laboratory (Tho &Yeung, 2016). The use of remote laboratories increases learners' critical thinking and observation (West, 2015; Ouma, 2011). Lack of critical thinking can be improved by exposing learners to a learning environment that requires observation recording and analysis. The nature and quality of learning materials presented to learners may inhibit critical thinking hence little will be retained in the Cognito of the learners. Some learners use VARK as detailed that Visual Audio Reading/writing and

the Kinaesthetic (Sreenidhi & Helena, 2017). Kinaesthetic is about touching learners should be able to use their senses in handling learning materials. As mentioned, scaffolding, require show and tell, tapping into prior knowledge, giving time to talk, pre-teach vocabulary, using visual aids and pausing, asking questions and pausing and reviewing (Alber, 2014). Then all the strategies of scaffolding may not be used in a single lesson but progressively.

The existing literature does not indicate what kind of science laboratories are being used in Kasese secondary schools. The traditional science laboratories that have chemicals and laboratory apparatuses remain significant in helping learners acquire skills needed in chemistry practical lessons. This review emphasizes the importance of outfitting the Chemistry laboratory with the necessary as mentioned to have eight (8) categories; Chemistry laboratory equipment, laboratory accessories, Laboratory Cooling Equipment, Laboratory mixing equipment, Laboratory Filtration Equipment, Laboratory consumables, Laboratory Cooling Equipment, and Laboratory Safety Equipment. The existing science laboratories maybe with little or substandard equipment kept for the final examination. The cause may be due to a lack of sufficient funds to purchase the necessary equipment for practical lessons (Akomolafe, 2016).

Chemistry practical lessons are an essential feature of secondary science education (Affeldt, Meinhart & Eilks, 2018) hence the high proportion of Chemistry lesson time in secondary schools is given to Chemistry practical lessons with the assumption that it leads to distinctive attainments in students (Abungu, Okere & Wachanga, 2014). Although reports that questions have been raised by some science educators about their effectiveness as a teaching and learning strategy, this is yet to be thoroughly studied in Kenya. Whilst such an approach is generally effective in getting students to do things with objects and materials, it is seen as

relatively ineffective in developing their conceptual understanding of the associated scientific ideas and concepts (Okongo, 2015).

In countries with a tradition of Chemistry practical lessons in school, Chemistry teaching (such as the UK), Chemistry practical lessons are often seen by teachers and others (particularly scientists) as central to the appeal and effectiveness of Chemistry learning (Cheung & Education, 2008). Although many science teachers believe that student Chemistry practical lessons lead to better learning and indeed better performance – because we all understand and remember things better if we have done them ourselves, many educators have expressed concern about their effectiveness in promoting learning (Dana & Yendol-Hoppey, 2019). the role of laboratory Chemistry practical lessons continues to accord a central role in laboratory work in science teaching that does not seem reasonable and feasible anymore in developing countries (Bird, Willoughby & Frey, 2013). Due to arguments such as these and taking into consideration of the relatively high demand for facilities and time, then the effectiveness and usefulness of Chemistry practical lessons as a teaching and learning strategy have to be addressed (Bird et al., 2013).

Although Chemistry courses at all, levels have included Chemistry practical lessons where students follow procedures directing them to mix chemicals, make measurements, analyse data, and draw conclusions (IBE et al., 2013). Chemistry practical lessons often consist of what is generally described as "cook-book" exercises and are often dull and routine, rather than engaging or inspiring. science teachers do not usually find it convenient to make Chemistry practical lessons the centre of their instruction (Rönnebeck, Nielsen, Olley, Ropohl & Stables, 2018). They usually complain of a lack of materials and equipment to carry out Chemistry practical lessons and at the same time, some of these materials and

equipment may be locked up in the school laboratory store without teachers being aware of their existence (Rönnebeck et al., 2018).

Although the importance of Chemistry practical lessons in school science is widely accepted, it is also important that the nature of Chemistry practical lessons be supportive of learning (Abrahams & Millar, 2008). For many students, what goes on in the laboratory in form of Chemistry practical lessons is said to contribute little to their learning of Chemistry or their learning about Chemistry and its methods. Some students may find the practical activity a sheer waste of their time. These concerns have led to calls for more authentic practical experiences, or to re-think, re-evaluate, and perhaps reduce, the amount of chemistry practical lessons, to leave more room for other learning activities (Lowe, Newcombe & Stumpers, 2013).

The implementation of secondary school chemistry was examined among other issues, insufficient teaching and learning facilities were one of the difficulties faced in implementing the chemistry curriculum in secondary schools (Cheung & Education, 2008). In addition to the course books and set books, parents should provide other materials for their children. It is advised that planners should consider several scenarios for each institution's facilities, instructor population, and even climatic circumstances. The teaching and learning process is impacted by the facilities chosen and used. The facilities and materials required for an efficient learning process are chosen based on the subject being taught.

On the variables affecting performance in science classes, research was done. The practical books, practice books, mathematical set, and hand clock were the key facilities examined in the study. According to the study, a well-stocked library will also have enough reference volumes for both teachers and pupils. However, other pertinent facilities required to affect student performance were not examined in this study. Additionally, it did not discuss how

accessibility to other amenities can influence pupils' academic success. Facilities could affect pupils' academic success (Oseko, 2010). The relationship between use of laboratory facilities and students' academic performance and found that there was a positive correlation between the use of laboratory facilities and students' academic performance concerning science teaching and the promotion of strong academic performance in the subject (Olaefe, 2010). In a previous study, the association between students' academic achievement in Chemistry and the use of laboratory facilities was examined. It was discovered that the relationship between the two variables was insignificant (Oseko, 2010).

In a study conducted in Virginia, Cash (1993) created research that explored the effects of several building condition characteristics on student accomplishment while controlling for the socioeconomic background of the students. Facility quality and student accomplishment were significantly correlated when socioeconomic conditions were constant. When the socioeconomic status of students was taken into account, that student achievement was significantly correlated with air conditioning, absence of graffiti, condition of science laboratories, locker accommodations, and condition of classroom furniture, wall colour, and acoustic levels. In a study where 165 Georgian schools were divided into one of three categories: Half-Modern Learning Environment, Obsolete Learning, or Modern Learning results revealed that three categories varied in terms of lighting, colour schemes, air control, and acoustic levels in addition to the age of the buildings (Chan, 1996). It was further discovered that student achievement was highest in modern learning environments and lowest in obsolete learning environments, as one might anticipate. It was therefore concluded that modern surroundings' adaptability and technological advancements better prepared pupils for success and that to reject that fact was to overlook the physical challenges of learning. Teaching-learning facilities, teaching methods, and learners' background knowledge from primary seven (PLE) remain correlational to students' academic performance.

Learning-teaching facilities compromise all instructional learning aids that are at teachers' and learners' exposure to simplify or aid understanding of the teaching-learning process in education. The lack of learning materials is manifested by low academic success, high dropout rates, problematic behaviour, low teacher motivation, and missed educational objectives. This situation cannot go without an understanding of institutional governance which entails financial autonomy, transparency, employee relations, and accountability. The institution's governance may also be reflected in the teaching-learning process as revealed by the clients. The evaluation of an institution can be done by collecting information from internal clients who are employees or external clients who are students and parents (Kibalirwandi, 2022). The study focused on the influence of teacher-learning facilities on students' performance in Chemistry in Kasese Municipality, Kasese District.

Teaching Methods and Students' Academic Performance

Teaching is a process of facilitating the learning process of a less informed person by a more experienced person. Teaching may still be defined as an "intimate contact between a more mature personality and a less mature one which designed to further the education of the latter". It is further expressed by the concept of teaching by an equation. "Teaching is learning as selling is to buying". In the words "Teaching is arrangement and manipulation of a situation in which there are gaps or obstructions which an individual will seek to overcome and from which he will learn in the course of doing so". Therefore, "Teaching is a system of actions intended to induce learning". It is further defined as "Teaching is a form of interpersonal influence aimed at changing the behaviour potential of another person" (Rajagopalan, 2016). Smith in 1963 further extended the definition of teaching as "Teaching is a system of actions involving an agent, an end in view and a situation including two sets of

factors those over which the agent has no control (class size, characteristics of pupils, physical facilities, etc.)

Teaching is a behavioural action aiming at influencing the learners or children and teachers hence both are fellow travellers in search of knowledge (Sequeira, 2012). Learning can be considered as "change that is permanent in nature because change is brought into students by a teacher through techniques like developing specific skills, changing some attitudes, or understanding specific scientific law operating behind a learning environment (Munna & Kalam, 2022)". Learning is best done with different categories of learners in the classroom identified as auditory learners, visual learners and kinesthetic learners. The auditory learners understand better when the teachers use lectures and discussion methods. Visual learners enjoy learning by seeing charts, pictures, video clips, experiments and graphs. The third category of learners is kinesthetic learners or hands-on learners who actively participate in experiments. The VARK model of learning styles suggests that there are four main types of learners: visual, auditory, reading/writing, and kinesthetic. The idea that students learn best when teaching methods and school activities match their learning styles, strengths, and preferences grew in popularity in the 1970s and 1980s (Prithishkumar & Michael, 2014). One of the most common and widely-used categorizations of the various types of learning styles is Fleming's VARK model (sometimes VAK - an acronym for the Visual (V), Auditory (A), and the Kinaesthetic (K) sensory modalities) which provides the learners with a profile of their learning styles, based on the sensory modalities which are involved in taking in information. This model expanded upon earlier Neuro-linguistic programming (NLP) models. In NLP the senses are split into three groups (Visual, Auditory and Kinesthetic) which are referred to as Representational Systems (Sreenidhi & Helena, 2017).

The teaching of chemistry and other science subjects requires an understanding of child development theories as well as ecological system theory. The learner-centred methods require the use of teaching-learning facilities that enhances learners' use of senses; eyes for seeing, ears for hearing, tongue for testing, fingers for touching, and noise for smelling. Science teaching emphasizes observation and an inquiring mind as the basic ingredients that facilitate knowing and knowledge. Inductiveness is related to the careful observation of facts from which scientific conclusions are derived (Atibuni, 2015.)

The performance of students in the subject in recent public examinations is disappointing, despite the significant potential embedded in learning Chemistry, its importance to humanity, and the efforts of researchers to improve the quality of its teaching and learning, especially at the secondary school level (Dana & Yendol-Hoppey, 2019). It is crucial to emphasize that the goals of Chemistry teaching and learning may not be met unless this trend is reversed (Mwangi, 2016). The ineffective teaching and learning of Chemistry are evidenced by the weak performance in the sciences, particularly Chemistry, on the Kenya Certificate of Education (Musyoka, 2013). It shows a lack of mastery of the necessary skills, which may result from learners' insufficient exposure to laboratory activities. It is a sign that there is a problem with the secondary school system for teaching and learning chemistry. Chemistry should be taught using an activity-based approach in a well-equipped laboratory learning setting because science depends on experimentation (Mwangi, 2016).

Laboratories are crucial for increasing students' academic performance in science subjects and the scientific method that fosters students' enthusiasm, curiosity, good attitudes toward chemistry, creativity, and problem-solving skills. The laboratory is an important teaching and learning chemistry for experiments are best done from the laboratory (Suryawati, 2017). The crucial function that the Chemistry laboratory plays in providing the students with a wealth of

specialized tools provides an opportunity to perform better in chemistry subjects (Aydin & Reviews, 2011). The learners must be extremely well-prepared to use all of this equipment. At this time, teachers must work to implement the most up-to-date teaching methods that can improve performance and maintain students' interest in the topic (Atibuni, 2015).

Inadequate laboratory facilities affect students' attitudes toward the subject they find challenging and ultimately result in students' academic performance in the same subject. It was discovered that professors' incapacity to guide candidates through practical sessions in the lab is to blame for students' low performance in practical Chemistry. Ibe, Adah, and Ihejiamaizu (2013) made a similar discovery and reported that there are numerous instances where candidates' volumetric analysis *titrates* cannot be marked by the examiners because the teachers' titrate differ greatly from those of the students, and in some cases, teacher's titrate values are so outrageous that they are completely discarded. This study reveals that a lack of science facilities and equipment in many secondary schools is a strong indicator of students' low performance in practical scientific courses like chemistry (Fry,).

It is necessary to re-evaluate the circumstances surrounding low performance in Chemistry teaching and learning to remedy the issue (Olubu & Sciences, 2015). The focus of such a review should be on figuring out how the laboratory learning environment affects students' learning outcomes (Nja, Cornelius-Ukpepi, Edoho, Neji, & Reviews, 2020). Students' learning results increase when they can actively participate in their education. This is made possible through learning environments that encourage this kind of active engagement (Nja et al., 2020). It should be highlighted that providing adequate laboratory equipment goes hand in hand with improving the learning environment in the context of laboratory facilities.

Inadequate laboratory learning environments in secondary schools may be the cause of students' low performance in Chemistry and other practical subjects (Lowe, Newcombe &

Stumpers, 2013). Additionally, it appears from the assessment of the literature that little research has been done in Nigeria on the impact of the laboratory learning environment on students' learning outcomes in Chemistry classes (Ogembo et al., 2015). The lack of relevant literature makes a scientific investigation of the laboratory learning environment necessary (Owoeye & Olatunde Yara, 2011). Investigating the impact of a laboratory learning environment on students' learning outcomes in chemistry was the main goal of the current study. Being a practical science, chemistry should be taught and learned through practical experiences (Abungu, Okere, Wachanga, & Research, 2014). Chemistry practical lessons are a crucial component of a successful science curriculum, and science educators have stated that there are numerous advantages to learning via lab exercises (Abungu et al., 2014). Engaging students in practical lessons are important for teaching learning and learning (Akomolafe et al., 2016). This aids them in applying the notions they have learned in the classroom. This suggests that learners are more likely to perform well when they are engaged in practical lessons, and the opposite is also true (Emmanuel, Adom, Josephine & Solomon, 2014).

The absence of practical Chemistry courses by Chemistry students causes poor communication and observational abilities, which leads to students' poor performance (Abungu, 2014). High-quality Chemistry practical lessons aid in students' grasp of scientific principles and procedures (Emmanuel et al., 2014), which is why significant funds are invested in setting up and outfitting Chemistry labs in secondary schools (Akomolafe, 2016). This review emphasizes the importance of outfitting the Chemistry lab with the necessary tools once more.

Chemistry practical lessons are an essential feature of secondary science education (Affeldt, Meinhart, Eilks, & Technology, 2018), hence high proportion of Chemistry lesson time in

secondary schools is given to Chemistry practical lessons with the assumption that it leads to distinctive attainments in students (Abungu, 2014). Although (Mwangi, 2016) report that questions have been raised by some science educators about their effectiveness as a teaching and learning strategy, this is yet to be thoroughly studied in Kenya. Whilst such an approach is generally effective in getting students to do things with objects and materials, it is seen as relatively ineffective in developing their conceptual understanding of the associated scientific ideas and concepts (Okongo et al., 2015).

In countries with a tradition of Chemistry practical lessons in school, Chemistry teaching (such as the UK), Chemistry practical lessons are often seen by teachers and others (particularly scientists) as central to the appeal and effectiveness of Chemistry learning (Atibuni, 2015). Although many science teachers believe that student Chemistry practical lessons lead to better learning and indeed better performance – because we all understand and remember things better if we have done them ourselves, many educators have expressed concern about their effectiveness in promoting learning (Dana & Yendol-Hoppey, 2019). For example research on the appraisal of the role of laboratory Chemistry practical lessons concludes that continuing to accord a central role to laboratory work in science teaching does not seem reasonable and feasible anymore in developing countries (Bird, Willoughby, and Frey, 2013). Due to arguments such as these and taking into consideration of the relatively high demand for facilities and time, then the effectiveness and usefulness of Chemistry practical lessons as a teaching and learning strategy have to be addressed (Bird et al., 2013).

Successful teaching and learning of Chemistry depend partly on methods whose activities target most learning senses (Wachanga & Mwangi, 2016). This may imply that there is a need for teachers to vary the teaching technique in their day-to-day teaching activities. Apart from the most commonly applied lecture method approach, there is a need to employ other

teaching methodologies such as class demonstrations, practicals and field excursions which are more students involving. The participation of students in the lecture method is less involved. The teaching approach that a teacher adopts is one factor that may affect students' performance. (Mills 2010).

Ideally, a small group class experiment is most suitable whereby the teacher designs chemistry Practicals in such a way as to encourage learner discovery of information. In this type of chemistry Practicals type of lesson, the learners perform guided experiments in small groups engaging in hands-on activities. Learners then write a scientific report in which they justify their conclusions based on the data collected.

Students learn so much more by actually doing it than by just being told or even watching it being done (Abrahams, 2011). Science Practicals are quite efficient in creating new images of a particular subject and by doing things; you are likely to remember. However, the quality of the practical activity is a big concern as it determines the images created during the learning process and ultimately performance in the subject. An environmental factor such as physical buildings to offer classrooms and laboratories where equipment or apparatuses are kept and practicals are carried out is significantly important. As mentioned learning requires observation, measurement and recording of whatever you observe in the experiment workspace should be considered when designing the experiment and science lesson (Atibuni, 2015).

Student, teacher and school environment factors determine academic achievement in senior secondary school Chemistry in Oyo state (Adesoju & Olantunbosun, 2014). Chemistry teaching can only be result-oriented when students are willing and teachers are well-disposed to using the appropriate methods. The teacher, learner, curriculum and environment factors in

the whole process of teaching-learning are significant in the academic performance of science subjects.

The majority of Greek pupils in understanding Chemistry concepts, and therefore perform well in the National Examinations (Danili & Reid, 2012). The aim was to explore the problems and to suggest ways in which the situation might be improved. They suggested that approaches to learning must take into account cognitive factors in the learners in the context of information processing and understanding. If this is done, learning is much more effective.

Practical science involves doing experiments or practical exercises with scientific apparatus usually in a science laboratory. There are five types of teaching practical work in science: illustrative experimenting, enquiry-based experimenting, investigating, using basic skills and observing. For illustration experiments using online resources, students can access the Leybold science kit from www.leybold-shop.com. The online resources will help both teachers and students to understand the practical handling of chemistry experiments and knowledge. The digital application (DA) and the virtual laboratories (VLs) were constructed from scratch to be used from the Interactive Board (IB) sometimes others call IB a smart board for science (Papadinitropoulos, Dalecosta & Pavlatou, 2020). The innovation helps the students to discover new knowledge with information through teachers' guidance whereas inquiry teaching is largely investigative and involves providing students with content-related problems which serve as a focus for the subject research activity (Kibga, Sentongo & Gakuba, 2021). Experimentation can develop understanding related to the scientific content, problem-solving skills, science processes skills, understanding of the nature of science, students' self-confidence and high-order cognitive skill. In addition, although hands-on laboratory work is an indispensable element of understanding chemistry courses, various limiting factors such as insufficient laboratory infrastructure, overpopulated classes, lack of

teachers' self-confidence, and an excessive amount of time and effort required to conduct accurate experiments result in the use of experiments through demonstration and in many cases in the absence of experiments (Papadinitropoulos, Dalecosta & Pavlatou, 2020). This experience, in Greece, proposes to have STEM relevant in the secondary school education system.

Students get difficulties in the learning process and understanding Chemistry concepts and their alternative conceptions of Chemistry (Townsend, 2015). Therefore, interactive boards or the use of computers increase the possibility of passing chemistry because of the hands-on application using both digital applications to access remote laboratories. These learning facilities can enhance and motivate learners to study chemistry with the hope to win and succeed in chemistry. Remote chemistry laboratories prepare learners into critical thinkers.

The performance of mathematics in many countries in Africa has been on a downward trend hence STEM is currently the emphasis. Inappropriate teaching methods and a high staff turnover of mathematics teachers in the schools are also responsible for low academic performance. Thus there is a need to find out how teaching methods influence the performance of Chemistry in public secondary schools. Ndambuki (2013) observed that a lack of facilities or improvisation of learning resources makes chemistry an abstract subject.

In Uganda's secondary schools, the impact of the cooperative class experiment teaching style on students' chemistry achievement. The effects of the cooperative class experiment (CCE) learning materials on students' academic performance (Majere, Role & Makewa, 2012). The CCE method improved students' understanding of chemistry more than conventional approaches. Gender did not, however, influence performance. When the CCE approach was utilised, neither school type nor students' gender greatly impacted their academic performance, but it considerably impacted boys' performance, with students in boys' schools

receiving higher grades (Kabunga, 2018). Education authorities should urge chemistry instructors to utilise it and teacher educators to include it in the teacher-training curriculum because the CCE technique benefits pupils regardless of the type of school.

Primary school Background Knowledge and students' performance in chemistry

Education is a lasting process in a person's lifetime. Primary school education provides a foundation for secondary and higher education. Academic performance in primary education plays a crucial role in obtaining further educational opportunities. In China, primary schools are regarded as the foundation level of all education schools (Li & Qui, 2018). Poor primary school background in science, teachers' qualifications and inadequate laboratory facilities at primary and secondary school levels greatly influence students' performance in science. The setting and socializing influence of the primary school as well as the child's family mould the personality of the child. It is further believed that the falling level of academic achievement is attributed to teachers' non-use of verbal reinforcement strategy (Kambi, Oladaya & Fakai, 2020). The teachers and pupils should be able to understand their local language concepts to enable them to increase their knowledge.

In primary schools, 75% of teachers believe that pupils' performance is influenced by their home or family background (Kambi, Oladaya & Fakai, 2020). While 33.4% of students' performance is associated with primary school background knowledge, teaching-learning facilities at the primary school level were not considered to influence the use of teaching-learning facilities at secondary school levels (Kibalirwandi, Maate & Mwesigye, 2023). The example of Universal Primary education is presented for African low primary school foundations and how poor quality in primary school provides a poor foundation for secondary schools. What has been the impact of these free education policies in the country? Studies on the impact of the Universal Primary Education policy6 have highlighted how educational

attainment 7 increased whereas the quality of education declined 8. Concretely, it has been shown how UPE had generally had a positive impact on enrolment rates: they increased from 53.1% in 1990 to 94.2% in 1998.9 It is important to note that, while previous research10 shows a positive impact on completion rates, these rates remain low: Data based on the Ugandan bureau of statistics and Uganda Ministry of Education show that in 2003, only about 22% of the students who entered the schooling system at the start of the UPE had reached P7 in 2003 (Huylebroeck & Titeca, 2015).

Several studies have shown that children who enter kindergarten at age 48-54 months with educated parents have a high chance of learning a child is rigorous within the first 12 years and below (Escolano-Pérez; Herrero-Nivela & Losada, 2020). The brain develops through a dynamic interaction between underlying biological processes and exposures and experiences in the environment. This process begins at conception and continues throughout life (). During a child's early years, the brain develops in rapid and fundamental ways, and connections among neurons are reinforced (Foundation for Child Development; FCD, n.d). Motor skill development and cognitive development are inseparable hence household activities given to children like collecting water, sweeping, washing plates, cleaning tables, moving chairs, moving plates after eating, serving water, and serving food from the main table to individual coffee tables to mention but a few aim at building motor skills as well as cognitive development. A child who fails to follow instructions given by parents, will never efficiently follow instructions of the teachers. However, childcare and parenting experience can still dwarf both motor skills and cognitive skills (NIH-AP, 2007). In Russia, Switzerland, Australia, Japan, and Germany school entry is 6 (six) years, while in Sweden, children enter school at age 7, in England, they begin school between 4 and 5 years of age, and in New Zealand, children begin school on their fifth birthday, rather than on a specific uniform date in the fall. Although school entry also varies across the United States, with cutoff birth dates

for enrollment typically set by the state. children in traditional American schools begin kindergarten at about age 5. placing the United States in the earlier portion of school-entry ages when compared with other countries. In Uganda. children in the urban centres begin kindergarten at 36-48 months while children in the rural community begin between 48-60 months. The decision for a child to begin kindergarten is by the parents based on the distance between home and school, parents' financial capabilities to pay for the child, siblings to go with the baby. and the quality of kindergarten schools

Parental involvement is defined as concerning several different parental behaviours including parental aspirations for their children's academic performance. parents' communication with children. parents' participation in activities in school, parents' communication with teachers. parental rules and so on (Rahman. 2001). Numerous studies have been done to confirm the assumption that students do better when their parents are involved in their education. The parents remain in the first environmental microsystems of the child as proposed by Bronfenbrenner the American Psychologist (German. 2015). Involvement in parenting. communicating. volunteering. learning at home. decision-making. and collaborating with the community requires both parents and early childhood care professionals. There are several home-related parental involvement types as parenting style. discussing school activities. checking homework. aspirations and expectations. reading at home. supervision and home rules. while school-related aspects include contacting school personnel. attending parent-teacher organisations and volunteering at school (Siraj & Taggart. 2014; FCD. n.d). On the other hand. academic achievement can be defined as "learned proficiency. Academic achievement can be defined as learned proficiency in basic skills and content knowledge. Academic achievement describes academic outcomes that indicate the extent to which a student has achieved their learning goals. Academic achievement may refer to completing educational benchmarks such as a bachelor's degree. Academic achievement is often

measured through examinations or continuous assessments. Academic achievement can be defined as learned proficiency in basic skills and content knowledge. Documentation of achievement is an issue that has seen increasing concern among educators, policymakers, and the general public in recent decades and has been the driving force behind legislative and policy development in education since the turn of the 20th century.

Communities, parents, and sponsors should continue to be encouraged to build and maintain the physical infrastructure at educational institutions. This is because a lack of such facilities impedes learning (Republic of Kenya, 1988a). The relevance of school facilities in connection to high-quality education is noted by DFID (2007). Achievement differences could be attributed to different educational facilities. Classrooms, lecture halls, auditoriums, administrative buildings, libraries, workshops, play areas, assembly halls, and specific spaces like clinics, staff quarters, student hostels, kitchens, cafeterias, and restrooms are only a few examples of physical amenities. According to him, learning experiences are successful when there are sufficient physical facilities in terms of both quantity and quality. He also claims those unattractive school buildings, crammed classrooms, a lack of play areas, and environments devoid of aesthetic beauty can all lead to subpar academic performance. According to Fonseca and Conboy (2006), creating a culture of success can be aided or hindered by the physical layout and organisation of schools. According to the Ministry of Education Science and Technology, MoEST (2005), it is crucial to guarantee that there are sufficient and suitable facilities for teaching and learning for educational programmes to be executed successfully. It has long been believed that curriculum and instruction affect learning. But it's becoming more obvious that our schools' physical state might affect students' academic performance.

Attitudes of Students towards chemistry

Attitude can be defined as how a person views and evaluates something or someone, a predisposition or a tendency to respond positively or negatively toward a certain idea, object, person, or situation (Vargas-Sanchez, Plaza-mejia& Porras-Bueno, 2016). Attitude can further be defined as how a person views and evaluates something or someone, a predisposition or a tendency to respond positively or negatively toward a certain idea, object, person, or situation. It is traditionally structured along three dimensions: cognitive (perceptions and beliefs), affective (likes and dislikes, feelings, or evoked emotions), and behavioural (actions or expressed intentions toward the object based upon the "cognitive" and "affective" responses) as presented (Vargas-Sanchez, Plaza-Mejai & Porras-Bueno, 2016). The conative component relates to how we act in response to an object. Conative is when a person is acting a certain way toward something. It is sometimes referred to as the behavioural component of attitude because it focuses on behaviour. The person's attitude reflects their intentions. The cognitive process refers to the knowledge or beliefs someone has about a particular thing. The effective process is an emotional response to a certain thing. (Mcleon, 2023). Essential attitudes, but more challenging to locate in these two groups, are perseverance, originality, responsibility, independence of thinking, cooperation, and self-criticism. Teachers and society try to achieve these attitudes through school activities in teaching and learning science. Having a good, positive attitude, along with positive thinking, at work will reflect on what you do and make you a more productive employee. This can determine how well you get your projects done, also how others perceive you (Al-Najdi, 2013). Attitude implies evaluation, which is usually done on a bipolar continuum from favourable to unfavourable, or from positive to negative, that could comprise attributes such as good-bad, harmful-beneficial, pleasant-unpleasant, and likeable-dislikeable. In addition, these evaluations are related to a specific object, they are not "free-floating", but have a

quality of "aboutness" (McGrane, 2019). These attitudes are mainly a measure of the students' expressed preferences and feelings towards science, and for this reason, it is necessary to consider their importance and significance. They influence students' motivation and interests, and, therefore, their behaviour (Osborne, 2010; Mao, 2021). Our findings suggest a substantial relationship between attitudes and academic achievement. The results also suggest that academic achievement in chemistry is more dependent on attitudes toward science than the aptitudes of students. The basic premise underlying any teaching is that the pupil can learn and change and wants these things to happen regardless of past performance (Murkowski, 1999). Negative attitudes discourage, limit, and even prevent learning, positive change, and growth. Gender, instructional methods, and grade level were found to be the most common factors positively affecting students' attitudes toward chemistry (Musengimana, Kampire & Ntawiha, 2021). Research studies have identified several factors influencing attitudes towards science in general. These can be broadly defined as gender, personality, structural variables and curriculum variables (Osborne, 2003). Psychologists have identified three types of attitudes. These are; cognitive, affective and conative. The cognitive component refers to a person's knowledge or belief about something like one believes that all snakes are deadly; this is personal cognitive thought after a learning experience of an encounter or story of someone bitten by a snake. The affective component refers to a person's emotional response to something like when one talks of being terrified by a snake and a listener may hate all snakes. He/she is emotionally and effectively feeling about snakes. He feels terrified of snakes. The third type is the conative component which refers to actions taken this may lead to avoidance of particular situations or subjects based on what is known (Al-Najdi, 2013).

In inclusion, there is no single universal list of factors influencing students' performance in chemistry that makes a school effective in science subjects. As there is no single universal list of factors affecting schools' effectiveness (Siraj & Taggart, 2014). However, in some meta-analyses of studies, physical facilities, school management-related factors, teacher-related factors, family background, students' attitudes, frequency of laboratory practical lessons and location of schools whether in rural or urban areas have been investigated. The teaching-learning facilities have not been given attention by researchers to Indeed, the notion of "students' performance" is not without controversy, which is reported in chapter five where academic performance is an outcome of students' performance. The researcher in this study has categorically, identified the difference between students' performance and students' academic performance to be two different notions. There is a symbiotic relationship between teaching-learning facilities, teaching methods, learners' primary school academic performance and students' performance. The teaching-learning facilities include; textbooks specific to subject content knowledge, laboratory apparatus, laboratory consumables, laboratory space, handling policies and guidelines. These teaching-learning facilities do not function in isolation from teaching methods, teachers and non-teaching staff, and basic education from primary school which also bear pre-primary background knowledge of pupils. Pre-primary education includes home or family background which salient variable throughout the education life of the learner. In fact, in reality, the ecological systems theory explains how parents live in the nucleus of the learners' immediate environment.

CHAPTER THREE: RESEARCH METHODOLOGY

Introduction

This chapter presents the methodology used for this study. Specifically, it presents the study design, study population, sample and sampling techniques, data collection methods, instruments, validity, reliability, procedure and finally data analysis techniques. Research methodology is the specific procedures or techniques used to identify, select, process, and analyze information about a topic. In a research paper, the methodology section allows the reader to critically evaluate a study's overall validity and reliability (Mishra & Alok, 2017).

Research Design

The researcher adopted a cross-sectional survey design to pick only some representative samples from selected secondary schools to represent students of ordinary chemistry as a population. In this study, the investigator measured the outcome and the exposures in the study participants in senior three (S.3 and some chemistry teachers) at the same time in 2019 (Nandugwa, 2018; Mishra & Alok, 2017). A cross-sectional survey design was conducted across respondents over a short period between August 2019 and August 2020 and no follow-ups of the respondents were made. The process of data collection from the field was done in the third term of 2019 by students and chemistry teachers who responded in February 2020 before the outbreak of Covid-2019. The survey was also preferred because it allows the researcher to get detailed information about the factors influencing the performance of learners in chemistry at the ordinary level in Kasese Municipality, Kasese District.

Study Population

The population of study may still be called the population of interest which is a subset of the target population (Majid, 2018). In the secondary school setting, learners, teachers, head teachers, the ministry of education, and parents are key stakeholders in the student's performance. The study population was taken in Kasese Municipality located in Kasese District, Western Uganda. In this case, the population of interest is senior three (S.3) students waiting to join Senior Four 2020. The eligibility criteria consist of inclusion criteria which are the characteristics of a participant fit into the study population. On the other hand, all those characteristics that do not qualify a participant to freely participate in the study are known as exclusion criteria as detailed below. The researcher estimated a total population of 1936 people in the ten senior secondary schools in Kasese Municipality.

Justifying the target population, Kibalirwandi, Akena and Mwesigye, (2018) assert that university employees represent the interest of external stakeholders when evaluating the quality of the products. They are also consumers of the products from higher institutions of learning; quality assurance systems are consumed by both external stakeholders and internal stakeholders. Utilization of output by all stakeholders when quality is ensured; outcomes are evidence-based in any production project (Kibalirwandi, 2022). Some secondary teachers have their children taught from the same secondary schools and students' performance is their concern.

Senior three (S.3) semi-candidates were appropriate participants because senior candidates were preparing for the final examination since it was the third term. The chemistry teachers, head teachers and municipal education officers had children within the same schools as well as being key informants. Key informants are defined as participants with authentic information. The head teachers were having a record of the previous year 2018 and they also

were capable of providing records for 2019 as shown in appendix 10. Appendix 11 shows the very students who participated in the survey whereby 45% passed meaning that the situation is persistent in lower secondary schools.

The learners in senior three were in the third term waiting to face UCE in 2019 which equally was evaluated in appendixes 09, 10 and 13. Appendix 09 shows a combination of the academic year 2018 and 2019 in terms of subjects. Appendix 09 shows candidates that failed in the year 2018 to be 12.8% while in 2019 also 7.8% of the students failed. Comparing appendix 10 for Kasese Municipality the summary shows that 38.78% passed signifying that 61.22% failed chemistry and it was the worsted performed subject also.

Sample and Sampling technique

Kasese Municipality has 17 senior secondary schools that are three government granted aided and fourteen private and community secondary schools. A total of 10 out of 17 secondary schools participated in the study. A sample size of 331 human participants (respondents) was got from the ten secondary schools; Kasese Senior Secondary School, Kilembe Senior Secondary School, Mount Rwenzori Girls Senior Secondary School, Asamu Model secondary school, Kasese Muslim Secondary school, Standard High Senior Secondary School, Snow Heritage Secondary school, Maryland secondary school, Bright Academy and Rwenzori Christian Vocational Secondary School. These ten identified strati using Yamane's sample size determination formula.

Yamane's sample size determination formula.

$$n = \frac{N}{1 + N(e^2)}$$

(Chitechi, Mbugua & Omieno: 2018).

Where N=1936, e=0.05 and n=is not known.

When calculating n=1936/1+1936(0.0025).

Sample size (n)=1936/5.84=331.5

Random sampling was conducted, where names of 14 (fourteen) private schools were written and 7 secondary schools randomly pick from the box. The three government-aided secondary schools were purposively selected to constitute the sample. In each of the schools mentioned above, students were given papers written on true and not true, which helped all those who picked true from senior three classes from each of the selected schools to participate in the self-administered questionnaire. The 30 chemistry teachers, three head teachers and one municipal educational officer were purposefully recruited for the study.

Table 3. 1: Categories of the population and key informants

Category of participants	Target population	Sample size	Sampling technique
Students taking chemistry in S.3	1938	331	Simple random
Key informants for qualitative			
Municipal Education Officer (MEO)		1	Purposive
Head Teachers		10	Purposive
Chemistry teachers		32	Purposive
Total	1938	374	

Key informants for qualitative

The term "key informants" traces its origin in ethnographic research and is used widely in cultural anthropology (Cossham & Johanson, 2019). Key informants provide qualitative data through in-depth interviews suitable for surveys. Key informant interviewees are qualitative in-depth interviews with people who are well-informed about the subject under investigation (UCLA, 2020). The Chemistry Teachers understand the subject and the learners. The head teachers know their chemistry teachers and students' behaviour is well known to the head teachers. The Municipal education officer is well informed of students' performance and teachers' professional capabilities in teaching science subjects. Key informants, therefore, provide information related to community behaviour and culture which may not easily be explained by quantitative methods (Burnards, 2004; Morse, 2009; Onwuegbuzie & Leech, 2007). The involvement of both chemistry teachers and student participants in this study increased high chances of reducing the refutability of qualitative results. The in-depth interviews with key informants increased the freedom of the study from bias (; Onwuegbuzie & Leech, 2007). The use of both qualitative and quantitative methods increased the rigour design of this study to capture in-depth information for further investigation into teaching-learning facilities affecting students' academic performance in chemistry subjects at the low secondary school level in Kasese Municipality, Kasese District, Uganda.

Data Collection Instruments

The data was derived from primary and secondary sources. The primary source includes a questionnaire and interview guide that students in senior three (S.3) and Chemistry teachers responded to during the data collection. The key informants were some of the chemistry teachers, seven of the head teachers and one officer from the municipal education office in Kasese Municipality. External data from documents, websites, and reports provided the secondary data which improved substantially this report. The quantitative data was collected

from the students using a self-administered questionnaire while qualitative data was collected from the key informants.

Questionnaire

A self-administered questionnaire with twenty-seven items organized into four subsections: background information, teaching-learning facilities, teaching methods, and students' academic performance was administered to the students in senior three (S.3) as in appendix 01. A considerable advantage of the self-administered survey is the potential anonymity of the respondent, which can lead to more truthful or valid responses. Also, the questionnaire can be filled out at the convenience of the respondent. Since there is no interviewer, interviewer error or bias is eliminated (Belisorio, 2015). The background information of the participants measured also students' motivation/attitude towards chemistry subject. It also captured previous performance in Mathematics, science and English at PLE. Background information identifies and describes the participants because of the well-defined research problem. The background information used in chapter one is different from the background used in the questionnaire or literature review. The background information includes gender, age, race, level of education, family background, health status, parents' income level, and marital status, to mention but a few (Chen, Kong, Gao & Mo, 2018). Based on the objectives of the study and existing literature review a researcher may include more or less of the identifiers (Chen, Kong, Gao & Mo, 2018; Brey, Musu & McFarland, 2019).

Interview

The structured interview guide in appendix 02 was administered to the key informants some teachers of chemistry, seven head teachers, and one person from the office of the MEO. The three items in the structured interview guide (Appendix 02) were used to investigate the teaching-learning facilities' effect on students' academic performance in Kasese Municipality.

The interview tools help the researcher to explain and get a better understanding and explore research participants or subjects' opinions, behaviour, experiences, phenomenon, etc. Interview questions are usually open-ended questions so that in-depth information will be collected (Clements, 2015). The probe question used helped in delving into a deep understanding of search of the effect of teaching-learning facilities on students' academic performance in chemistry.

Quality control

The self-administered questionnaire was first pre-tested from two schools in Bukonzo East Constituency. One school was public and another was a private secondary school in Kisinga Town Council. Some redundant items were removed to increase reliability and validity. The questionnaire for teachers was made into an interview guide other than being a self-administered questionnaire. The observation checklist was also developed to ensure that information not captured by the other tools may be captured. The control helped the study to restrain the influence of extraneous variables in the results during data analysis. Extraneous variables are independent variables that are not related to the purpose of research yet are capable of influencing the results. When the dependent variable is not free from the influence of extraneous variable(s), the relationship between the dependent and independent variables is said to be confounded by an extraneous variable(s) (Kothari, 2004). In this study, the researcher did not use confounding variables in the analysis.

Validity

The validity of a research instrument is the degree of accuracy at which the research instrument measures what it purports to measure. The researcher used five raters in testing for Content Validity Index (CVI) and the raters' percentages was (88 + 81+ 92+ 96+ 93) while

the 27 items. CVI was got to be 0.90 which stands at 90%. Using five raters was considered normal (Kibalirwandi, Akena & Mwesigye, 2018). Validity explains how well the collected work covers the actual area of investigation (Taherdoost, 2018). The three common types of validity are; face validity, content validity and construct validity. The Pearson correlation coefficient above also known as Pearson's product-moment correlation coefficient represents construct validity. The Pearson correlation of the questionnaire based on the 27 items twenty entries during the pilot study r=0.895 implies that validity was above 0.35 which is accepted as beneficial or sufficient (Oktavia, 2018).

Reliability

The reliability of an instrument indicates the consistency of the scores acquired from the instrument. The term reliability was first introduced by Spearman in 1904 who defined it as the ratio between the variances of the true scores with the variance of the observed scores. By estimating the reliability of an instrument, several criteria for the consistency of the scores can be explained (Oktavia, 2018). Cronbach's alpha is the most common measure used in measuring reliability. Reliability is the consistency of the research tools like the questionnaires' items. The reliability measures the three aspects of the tool: equivalence, stability and internal homogeneity.

The tool was pre-tested with 35 participants from two schools in Bukonzo East Constituency where one public/grant-aided provided 20 participants and one privately owned under PPP provided 15 participants. The questionnaire had 37 items that gave reliability was α=.578. The unstandardized items were deleted and a re-test was taken to give only 27 items. The table shows the first pilot test and the re-test showed Cronbach's alpha α=.713. Item 27 was formatted to provide D1-C6 as passed chemistry while P7_F9 signifies failure. This item made the questionnaire gain the reliability of α= .895

Reliability Statistics

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.578	.713	27

The reliability above 0.701 is sufficient to collect data that is empirically reliable and test what it purports to test.

Data Analysis

Data analysis is a systematic search for meaning and interpretation using both qualitative and quantitative. Data analysis is a way to process qualitative and quantitative data that the study is capable of presenting findings as communicated to others. Analysis was done using descriptive statistics where frequencies, mean and cross-tabulation were applied. Bayesian statistics were also applied since they capture the presence or absence of correlation between any two variables and determine the exact extent or degree to which they are correlated. Bayesian Statistics allows the researcher to continuously monitor the evidence in favour of (against) a hypothesis with Bayes factors (Bartos, Aust & Haaf, 2022). Pearson correlation coefficient provides evidence that the r test for reliability (Oktavia, 2018). Bayesian statistics has not been applied by most researchers because they are not familiar with it (Bartos, Aust & Haaf, 2022). The Chi-square was used to establish the effect teaching-learning facility on the student's performance in chemistry. The analysis was extended to establish if primary school background knowledge affected students' performance in secondary schools.

Quantitative Analysis

The research is guided by three objectives as stated in chapter one. A descriptive presentation where frequencies and means were used to establish general agreement on the 27 items provides evidence that a problem exists and possible solutions are significant. The interpretation given is based on statistical assumptions that details presented in chapter four provide insight into the problem. The nature of the variables shows that the dependent variable has a relationship with several independent variables where teaching-learning facilities account for a little but significant percentage. The Bayesian capture estimates without transformation of means hence all 27 items were used to determine the linear regression and Pearson correlation coefficient as shown in table 4.11 below.

Qualitative Analysis

Qualitative data does not make external statistical generalizations because the goal usually is not to make inferences about the underlying population. Qualitative data attempts to obtain insights into particular educational, social, and familial processes and practices that exist within a specific location and context (Onwuegbuzie & Leech, 2007). The use of both qualitative and quantitative increase high chances of problem analysis under investigation. The observation checklist used improved the credibility as well as an attempt to reduce bias in the qualitative data collected. The qualitative data was collected, transcribed, organized into themes, and presented in chapter four following consensus and agreements that most participants accepted. The verbatim statement presented in chapter four, by consensus participants was in agreement with the expressed opinion. The emerging cases like the need to train science teachers in English, under "teaching chemistry in English" as a second language resulted from item 23 in appendix 01 where recorded data within the document is a recommendation as well as discussion points of concern.

Measurement of Variables

The study used both the nominal scale and ordinal scale in the measurement of data. A nominal scaling was used for capturing gender, age, and occupation while an ordinal scale was used in ranking the data. In the study, the researcher used an ordinal scale based on a four-item Likert scale because it is very flexible and can be constructed more easily than most of the other types of attitude scales (Amin, 2005). The scale rating was 1-4 points and was showing the respondent's level of agreement with questionnaire statements. The Likert scale was used to measure participants' personal opinions towards the subject by asking the respondents to indicate where they Disagree, Not sure, Agree, and strongly agree with the statements about the topic. Data analysis was done by categorizing responses into frequency counts and percentages where 1= Disagree, 2 = Not sure, 3 = Agree, and 4 = strongly agree.

Inclusion and Exclusion Criteria

The characteristic of participants eligible for this study was students in senior three doing chemistry as a subject, enrolled in secondary schools within Kasese Municipality. Inclusion criteria are defined as the key features of the target population that the investigators will use to answer their research question (Patino & Ferreira, 2018). Inclusion criteria include demographic characteristics, and social, mental, and geographical that their participation will not compromise the study outcomes. In contrast, exclusion criteria are defined as features of the potential study participants who meet the inclusion criteria but present with additional characteristics that could interfere with the success of the study or increase their risk for an unfavourable outcome (Hornberger & Rangu, n.d). In this study, a student who did not know his/her previous term results in the chemistry examination was not allowed to participate. A new student in senior three who transferred from other secondary schools within or outside the Kasese Municipality was not recruited for the study.

Ethical Consideration

Ethical considerations in research are a set of principles that guide research designs and practices. These principles include voluntary participation, informed consent, anonymity, confidentiality, the potential for harm, and results from communication (Fleming & Zagwaard, 2018). These considerations work to; protect the rights of research participants, enhance research validity and maintain scientific or academic integrity. These principles were approved by the relevant authorities ranging from the candidates' department at Mbarara University of Science and Technology. About the postgraduate handbook, all proposals and theses shall be first approved by the supervisor and duly signed. A copy of the signed proposal shall be forwarded by the line department for approval, the approval at the department shall be granted after the candidate has presented the proposal to the department forum which includes at least two or more of the senior staff members. The senior staff member knowledgeable in the area of research becomes a main panellist to further advise the candidate. The department recommends to the candidate and REC/IRB at MUST to discuss the protocol and invites the candidate to present after it was approved. The MUST/REC recommended the protocol reference HRM 93/11/02 to UNCST (MUST, 2014). The study was approved by Uganda National Council for Science and Technology (UNCST) reference SS5043, office of the President reference HRM 93/11/02 as recommended by Mbarara University of Science and Technology Reference MUREC 1/7. The documents supporting this approval are attached in the appendix.

Limitations of the study

Limitations are conditions beyond the control of the researcher that place restrictions on the conclusion of the study and its applications (Kagaba, 2017). In this study, the researcher had challenges and they were adequately handled,

The first limitation was to establish the potential main participant to respond to the research questions since it was about establishing the effect of teaching-learning facilities on students' performance in chemistry in selected secondary schools in Kasese Municipality. The researcher, worked with an expert panel to establish the questionnaire and establish potential respondents who are in this case senior three (S.3) students doing chemistry subjects and have been in each of the schools at least in senior two as detailed in the inclusion and exclusion criteria. The main participants/subject/respondents were to answer or respond to the self-administered questionnaire.

The teachers and head teachers were to be given also the questionnaire as earlier planned, but it was identified that some information would not be fully discovered. Therefore, an interview schedule was immediately taken to delve deeper as the researcher could probe to dig deeper into the subject matter. The researcher did not get collect or interview any teacher at school he was purposively selective in identifying chemistry teachers to respond to the interview schedule in the appendix. These were identified after data analysis from the main participants (students) the information was to verify the quantitative data and information collected to fill the gap and proposal a real solution to the problem.

CHAPTER FOUR: PRESENTATION, ANALYSIS AND INTERPRETATION

Introduction

This chapter presents the both quantitative and qualitative findings of the study. The teaching-Learning facilities affect the student's performance in chemistry subject. The Uganda Certificate Examination results in the years 2018 and 2019 summary as attached in Appendix 09 shows that the best-performed subject was Arts (IPS) with a 99.2% overall pass, and Chemistry the worst-passed subject with 46.5%. Of the senior four (S.4) students who sat for chemistry subject only 46.5% passed and 53.5% all failed the subject in 2018 and 2019 respectively (The Independent, 2020; Serugo, 2019). As appendix 10 shows students' performance in science subjects in Kasese Municipality and chemistry was also performed with 38.75% in 2018 and 45.54% in the year 2019.

This shows that in Kasese municipality 61.25% of students failed chemistry a situation in that parents can hardly trust teachers in Kasese Municipality with their children. The above forms the basis for this data to be collected, analysed and interpreted to explain the relationship that exists between teaching-learning and students 'academic performance in chemistry subject. The findings include responses from 325 students in senior three (S.3) and 30 teachers of Chemistry from the ten selected senior secondary schools within Kasese Municipality. Seven head teachers and one person from the office of the municipal education office responded as key informants in this study.

The response rate was as the summary in table 4.01 below.

Response Rate

Table 4. 1: The response rate

Category of participants	Target population	Sample size	Actual participants	Response Rate
Students taking chemistry in S.3	1900	325	325	100%
Key informants				
Municipal Education Officer (MEO)	1	1	1	100%
Head Teachers	17	10	7	70%
Chemistry teachers	35	32	30	93.8%
Total	1938	368	363	98.6%

Respondent's Bio-data

The participants were the sample of students taken from senior three (S.3) whose age was between 15-21 years old both male and female; 33.5% and 66.5% respectively. The second category of participants was the key informants which includes; the chemistry teaching staff of 30 participants; 18 (60%) males and 12 (40%) females, the seven head teachers and one person from the office of the Municipal education office were consulted as key informants in this study.

Table 4.02 above shows that 68.99% (N=149) female students performed better in chemistry as compared to 65.14% (N=71) male students. That is gender does not very much influence the performance in chemistry at a mean of 1.66 with a standard deviation of 4. 473. Also, a type of school that is "public or private secondary Schools" of mean 0.514 with a standard deviation of 2.539 does not seem to influence the students' academic performance. The scale for gender is 2 while school 10 within this results show that gender and type of school descriptive mean is proving insignificance to determine high academic performance in chemistry yet it cannot be neglected.

Table 4. 2: My average performance *in chemistry* * *My gender is Cross tabulation*

Count				
		My gender is		Total
		"Male"	Female	
My average performance in chemistry	D1	5	22	27
	D2	12	23	35
	C3	17	19	36
	C4	16	24	40
	C5	11	30	41
	C6	10	31	41
	P7	15	15	30
	P8	3	25	28
	F9	20	27	47
Total		109	216	325

Key Interpretations

Performance between D1-C6 is treated as passed, and P7-F9 is treated as failed in the internal evaluation. However, it was agreed that failed grades can be improved during the final examination. The researcher further established the chi-square between the participants' gender, current school and students' performance in chemistry.

Table 4. 3: Chi-Square Tests between my gender, current school and performance in Chem

	Value	df	Asymptotic Significance (2-side
Pearson Chi-Square	194.952[a]	72	.0
Likelihood Ratio	203.308	72	.0
Linear-by-Linear Association	.396	1	.5
N of Valid Cases	325		

a. 74 cells (82.2%) have an expected count of less than 5. The minimum expected count is 1.66.

When testing the effect of gender, the current school of the learners and students' performance in chemistry the Chi-square was $\chi^2=194.952^a$ in table 4.03 signifying that a relationship exists. As the researcher wanted a clear understanding of the statistics, the

interviewee supported the findings from a qualitative point of view. The relationship exists because some schools in this municipality lack favourable teaching-learning facilities like textbooks, laboratory equipment, and consumables such as chemicals and other metal oxides, salts etc. The interviewee's argument is supported by the results in table 4.04 below which shows that schools marked 3 & 9 failed chemistry. School number 3 had 68.75% of participants failing chemistry below C6 and school 9 had 5) % failing chemistry. Of these two schools one is publicly supported by the government and another one is privately owned by a businessman in Kasese municipality. There is no evidence that all students enrolled at schools 3 & 9 are not capable of passing chemistry.

Table 4. 4: Cross Tabulation * my average performance in chemistry * My Senior Secondary School *

		Participating in Senior Secondary School in Kasese Municipality										
Category	Grades	1	2	3	4	5	6	7	8	9	10	Totals
My academic Performance in Chemistry Subject	D1	4	1	0	0	0	7	0	2	0	13	27
	D2	7	4	1	2	5	2	0	6	2	6	35
	C3	7	12	1	1	2	5	0	1	1	6	36
	C4	5	10	3	3	4	3	2	5	2	3	40
	C5	7	6	2	2	1	1	5	8	5	4	41
	C6	4	3	3	3	10	0	7	10	1	0	41
	P7	3	3	1	3	6	2	2	2	3	5	30
	P8	2	0	10	3	2	3	3	0	3	2	28
	F9	2	0	11	4	11	5	1	6	5	2	47
	Totals	41	39	32	21	41	28	20	40	22	41	325

Senior Secondary Schools

1. Kasese Senior Secondary School*
2. Kilembe Senior Secondary School*
3. Mount Rwenzori Girls*
4. Asamu Model Secondary School
5. Kasese Muslim Secondary school
6. Standard High Nyamwamba
7. Snow Heritage Secondary School
8. Maryland High School
9. Bright Academy SS
10. Rwenzori Christian Vocational Secondary School

The above secondary schools marked with asterisks are government-aided secondary schools with adequate supplies of textbooks, and laboratory equipment and teachers are paid well by

the government. As mentioned, government grant-aided secondary schools marked with asterisks * had 28.57% failed students in chemistry while private secondary schools had 34.27% failed students. The failure of chemistry subject may not be attributed to the type of school since school number 3 (three) table 4.03 above is government grant aided.

Table 4. 5: A regression between my performance in chemistry subjects and PLE grades at enrolment in secondary school.

Bayes Factor Model Summary [a, b]						**sign**
Bayes Factor [c]	R	R Square	Adjusted R Square	Std. error in the Estimate	f	
.001	.471	.222	.152	.46	3.192	0.001
a. Method: JZS						
b. Model: (Intercept), My Score in PLE Mathematics was, My PLE results in Science was, My English Results in PLE were as						
c. Bayes factor: Testing model versus null model (Intercept).						

The results in table 4.05 above show that R=0.471 which is the Pearson correlation and R^2=0.222 implying that entry results of primary seven (PLE) can only account for 22.2% and other variables account for 77.8%. The f-ratio mentioned in table 4.05 above implies that the testing model has a small percentage to allow rejection of the null model, "There is no significant relationship between my performance in chemistry and my previously obtained grades in PLE". Results show that F-ratio is 3.192 implying little support to accept the null hypothesis. Therefore, the null hypothesis that "There is no significant relationship between my performance in chemistry and my previously obtained grades in PLE" was rejected and the alternative hypothesis accepted that "background primary school knowledge is significant for a learner to perform well in secondary schools". This may be seen in empirical evidence in Chi-square table 4.06 below.

Table 4. 6: Chi-square test between my performance in chemistry and background knowledge in primary school.

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	150.686[a]	56	.000
Likelihood Ratio	149.640	56	.000
Linear-by-Linear Association	33.652	1	.000
N of Valid Cases	325		

a. 44 cells (61.1%) have an expected count of less than 5. The minimum expected count is .17.

The chi-square test for independence also called Pearson's chi-square test or the chi-square test of association, is used to discover if there is a relationship between two categorical variables. In this case, students' performance in chemistry subjects and students' gender, and students' type of school show the high value of Pearson chi-square statistic; χ^2=150.686[a] signifies a high the more likely it is to be significant. The likelihood-ratio chi-square statistic G^2 = 149.640 is based on the ratio of the observed to the expected frequencies. The likelihood ratio that is greater than 1 signifies that the test results are associated with the usefulness of gender and type of school. There is a presence of a problem with gender and type of schools in Kasese Municipality. The evidence can be traced from the results shown in table 4.04 where school marked 3 had 22/32 (68.75%) failures and 31.25% passed in chemistry. School number 3 is a single girl's school within the Municipality. Private School number 4 belongs to a businessman who does not know school management compared to some private schools 10 and 9 both owned by professional teachers. Then we conclude that both gender and type of school in terms of management and available human resource remain significant in influencing students' performance in chemistry.

The quality of primary school education is crucial in designing the quality of secondary school and post-secondary quality of education (Li & Qui, 2018). China's primary education and secondary education have been designed to feed universities and other tertiary education institutions for the development of the human resource. The foundation of primary schools is the pre-primary education given at home and nursery schools. The education system should be able to acknowledge quality pre-primary education, primary schools, lower secondary school and high secondary in pursuit to prepare the quality of university graduates. This is in agreement with the general goal of the Ministry of Education and Sports, "The goal of education is to provide Quality Education and Training policies to all Ugandans". Government has therefore continued to put in place measures to address equitable access to affordable quality and relevant education in line with international, regional and national policies as well as legal commitments" (MoES, 2010; Uganda, 2015). The current failures obtained in chemistry at UCE do not provide evidence and value of money injected in both primary and secondary schools. There is a record of work to prove that, Less than half of children are literate at the end of primary school. In secondary school, only 15 per cent of students are proficient in biology, 43 per cent in English and 47 per cent in mathematics. The cause of this senior may be associated with teaching-learning facilities that require collective effort in securing them to the schools. The school environment also plays a part in children's motivation to stay in school and learn (UNICEF, 2019). This scenario requires further guidance on UPE and USE program implementation to enhance value for the money and increase equitable and quality education in the country.

Descriptive Presentation and analysis of the findings

The dependent variable was the academic performance in chemistry and the independent variables were. teaching-learning facilities. teaching methods, and generalized factors affecting the teaching of chemistry subjects at the ordinary secondary level in Uganda. The students in this study form primary respondents whose information should be extracted for purpose of the understanding circumstance surrounding the phenomenon understudy. The chemistry teachers partly inform the study as main key informants followed by the head teachers and the municipal education officer. The main research tool for students was divided into four sections; background information had seven (7) items or sub-constructs. section B teaching-learning facilities had six (6) sub-constructs, section C teaching methods had six (6) sub-constructs and section D generalized factors affecting the student's academic performance in chemistry had six (6) sub-constructs. The three independent variables used a 4-point Likert scale disagree, not sure, agree and strongly agree.

Teaching-Learning Facilities and Academic performance in chemistry

Table 4. 7: The effect of Teaching-Learning Facilities on Academic Performance in Chemistry.

Teaching-Learning facilities	DA	NS	A	SA	X	Std. dev't
Reference textbooks are frequently used in class	44.3% N(144)	4.9% N(16)	30.2% N(98)	20.6% N(67)	2.27	1.225
Practical work is frequently used in science laboratories	19.7% N(64)	7.7% N(25)	25.5% N(83)	47.1%	3.00	1.157
The school has a laboratory assistant who helps in preparing practical lessons	3.4% N(11)	5.8% N(19)	27.1% N(88)	63.7% N(207)	3.51	.756
The school has adequate lab apparatus for chemistry	18.2% N(59)	7.7% N(25)	25.5% N(83)	48.6% N(158)	3.05	1.136
The Lab apparatus are used frequently used by students to demonstrate observation skills	20.6% N(67)	9.5% N(31)	29.5% N(96)	40.3% N(131)	2.90	1.147
Laboratory practical texts books are available to students	58.8% N(191)	9.8% N(32)	18.2% N(59)	13.2% N(43)	1.86	1.132

Key: DA means Disagree, NS means Not sure, A means Agree, SA means Strongly Agree, X=mean, and std. dev't means standard deviation. The participants were N=325, whose responses appear in table 4.07 above.

The mean above 2.5 indicates general agreement while the below 2.49 implies disagreement. However, the pooled mean for the whole variable is 2.765 implying 69.13% for general agreement implying that teachers do not frequently use chemistry textbooks in class. In table 4.07 above, an overwhelming support (90.8%) of participants claim that secondary schools have laboratory assistants who always help chemistry teachers in the preparation of laboratory experiments for easy lab management. The 3.51 mean implies that there was general agreement with the statement mentioned in table 4.05 above. This explains why appendix 09 national statistics and appendix 10 Kasese Municipality statistics shows improvement between the year 2018 and 2019 n students' performance in chemistry and other subjects. This may be guessed right that after failing in 2018, head teachers and school management committees may have improved in the provision of teaching-learning facilities.

The researcher interviewed one head of the chemistry department, "why is this being reflected that chemistry teachers do not frequently use chemistry texts books in classes when teaching?" the interviewee responded by saying, *the reference books that were sent from the Ministry of Education and Sports are never frequently used because some teachers use pamphlets written by teachers from best performing secondary schools in Kampala.* On probing, one of the heads of the chemistry department, the argument was refuted, *some teachers who part-time in many secondary schools often have less time to concentrate looking for lesson notes from textbooks.* As the researcher further probed, what is the most common pamphlet on the market in ordinary-level chemistry? The researcher further inquired from one of the teachers in charge of SESEMAT to establish why teachers frequently prefer pamphlets to subject reference texts books. The interviewee from an informed point of view argued, *Government has basic textbooks to be used and other authors of pamphlets are simplifying work targeting market and examination knowledge only. But if a student would take time to read through the textbook with their teachers, then would understanding and passing be possible? However, teachers do not make references to authentic textbooks given by the government.*

The empirical evidence shows that libraries are teaching-learning facilities that have not been used effectively by teachers to enhance students' potential for research from textbooks and laboratory experiments. The sub-construct, "Practical work is frequently used in science laboratories" was accepted by 72.6% with a mean of 3.0 and a standard deviation of 1.157. These calculations imply that chemistry teachers present most of their chemistry lessons from science laboratories. This may be the cause why 67.7% of participants claim to be passing chemistry. The said 67.7% agree that their performance in internal examination is always between D1-C6, while 32.3% argue that their performance is between Pass (P7) and F9 as in table 4.07 and table 4.02 above.

The statement that "The school has adequate lab apparatus for chemistry" in table 4.07 above was generally accepted by 74.1% with a mean of 3.05 and a standard deviation of 1.136. While inquiring from one chemistry teacher he was able to say, *Government has been giving funds to most private secondary schools under a private partnership policy. These funds are sometimes known as USE capitation grants*". As the researcher was able to find out from one head teacher said, "*Government allows head teachers and management to purchase more laboratory equipment from such funds like USE capitation grants. Both private and public secondary schools can use such an opportunity.* Also, government-aided secondary schools have received laboratory equipment and textbooks from the Ministry of Education and Sports. The participants further agree that *the Lab apparatus are used frequently used by students to demonstrate observation skills.* The general agreement on the above variable is having a mean of 2.90 and a standard deviation of 1.147 as shown in table 4.07 above.

Finally, on these variable participants still argue that laboratory guide textbooks are not adequately owned by the students. Participants who do not agree with the availability of laboratory textbooks were 68.6% with a mean of 1.86 implying that participants are not in agreement with the availability of laboratory textbooks in the schools. The interviewee explained that the practical guide or laboratory text handbook has got several practical questions that students can use. The participants argue that,

The teaching-Learning facilities contribute a lot to students' academic performance because issues to study chemistry require observation and recording. Like preparation of laboratory experiments like the preparation of hydrogen gas. Students have to be in the laboratory, apparatus, and substances like Zinc granules, Copper (2) Sulphate as a catalyst and Hydrochloric dilute acid must be prepared by the laboratory assistant in time. This variable is fit for this inquiry because it provides the existing realities.

The students are supposed to observe, write and calculate for a rate of reaction. All these above-mentioned must be considered for accessibility of the teaching-learning facilities. An example of a chemistry practical guide found on the website is Ivan Muduku for ordinary-level chemistry practical guide. This author has written both chemistry practical guides for the "O" level and "A" level with organized content on; volumetric analysis, qualitative analysis, chemical kinetics and thermo-chemistry. The chemistry practicals were identified to be significant as another interviewee responded to the question about chemistry practical guidebooks. *As head teachers, we encourage our teachers to write and organize their lesson notes into booklets so that they keep reviewing their work in class and mastery of content will be possible for both learners and teachers.* However, school management allows the head teachers to purchase books as recommended by the heads of the department such as chemistry, biology, physics, computer, and mathematics. STEM has been emphasized by government leaders as well as international agencies and governments.

Table 4. 8: My Average Performance in Chemistry

Table 4.08 My average performance in chemistry

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	D1	27	8.3	8.3	8.3
	D2	35	10.8	10.8	19.1
	C3	36	11.1	11.1	30.2
	C4	40	12.3	12.3	42.5
	C5	41	12.6	12.6	55.1
	C6	41	12.6	12.6	67.7
	P7	30	9.2	9.2	76.9
	P8	28	8.6	8.6	85.5
	F9	47	14.5	14.5	100.0
	Total	325	100.0	100.0	

Table 4.08 above shows that 19.1% of students obtain distinctions (D1 &D2) in chemistry while 48.6% of the participants can obtain credit passes (C3-C6) in internal examinations.

The trying students of 17.8% obtains passes 7 and 8 while 14.5 (N=47) fail with F9 grades as shown in table 4.07 above. The information provided in the field brings hope that performance in chemistry may improve to 67.7% in the year, 2020. However, the projection could not come true because of covid-19 pandemic students were forced into lockdown.

Teaching Methods and students' Performance in Chemistry

Table 4. 9: Descriptive statistics on teaching methods and performance in chemistry.

Teaching methods/Strategies	DA	NS	A	SA	X	Std. dev'
Teachers' knowledge and skills are very good in chemistry	12.9% N(42)	5.2% N(17)	26.2% N(85)	55.7% N(181)	3.25	1.034
The class has students who get above 80% in chemistry	39.4% N(128)	18.5% N(60)	23.1% N(75)	19.2% N(62)	2.22	1.159
The effectiveness of teaching chemistry is a result of students' activeness	13.5% N(44)	12.9% N(42)	34.2% N(111)	43.4% N(141)	2.99	1.033
I observe the processes of experiments in laboratories well	14.5% N(47)	9.5% N(31)	32.6% N(106)	43.4% N(141)	3.05	1.053
I write well what I observe during laboratory experiments	13.5% N(45)	8.3% N(27)	35.7% N(116)	42.2% N(137)	3.06	1.029
I participate in small groups discussing chemistry	26.2% N(85)	4.0% N(13)	31.7% N(103)	38.2% N(124)	2.82	1.200

Key rating

DA means Disagree, **NS** means Not sure, **A** means Agree, **SA** means Strongly Agree, **X**=mean, and **std. dev** means standard deviation

Any mean above 2.5 implies that there is general agreement signifying that participants agree that teachers' knowledge and skill affect students' academic performance in secondary schools in Kasese Municipality. The interviewee argued that *teaching methods require the teacher to be skilful with scaffolding strategies. When building a mansion, a builder will get ladders to help him to reach high heights. That stand is a scaffold. The teacher has to look for learning aids like digital teachers.co.ug/a-level-physics-chemistry/teachers' skills and knowledge to help students to learn how to observe demonstrations and experiments in*

chemistry. However, demystifying the fact that chemistry is a hard subject must be handled by chemistry teachers.

Scaffolding in the teaching of chemistry like any other science is important to enhance understanding and critical thinking among learners. Scaffolding refers to a method when teachers offer a particular kind of support to the student as they try to learn and develop new concepts or skills. The first strategy requires "show and tell", the second "tap into the prior knowledge", the third, "give time to talk", the fourth, "pre-teach vocabularies", the fifth, "use visual aids", and the sixth step is to "pause, ask questions, pause and review" (Alber, 2014). Questions should be designed early enough that are open-ended not closed questions that will always require Yes/No responses. For instance, experiential learning will require students to actively get engagement through doing and reflecting on activities which empower them in critical thinking and prepare them for future reference. The questions are stated in an open-ended style such as; how is oxygen prepared in the laboratory? How do you confirm that the gas prepared is oxygen? What materials and equipment will a scientist require in the preparation of oxygen in the laboratory? How is oxygen important in the hospital? Why should oxygen be carried in plastic bottles or glassed with close-fitting covers? All these mentioned open-ended questions require critical thinking.

The key informant interviewed said *SESEMAT has often organized capacity-building workshops that have improved teachers' skills in the teaching of chemistry and other basic science subjects in Kasese and Uganda at large. However, without sending science teachers for refreshed course pieces of training, skills may not be up-to-date.*

The chemistry subject achievements by the students gaining above 80% in internal examinations show that the course works had a low mean as shown above in table 4.09. The mean of 2.27 implies that there is low agreement that students do obtain above 80%. These

statistics are in agreement with what was revealed in table 4.08 above where students who get D1 and D2 were only 19.1%. The researcher wanted to know, "if the use of textbooks and chemistry pamphlets would make a difference in achieving high grades in chemistry subjects". An interviewee who was a head of the department chemistry argued,

In chemistry textbooks like New Chemistry by Lambert, students can get detailed information to aid high performance in class. Pamphlets sometimes are results-oriented but they cannot make students understand well the knowledge required for the best students .these pamphlets encourage rote or memorization with little understanding of the subject content. In most cases, some pamphlets have proved poor in terms of mistakes committed while typing and printing. These pamphlets lack proofreading and content editing by a reviewer or academic editors. A single page may have 10-15 mistakes which are a result of a lack of proofreading the work. The current curriculum requires a deep understanding which may not appear in the pamphlets. The question of why teachers want pamphlets is about part-time teachers having no time to prepare notes from subject course books.

Participants agree that they observe well the experiments in a science laboratory. The sub-construct mean of 3.05 and the standard deviation was 1.053 were observed. It was further observed that participants agree that they write well what they observe during experiments at a mean of 3.08 as shown in table 4.09 above. The chemistry teacher interviewed further elaborated; *there is a need to understand the preparation, process and output stages in most chemistry experiments. As mentioned, when teaching volumetric analysis experiments. Volumetric analysis is the experimental analysis of determining the mass or concentration of a substance relative to another substance of known concentration called a standard solution. The experiment may require the following; 1. Standardisation of acids or bases, 2- Determination of the atomic mass of a metallic element or radical, 3- Determination of several moles of water of crystallization in the hydrated compound, 4- Determination of*

basicity of an acid". The laboratory textbook guides can piecemeal these experiments into 2-6 following step by step. These experiments help the learner to conceptualize the idea or topic on volumetric analysis.

The researcher wanted to find out how laboratory guide textbooks are acquired and who prepares them. One of the interviewees said, "*Teachers of chemistry prepare lab guide textbooks for experiments. These manuals or pamphlets are presented to the school administration. At the closure of the year, in the parents' circulars, parents are informed of the price for each pamphlet laboratory guide and parents are requested to purchase. For instance, the school may request parents to pay 10000-20000 shillings per copy! This helps teachers not to get involved in money collection from students.* The participants in this study accepted that students pay for practical lesson guide booklets which happen to be additional income to the teachers.

The head of the chemistry department further explained, *In chemistry laboratory experiments, the teacher will have explained the volumetric analysis how to write an equation, standardization of acids and bases, calculate moles preparation of hydrogen and then inform the laboratory assistant to prepare for the experiment. The keywords would be pipetting, add an indicator, titrate with solution BA2, and observation.* The researcher probed by asking, "What is the work of the lab assistant then?

A teacher in the department hereafter referred to as "interviewee" responded, *The work of the Lab assistant is to organize the apparatus, Mark Solution BA1 which is 0.1M sodium carbonate solution, BA2 which is the hydrochloric acid solution of unknown concentration. At the time of preparation, the lab assistant with the chemistry teacher may run the experiments during the pre-class time to understand better process and output. The Lab*

ssistant will keep a record of research and document findings of particular research done ithin the laboratory.

he above responses provide explanations as to why teaching-learning facilities, teaching ethods and changed or directed "mindset" would be pertinent for students' performance in iemistry. However, some items in table 4.09, and table 4.10 above show low mean implying w agreement in accepting the statement presented as posterior distribution. The belief that l knowledge originates from previous cognition is the posterior. However, the knowledge ay account for 22.2% as shown in table 4.05 above which provides R^2 to be 0.222. The R^2 table 4.05 implies that other factors can account for the variation (Field, 2009).

able 4. 10: General teaching methods influencing students' performance in chemistry.

eneral factors affecting erformance in chemistry	DA	NS	A	SA	X	Std. dev'
he chemistry teacher builds on our revious knowledge when teaching	9.8% N(32)	4.6% N(15)	26.2% N(85)	59.4% N(193)	3.35	.956
he chemistry teacher allows udents to talk during the teaching-arning process	17.2% N(56)	3.7% N(12)	30.2% N(98)	48.9% N(159)	3.11	1.099
he teacher pre-teach new ocabulary before teaching content ith hard chemistry vocabulary	36.9% N(120)	14.5% N(47)	27.4% N(89)	21.2% N(69)	2.33	1.178
he teacher uses pictures, charts, mbols, and examples to explain oncepts in chemistry	21.8% N(71)	8.9% N(29)	35.1% N(114)	34.2% N(111)	2.82	1.129
eacher reviews previous kaminations and tests before giving ew examinations	24.0% N(78)	5.2% N(17)	29.8% N(97)	40.9% N(133)	2.88	1.188
hemistry teachers are available for onsultation outside classroom aching.	21.8% N(71)	4.6% N(15)	25.8% N(84)	47.7% N(155)	2.99	1.184

Key rating

he researcher used a 4-point Likert scale where; **DA** means Disagree, **NS** means Not sure. **A** eans Agree, **SA** means Strongly Agree, **X**=mean, and **std. dev** means standard deviation,

Participants (85.6%) whose opinions are expressed in table 4.10 above agree that chemistry achers built on previous knowledge as shown above with a 3.35 mean and standard

deviation of 0.956. This implies that above 83.75 % of the participants are in general management that teachers link new lesson content to the previous knowledge best known to the learners.

Participants also agree that chemistry teachers all participatory class discussions during lesson presentations, which helps students to perform well in chemistry. This argument is supported by 79.1% at an average mean of 3.11 implying that general agreement is above 3.11 of a maximum 4 (as provided by the Likert scale) at 1.199 standard deviations. The challenges of English as a second language require having a new vocabulary to teach students to understand new concepts in the subject. However, 51.4% of the participant does not agree that pre-teaching is done by teachers. The mean average is 2.33 below 2.5 which is the mean average set for general agreement. As also identified in Zanzibar, students did perform well because of a language barrier as students were best used to Swahili language and chemistry vocabulary in English (Hassani, 2015). As the researcher delve into the causes of failures in chemistry subject, the interviewee said, *most chemistry teachers have few words to explain major concepts in English hence students understand the new concept by faith.* However, he admitted that such training in teaching chemistry in English as a second workshop would be given to most chemistry teachers.

The use of learning aids like pictures, video clips, audio and demonstration to aid understanding was acknowledged by 69.3% of the average mean of 2.82 at a standard deviation of 1.188 as shown in table 4.10 above. This low utilization of learning aids was supported by the argument that a *theoretical lesson is sometimes taught first and then followed by a practical lesson following a conclusive work already in students' notebooks.* Another, interviewee on the same contested issue of using instruction aids argued that *Looking for learning aids takes time yet without them students do understand. After all, we*

were taught without a lot of learning aids and we passed chemistry. Students are lazy at reading chemistry given by the government.

The researcher probed, "mention some of the textbooks given by the government which the government provided". The interviewee responded to *Fountain Chemistry for Secondary Schools book 4. MK Publishers,* However, books like *New Certificate Chemistry by Lambert ... are good books in the library that students would consult for widening academic performance*. It was further understood that Lambert has good guiding practical lessons for understanding the subject. Besides the laboratory chemistry practical guide handouts. Lambert can serve the purpose.

The researcher probed into the discussion: do you want to tell me that school management does not provide some of these materials such as marker pens, manila papers, computers, and projectors? The teacher continued defending his inability to use charts, and other learning aids such as *using learning aids make the speed of delivery slow. Chemistry is wide and requires teaching many lessons than those given on the timetable*". Another probe question was given, what is the importance of the learning aid to the teacher? "*Learning helps learners but not teachers. However, teachers easily explain concepts with ease*. The presentation given in this argument shows a relationship between teachers' attitudes and learners' attitudes that require a "new mindset". The issue of learning aids in the teaching of chemistry and the use of new vocabulary do complement one another for learners to understand new concepts and phenomena like acids, bases and salts. The learning aids can be prepared by the laboratory assistant and chemistry teacher based on the understanding of the chemical properties of each.

For instance, acids are; taste sour, are corrosive to metals, change blue litmus red, and become less acidic on mixing with bases. Also, bases taste bitter, feel slippery or soapy,

change red litmus blue, and become less basic on mixing with acids. Therefore, learning aids can be; litmus papers, sodium bicarbonate, common salt, sugar, periodic table of elements, apparatus and others. This topic is fundamental for the "Introduction to chemistry didactics" by all means a periodic table must be taught to learners early enough when they get to know that chemistry is one of the subjects to be taught to learners. Five fundamental ideas about acids and bases should be disclosed to learners;

> "1. There are substances that form acidic solutions in water. Some substances form basic solutions in water. or: There are acidic, neutral and basic solutions. 2. An acid is a particle that can release protons (hydrogen ions). A base is a particle that can take up protons (hydrogen ions). 3. Strong acids show a stronger tendency to release protons (hydrogen ions) than weak acids. Strong bases show a stronger tendency to take up protons (hydrogen ions) than weak bases. 4. Acid-base-reactions are proton-transfer-reactions. 5. During neutralisation reactions, protons (hydrogen ions; respectively oxonium ions) react with hydroxide ions forming water molecules (Lemons, Hammerschmid, Jacklin-Farcher, Noska & Reiter, 2019)."

Such background information given to learners will demystify the belief that chemistry is hard. As one interviewee argued, *before students are enrolled in secondary schools they are told that chemistry is hard.* Students may be helped as teachers review chemistry examinations in class. The item, "Teacher reviews previously done examinations and tests before giving new examinations" was given a response as 70.7% of participants agree that teacher review examinations done in classes as shown in table 4.05 above. This argument has an average mean of 2.88 with a standard deviation of 1.188. The researcher when interviewing another chemistry teacher, the interviewee said, *Chemistry is now made simple as more information is digitally presented in video clips. For instance, practical lessons can be accessed on websites*. This argument is also supported by the next item on consultation.

Participants 73.3% agree that chemistry teachers are consulted outside classrooms. This sub-construct under the variable of teaching methods affecting students' chemistry performance has a mean of 2.99 and has 1.184 standard deviations. The mean of 2.99 implies that the

general agreement is that chemistry teachers provide consultation as additional extra teaching to the students which improves academic performance. In interviewing another chemistry teacher, *Practical papers and Mock S.4 examinations can be accessed from the internet. Therefore, serious students will always consult and as a responsibility we guide those who come with problems to solve.* Students need to be encouraged to search for revised papers from Library and the internet since technology is a need and solution to some global problems. There is a positive response from teachers and head teachers are providing materials for learning aids.

Primary school Background Knowledge and students' performance in chemistry

Table 4. 11: a Chi-Square between Background Primary school knowledge and students' performance

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	340.496[a]	152	.000
Likelihood Ratio	329.941	152	.000
Linear-by-Linear Association	75.415	1	.000
N of Valid Cases	325		

a. 179 cells (99.4%) have expected count less than 5. The minimum expected count is .17.

Table 4. 12: Symmetric Measures

Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	1.024	.000
	Cramer's V	.362	.000
N of Valid Cases		325	

The chi-square square statistics appear in the value column as shown in table 4.11 (a) above. The chi-square for the teaching-learning facilities and students' performance is 340. 496[a]

(Pearson Chi-square) as detailed. In this case, background knowledge acquired from primary schools and students' performance in chemistry subject show the high value of Pearson chi-square statistic; $\chi^2=340.496^a$ signify a high chance that there is an effect of background knowledge acquired from primary schools on students' performance in chemistry. There is more likely to be statistically significant in this study as variables are tested Chi-square. The likelihood-ratio chi-square statistic $G^2 = 329.941$ is based on the ratio of the observed to the expected frequencies. The likelihood ratio that is greater than 1 signifies that the test results are associated with the usefulness of students' performance. There is a presence of the problem with background knowledge acquired from primary schools in secondary schools in Kasese Municipality.

The above high-value Chi-square implies there is a greater significance between the learners' background knowledge acquired while in primary school and the learners' performance in chemistry in secondary schools. Therefore, in the Chi-Square results above, it is revealed that a null hypothesis, "there is no significant relationship between background knowledge acquired in primary schools and students performance in chemistry in secondary schools" is rejected and we conclude that there is an existing relationship between the categorical variables.

Phi is a chi-square-based measure of association. The chi-square coefficient depends on the strength of the relationship and sample size. Phi eliminates sample size by dividing chi-square by n, the sample size, and taking the square root. In table 4.11a, the phi-value of 1.024 signifies a high correlation between background knowledge in primary schools and students' performance variables. Cramer's V is a measure of the strength of association between two nominal variables. It ranges from 0 to 1 where: 0 indicates no association between the two variables. 1 indicates a perfect association between the two variables. In this case, the value 0.362 is towards zero or 36.2% showing a weak range but a good minimum threshold for

suggesting that there is a substantial association since table 4.12 shows those other variables account for the remaining values towards the perfect association. The effect size, or magnitude of the association between the two variables, is given in the Symmetric Measures table 4.11 b. The most commonly used statistic is the Phi coefficient, which ranges from 0 to 1. Higher values (phi-1.024) indicate a stronger correlation between the two variables; background knowledge acquired from primary schools and students' performance in chemistry. This explains why the researcher used moderating variables in this study.

Hypothesis:

H_0: *There is no significant relationship between teaching-learning facilities and students' performance in Chemistry.*

The researcher opted to use Bayesian inferential statistics in testing the hypothesis. In Bayesian processing, the researcher recovers the whole range of inferential solutions, rather than a point estimate and a confidence interval as in classical regression (Bartos, 2022). As can be seen, the model comparison is determined by both data and the prior distributions for the parameters, which effectively specify the model comparison/hypothesis test. There are several benefits when researchers use Bayesian statistics such as; (1). Bayesian estimation allows researchers to seamlessly incorporate external knowledge into statistical models via prior distributions. (2). the possibility to monitor the evidence continuously, and (3). The use of Bayesian statistics presents a possibility to embrace uncertainty about the data-generating process.

Table 4. 13: Linear Regression showing Teaching-Learning Facilities and Students' performance in Chemistry.

Bayes factors model summary

Bayes factor [c]	R	R^2	Adjusted R	Std. the error in estimation	Significance
4.734	0.868	0.753	0.650	1.5	0.001

a. method: jzs

c. Bayes factor: Testing model versus null model (intercept)

a. When the sample sizes are known, the p-value provides as much information about a data set as the confidence interval of Cohen's d or a JZS Bayes factor (Francis, 2017). b. Model: (Intercept), My gender is , My Score in PLE Mathematics was, My PLE results in Science was , My English Results in PLE were as, My Career Aspiration is to become , I enjoy chemistry, Chemistry is a hard subject, Reference text books are frequently used in class, Practical work is frequently used in science laboratories, The school has laboratory assistant who helps in preparing practical lessons, The school has adequate lab apparatus for chemistry , The Lab apparatus are used frequently used by students to demonstrate observation skills , Laboratory practical texts books are available to students , Teachers personal knowledge and skills is very good in chemistry, The class has students who get above 80% in chemistry, Effectiveness of teaching chemistry is a result of students activeness , I observe the processes of experiments in laboratories well, I write well what I observe during laboratory experiments, I participate in small groups discussing chemistry, The chemistry teacher builds on our previous knowledge when teaching, The chemistry teacher allows students talk during teaching-learning process, The teacher pre-teach new vocabularies before teaching content with hard chemistry vocabularies, The teacher uses pictures, charts, symbols, to mention but

a few. To explain concepts in chemistry, the Teachers review previous done examinations and tests before giving new examinations. Chemistry teachers are available for consultation outside classroom teaching

In table 4.12 above, R represents the Pearson correlation and R^2 represents the account for the variation of the teaching-learning facilities and students' academic performance. Other factors account for 15% (Field, 2009). For instance, this research did consider the following: employees' salary, part-time teaching, workers' extrinsic motivation that comes with the availability of employees' accommodations, medical allowances, staff development scheme, staff children's education benefits, NSSF contribution and savings plan, retirement benefits, and other non-financial benefits.

Table 4. 14: Chi-square test between teaching-learning facilities and students' performance in chemistry.

Table 4. 14 (a) Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	281.039[a]	136	.000
Likelihood Ratio	300.543	136	.000
Linear-by-Linear Association	60.411	1	.000
N of Valid Cases	325		

a. 159 cells (98.1%) have expected count less than 5. The minimum expected count is .08.

Table 4.14(b) Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.930	.000
	Cramer's V	.329	.000
N of Valid Cases		325	

The chi-square square statistics appear in the value column as shown in table 4.13 (a) above. The chi-square for the teaching-learning facilities and students' performance is 281.039[a] (Pearson Chi-square) as detailed. In this case, teaching-learning facilities and students' performance in chemistry subjects show high value of Pearson chi-square statistic: χ^2=281.039[a] signifies a high chance that the effect of teaching–learning facilities on students' performance is more likely to be significant. The likelihood-ratio chi-square statistic G^2 = 300.543 is based on the ratio of the observed to the expected frequencies. The likelihood ratio that is greater than 1 signifies that the test results are associated with the usefulness of students' performance. There is a presence of a problem with teaching-learning facilities in secondary schools in Kasese Municipality.

The effect size or magnitude of the association between the teaching-learning facilities and students' performance is given in the Symmetric Measures table 4.13 (b) above. The most commonly used statistic is the Phi coefficient, which ranges from 0 to Higher values indicating a stronger correlation between the two variables. Symmetric measures are reported separately for customers who did and did not have contact with a store representative. These measures are based on the chi-square statistic. Phi is the ratio of the chi-square statistic to the weighted total number of observations.

The Phi is a chi-square-based measure of association. The chi-square coefficient depends on the strength of the relationship and sample size. Phi eliminates sample size by dividing chi-square by n, the sample size, and taking the square root.

Cramer's V is a measure of the strength of association between two nominal variables. It ranges from 0 to 1 where: 0 indicates no association between the two variables. 1 indicates a perfect association between the two variables. In this case, the value 0.329 is towards zero or

32.9% showing the minimum threshold value association since table 4.13 shows that other variables account for the remaining values towards the perfect association.

It is interpreted as a measure of the relative (strength) of an association between two variables. The coefficient ranges from 0 to 1 (perfect association). In practice, you may find that a Cramer's V of 0.10 provides a good minimum threshold for suggesting there is a substantive relationship between two variables. This value given here is above 0.10 which is 3 times the minimum threshold value (Francis, 2017).

The "Linear-by-Linear Association" statistic is used when the variables are ordinal, but many simply use Pearson chi-square for those as well. The main one of interest is the Pearson Chi-Square value of $\chi^2=281.039^a$ as in table 4.13 (a) above. The variables were marked as being ordinal hence the system had to produce linear by linear association signifying that ordinal variables exist. Examples of ordinal variables include: reference textbooks are frequently used in class ("Disagree, not sure, agree, and strongly agree), My performance in chemistry ("D1, D2, C3, C4, C5, C6, P7, P8), these values signify hidden nominal values. These are presented on a Likert scale of 4 as shown in appendix 01.

Table 4. 15: Attitude and students' performance in chemistry

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	132.094[a]	72	.000
Likelihood Ratio	146.061	72	.000
Linear-by-Linear Association	17.009	1	.000
N of Valid Cases	325		

a. 67 cells (74.4%) have an expected count of less than 5. The minimum expected count is .42.

The learners' attitude that is reflected in items 6, 7 &8 on the questionnaire, provides an estimated variable and my performance. Attitudes and performance have an existing

relationship with Pearson chi-square statistic; $\chi^2=132.094^a$ signifies a strong relationship between students' attitudes towards chemistry subject and students' performance in chemistry.

Table 4. 16: The teaching-learning facilities, teaching methods, general factors and background knowledge synergically influence students' academic performance in chemistry subject.

	Bayes factor [c]	R	R^2	Std. error	f-ratio	sign
My performance in chemistry subject	Teaching-learning facilities	0.579	0.335	0.42	6.671	0.00
	Teaching methods	0.507	0.257	0.44	4.579	0.00
	General teaching methods	0.435	0.189	0.46	3.084	0.00
	Background knowledge in Primary schools	0.578	0.334	2.14	7.246	0.00
	Attitudes	0.498	0.248	2.24	10.358	0.00
	Overall effect	0.868	0.753	1.5	7.346	0.00

The R=0.868 implies that the Pearson correlation between identified factors affecting students' academic performance does exist. The $R^2=0.753$ implies that these identified factor account for 75.3% and other factors not mentioned here in the tool account for 24.7%. Linking the literature review with this study, issues to do with good governance and workers' incentives both financial and non-financial may account for the variation. The twenty-six (26) sub-constructs (variables) in appendix 01 were regressed using Bayesian. Item 27 as in appendixes 01 was, "My performance in chemistry subject".

Conclusion

The relationship teaching-Learning facilities and students' performance in chemistry is strongly associated where the Phi value is 0.930 towards the perfect relationship of 1 as in table 4.13 above. This shows a strong relationship of almost 93% towards, 100 perfect. Statistics show that the relationship or p-value stands between 0 and 1. Therefore, table 4.03, table 4.06, table 4.11a & b, table 4.12 and table 4.13 shows some chi-square values that provide an interpretation of the existing relationship between variables. The identified moderating factors as shown in the conceptual framework show that teaching-learning

facilities are enhanced by the teaching methods and background primary school knowledge. The student's performance is also enhanced by the teaching methods and background primary school-acquired knowledge. However, the teaching-learning facilities, teaching methods, and background knowledge acquired in primary schools contribute to 69% and other factors here not mentioned in this study contribute to the remaining percentage.

The teaching-learning facilities, teaching methods, background acquired knowledge from primary, learners' attitudes, and other variables require enhancement from elementary education level and secondary school that quality education would be linked to higher education to producing productive human resources which is the main objective of education in Uganda as well as the global concern.

CHAPTER FIVE: DISCUSSION, SUMMARY, CONCLUSION AND RECOMMENDATION

Introduction

This chapter presents the discussion, and summary based on the three objectives, and the conclusion is following the three research objectives. The recommendations have been organized based on the emerging cases originating from the field that this study has not exhaustively handled. The researcher analysed data using descriptive statistics, and Bayesian Statistical data using Social Package of Social Statistics version 26.

The Response Rate

The response rate is the percentage of successfully answered responses divided by the initial sample multiplied by 100. It has also been defined as; "Response rates are calculated by dividing the number of usable responses returned by the total number eligible in the sample chosen" (Harrison, Henderson, Alderdice & Quigley, 2019). The survey response rate should be calculated as the number of returned questionnaires divided by the total sample who were sent the survey initially. Others subtract the number of undeliverable questionnaires from the initial sample to obtain the denominator (Fincham, 2008). The response rate may be influenced by the nature of the delivery of the research tools. Online delivery, face-to-face delivery, mailbox, telephone interviews, the time between delivery and collecting responses, length of the questionnaire, and timing or season of operation in the firm like the beginning of term or end of the term for schools may account for the rate of response. The number of questionnaires given out beyond the estimated sample may also affect the response rate if we are calculating the returned responses to the sample multiplied by 100. The response rate may increase from 28.7% pilot survey to 33.1% in the pilot because of the remainder (Harrison, 2019). In this study, the researcher made an appointment with chemistry teachers and students were prepared without prior knowledge of the questionnaire. The participants

esponded to the questionnaire within 20-30 minutes from senior class since chemistry is a ompulsory subject that all in S.3 must be offering chemistry as a subject. The undelivered ools were not considered among the response rate during this study. The delivered tools were is in table 4.01 chapter 4 above. The response rate of this study was calculated as the sample ize was 368 participants and the actual response was 363 because of undelivered responses eading to 98.6%. A response rate above 70% is sufficient (Mwangi, 2016) and this study has 97.3% which is adequate good for the study to be evaluated to have received a good response ate.

Biographical Data

The tool in appendix 1 was organized beginning with demographic data, previous performance in primary (background knowledge acquired from primary school), learners' motivation or attitude, teaching-learning facilities, teaching methods, other general teaching methods, and student's performance in chemistry subject.

The main research participants were students studying chemistry in senior three (S.3) whose was between 15-21 years old both male and female. The students were enrolled on senior secondary schools in Kasese municipality. The teachers of chemistry were potential key informants, the head teachers and employees within the office of the Municipal Education officer. The study enrolled 325 students, 30 chemistry teachers, 7 head teachers and one person from the office of the Municipal Education officer. The participants who responded to self-administered questionnaires were the students and other participants who responded to the qualitative research tool and hereafter referred to as interview. For the secondary data was provided by the head teachers' office such as raw data for appendix 10.

The participant's background information variables include gender, type of school (government grant-aided secondary and privately owned secondary schools), and entry scores /primary seven (PLE) results.

The recognized chemistry performance was evaluated at the achievement of grades D1 to C6 in table 4.02 for the internal examinations. Failure was evaluated at P7 to F9 where pass P7 is awarded between 55-59% and Pass 8 is 50-55%. In some private schools, the grading is as low as P7 is 40-49%, P8=35-39, and F9 is below 33%. Whatever, the criteria of grading, 68.99% of female students performed between D1 and C6 in chemistry as compared to 65.14% of male students table 4.02 above. Therefore, gender does not very much influence the performance in chemistry at a mean of 1.66 with a standard deviation of 4. 473. The gender and students' performance in chemistry subject had R=.029, R^2=0.001 at F-ratio =0.210 implying that 99.999 is not accounted for by gender in chemistry performance.

Statistics show that the type of schools "public or private secondary Schools" of mean 0.514 and with a standard deviation of 2.539 does not highly influence the students' performance. In table 4.03 the type of school and performance in chemistry failure in government grant-aided secondary schools was 28.57% while privately owned secondary schools were having 34.27%. Statistics comparing them with the information given in appendix 10 below that shows 38.75 failed chemistry in Kasese Municipality. The researcher further establishes statistical data and the linear regression where R=0.578, R^2=334, F=7.246, P< 0.05: significance 0.002. This calculation implies that Bayesian regression provides that Pearson correlation R=0.578 when R^2=0.334 when f-ratio is 7.246. It was established that type of school accounts for R^2=0.218 and variation is accounted for by other several variables that may be suggested hereafter. The f-ratio is 9.782 implying that only 9.78 chances to reject the factor that the type of school influences students' performance in chemistry. The key

informants, provided a clear interpretation of the statistics, the nature of the school in terms of financial autonomy to purchase and increase the quality of teaching-learning facilities.

Cross-tabulation schools and students' academic performance in chemistry as shown in table 4.04 above reveal that government grant-aided secondary schools marked with asterisks * had 28.57% failed while private secondary schools had 34.27%. The failing of chemistry subject may not be attributed to the type of school (private or public) since school number 3 (three) table 4.04 above is government grant-aided yet school numbered 10 has high academic performance. School numbers 2 and 10 show that academic performance is never influenced by the type of school since school number 2 is government grant-aided and 10 is a privately owned secondary school.

The results of table 4.05 above show that R=0.471 which is the Pearson correlation, and R^2=0.222 implying that entry results of primary seven (PLE) can only account for 22.2% and other variables account for 77.8% (Field, 2009; Bartos, 2022). The f-ratio mentioned in table 4.05 above implies that the testing model has a small percentage to allow rejection of the null model that states that, "There is no significant relationship between my performance in chemistry and my previously obtained grades in PLE". However, its contribution is not negligence it accounts for 22.2% and other variables account for the variations. The F-ratio is observed to be 3.192 implying that 96.808% of the chemistry performance is accounted for by other variables.

Summary of the key finding

The summary for this study has been organized according to objectives; teaching-learning facilities have a positive relationship with students' performance in chemistry subject. The second objective is; teaching methods in chemistry has got a positive correlation with student's academic performance and the third objective establishes the effect of primary

school background knowledge on students' Performance in chemistry in selected secondary schools in Kasese Municipality.

The ecological systems theory is significant in this study because students' performance is influenced by; teaching-learning facilities yet teaching methods, previously acquired knowledge from primary schools (background knowledge), and students' attitudes towards chemistry directly influence both independent and dependent variables. In utilizing Bayesian statistics, the linear regression provided statistical inferences that teaching-learning facilities contribute 33.5% towards the success of the students in chemistry. The background knowledge from primary school contributes 33.4%, students' attitudes towards chemistry contribute 24.8%, general teaching methods contribute 18.9, and teaching methods contribute 25.7%. The overall identified variables contribute 75.3% and other variables not mentioned here contribute to the variation of 24.7%. In table 4.15 R value is Pearson correlation while R^2 is the effect or contribution of the variable. In this case, the identified variable in table 4.15 contributes 75.3% towards students' performance.

Teaching-Learning Facilities and Academic performance in chemistry

The teaching-Learning Facilities such as chemistry textbooks, laboratory practical guide manuals, science laboratory equipment (apparatuses), and laboratory chemicals, were ranked as important in influencing students' academic performance in chemistry subject. Classrooms were regarded as a traditional resource in the school system hence it was not included in the analysis. Therefore, Pearson correlation between these variables was R=0.477, while R^2=0.227, F-ratio=8.073, P<0.05, 000sign. The empirical statistics imply that 22.7% of students' performance is accounted for by the accessibility of chemistry textbooks in school, laboratory guide manual in school and laboratory equipment and chemicals. Other variables like teaching methods, previous knowledge acquired from primary school and home.

students' attitudes, teachers' motivation, students' home status, nature of schools, and school environment may account for the rest of the percentage.

The variable (Teaching-learning facilities) was analysed according to the research tool, six sub-constructs were considered as textbooks, the number of practical lessons, the technical service provided by the laboratory assistant, the availability of apparatus, and the availability of laboratory textbooks. These sub-constructs when combined as in table 4.07 descriptive statistics show that participants had a general agreement over the importance. While using Bayesian linear regression, $R=0.579$, $R^2=0.335$, F-ratio=6.671, $P<0.05$, sign 000. These calculations imply that 33.5% is accounted for by the mentioned sub-constructs as increasing them also increases significantly. This may be accepted that students' academic performance is not an automatic event but an investment of given variables to enhance high performance.

Teaching Methods and Academic Performance in Chemistry

Table 4.09 above shows the descriptive statistics where frequencies and mean were used to establish the effect of teaching methods on students' academic performance. The results show that teaching methods are significant for students' academic performance as it is also revealed when considering the linear regression between "my performance grade in chemistry" and "teaching methods". Empirical evidence is that $R=0.507$, $R^2=0.257$, F-ratio=4.579, $P<0.05$, sign 000. This also implies that teaching methods account for 25.7% of students' performance.

Table 4.10 above in chapter four shows other variables that state like; teacher builds on student's knowledge and skills, the teacher involves learners in talking or participation, the teacher pre-teachers new vocabulary or new concepts, chemistry teachers uses learning aids like charts, picture ad video clips, chemistry teachers reviews previous examinations and lessons, and finally chemistry teachers allow consultation outside normal routine teaching

hours. These sub-constructs or variables combined influence students' academic performance in chemistry subject. Table 4.10 shows where participants rank their teachers as not doing or doing the right. As compared to linear regression using Bayesian statistics, R=0.435, R^2=0.189, F-ratio=3.084, P<0.05 implying that factors affecting students' academic performance in chemistry subject do exist.

Primary school Background Knowledge and students' performance in chemistry

Table 4.15 shows that previous primary school-acquired knowledge positively correlates with students' performance in secondary schools. The capacity to read and write, the capacity for the learner to use VARK model which means visual, auditory and kinesthetic refers to the presentation of the system compared to the Fleming various types of learning with the acronym VARK (Prithishkumar & Michael, 2014). The VARK model refers to the visual for V, auditory for A, reading/writing for R and kinesthetic for K (Sreenidthi & Helena, 2017). These descriptions of learning types recall back to the early age of personality development and zero on attitude orientation.

Teaching chemistry and other science subjects requires an understanding of child development and learning theories. The five senses have to be utilized hence VARK model is necessary for preparing a scaffolding structure in the laboratory for learners to stand on when learning science subjects. The five senses must be utilized; eyes for seeing, ears for hearing, hands for touching, tongue for testing and noise for smelling (Atibuni, 2015). Reading readiness has been defined as the point at which a person is ready to learn to read and the time during which a person transitions from being a non-reader into a reader. Other terms for reading readiness include early literacy and emergent reading. Reading readiness is an act of preparing or a degree of preparedness for formal reading instruction or any other activity or task in school.

The results of academic performance in primary schools were considered to be a foundation for achievement in secondary school. Since chemistry has concepts that may not easily be translated into local languages hence the work of an English teacher in primary school was appreciated for being a significant contribution towards students' performance in chemistry. The statistics show that primary school background knowledge contributes 33.4% success towards students' performance in chemistry. Table 4.15 and table 4.11a shows how R^2=.334 and Pearson chi-square statistic; χ^2=340.496[a] . The Bayesian statistics where linear regression provides correlation between variables and chi-square provides measures to determine the contribution of one variable over the other variable. The two categorical variables, in this case, are; background knowledge acquired from primary school and students' performance in chemistry in selected senior secondary schools. In this case, the Phi value shows 1.024 while the crammer's V is 0.362 . If the primary foundation education is neglected, then little will be contributed hence lowering the students' performance in chemistry since they can read and write, they can calculate moles, and they can be able to identify living things and non-living things. Quality primary school education provision is significant in the foundation of secondary and universities.

Discussion

The response rate, background information, and summary above show that a problem exists for research to inform policymakers. Studies have shown that science subjects are poorly done in secondary school and students, teachers, head teachers and parents non-of them accept to be a response for the failing of chemistry and others stem subjects. Teachers think that students are responsible for their failure because of their low attitude towards science subjects. The claim that science is for male students was also fronted as a cause for students to fail basic science subjects (Namatende-Sakwa & Longma, n.d; Amr, Mohamed & Mnjokava, 2016). The lack of laboratory science, textbooks, apparatus, and qualified and

competent teachers' knowledge and skills were identified as causes of failing basic science subjects. As the government of Uganda has initiated several reforms, the education white paper 1992 provides an "Eye opener to inform policymakers" that basic science subjects were made compulsory for S.1-S.4 learners in Uganda (Oonyu, Sikoyo & Namubiru, 2018: UNAS, 2019; UNESCO, 2017).

The government of Uganda has between 1988 and 2007 Ministry of Education has undergone into several reforms, Introduction of Universal Primary Education (UPE) which was initiated in 1997 (Amr, Mohamed & Mnjokava, 2016). The UPE reform policy caused high enrollment of pupils in primary schools increasing from 2,000,000 to 7,000,000 pupils country-wide (Oonyu, Sikoyo & Namubiru, 2018). In 2007, Universal Secondary Education (USE) was introduced which even allowed private partnerships for private secondary schools to benefit from USE capitation grants. The private secondary schools that benefited from the PPP funds from the government were able also to equip their science laboratories with chemicals and apparatuses (O'Donoghue, 2018). In 2006, the government of Uganda made basic science subjects compulsory for all. The lower senior secondary students in Uganda were obliged to sit for all basic science subjects at UCE (Namatende-Sakwa & Longman, n.d: Amir, Mohamed & Mnjokava, 2016). In 2008, SESEMAT was introduced to promote; good lesson preparation, good lesson delivery, and enhance active learner participation in teaching-learning of science subjects (UNESCO, 2017). All these initiatives are in harmony with global strategies to improve the quality of education that equip individuals for productivity and innovation. It is believed that in economies with high science technology and innovations, economic growth is comparably on track better than those countries with low levels of science and technology. In 2009, the President of Uganda at his request visited the faculty of Engineering, Art, Design and Technology after observing the progress, he directed the Ministry of Finance and economic planning to support innovation worth Ug. Sh. 25

billion (MakCEDAT, 2022). This evidence that the ruling political party; NRM is having "good will' for research and innovations.

The political "will" that the government wanted to increase the number of scientists in the country has not been fully achieved. These initiatives have forced the government to provide several incentives such as increasing the annual salaries of university science lecturers, and secondary school science teachers, and research funding for scientists (Ilakut, 2019; Mulengera News, 2022). The presidential initiative for science and technology has funds to support research in the country. To their dismay, in 2018 and 2019 UNEB results did not show a reflection of invested funds in science, especially chemistry. In 2018, UNEB results show that 46.5% of students passed and 53.5% failed. However, in 2019 UNEB registered improvement where 54.6% of candidates passed chemistry and 45.4% failed (Serugo, 2019). Failure in chemistry has appeared in other studies where between 2005 and 2008 chemistry performance was as 55%, 55%, 30% and 26% (Ankwasiize & Bazirake, 2017).

Kasese District especially Kasese Municipality where secondary schools have existed for 38 years since 1982 has equally experienced low performance in chemistry subject. Secondary schools have been gradually established by different stakeholders; churches and individual proprietors. The academic performance in chemistry as one of the key basic science subjects is a matter of concern for research in Kasese Municipality. The first secondary school to be established in Kasese District was established in 1974 by Migdad Saad son of Saad bin Said of Bwera-Kasese (Kibalirwandi, 2022). Kasese District schools and management were warned against examination malpractices in 2018 by the Secretary General of UNBO (Mawanda, 2018). The combination of events where secondary education is recently established and examinations malpractices where intelligence reports were showing plans that some schools were planning to get involved in examination malpractices. A study was

appropriate to be conducted to establish the relationship between teaching-learning facilities and students' academic performance in chemistry.

Teaching-Learning Facilities and Academic performance in chemistry

The physical facilities such as; school plants as buildings, classrooms, school libraries, science laboratories, toilet facilities, learning materials and other materials would likely motivate students towards learning (Akomolafe & Adesua, 2016). It was reported that physical facilities motivate learners to perform better in academics performance. The teaching-learning facilities are those essentials that aid the teaching-learning process to be successful for purpose of enhancing academic performance. SESEMAT identifies several problems that cause students to fail basic science subjects; lack of understanding of the questions, inability to observe and write what has been observed, lack of practical experience to manipulate laboratory equipment and reading correct measurements when performing experiments (UNESCO, 2017). The participants identified that textbooks are not adequately used in teaching chemistry. For instance, most teachers present lesson notes with further reading details referring to library books. It was further observed that some teachers use notes that were once given to them by their teachers when still in secondary school. Lack of teacher preparation emerges as a problem during this study which even SESEMAT is already addressing in their in-service training (INSET) programmes.

Teaching-Learning facilities are those instructional aids that enable teachers to deliver science content to students in a more concrete nature to enhance understanding of abstract and complex scientific concepts (Kamba, Libata & Usman, 2019). In these studies, chemistry textbooks, laboratory apparatus, consumables like chemicals, the presence of laboratory technicians, and laboratory guide manuals having practical questions and answers that guide self-learning experiments were considered among basic teaching-learning facilities. Results

show that teaching-learning facilities itemized in appendix 01 account for 22.7% and other factors account for the rest of the 77.3%. The teaching-learning facilities do not exist in isolation without teaching methods and other general factors. Good academic performance depends on good school management. "There is a strong positive correlation between how well-managed a school is and its performance; well-managed schools get better student results. This indicates that improving school management across all types of school would be a good area for intervention and support (O'Donoghue et al. 2018)". Teaching-Learning facilities are needed as participants argue that, textbooks, apparatuses, and laboratory manuals all help in improving the quality of education in secondary schools. However, the school management has to appoint laboratory technicians to manage the apparatuses and chemicals to control the costs and durability of the equipment.

Teaching Methods and Academic Performance in Chemistry

The work of the teacher has remained significant even when technology and innovation have incredibly filled the gap in globalization (Satish & Priya, 2012). Technology will replace some of what teachers currently do, while at the same time supporting teachers as they take on new, often more sophisticated duties and responsibilities as a result of technological change (World Bank, 2020). "Teachers can be facilitators of learning, part of a learning team, a collaborator with outside expert mentors, peer mentors to parents, and team leaders on a project-based learning activity, among other roles. At the same time, in those circumstances where teachers are scarce or where teachers are of 'low capacity', technology can play an important role in assisting learners to, in part, overcome this deficit. Where teachers lack content or pedagogical knowledge, technology can support the use of structured lesson plans or text-based nudges to help build this capacity ()". The role of a teacher must change and technology has to be used collaboratively between students and teachers. Teaching is the process through which a more informed person guides a less informed person into a rightful

way of understanding a specific knowledge. The teacher helps the learner to understand abstract and complex scientific concepts and knowledge that may be applied in real-life experience. The results above show that teaching methods used in handling teaching-learning facilities account for 25.7% and teaching learning accounts for 22.7%. The two combined make the learner achieve his /her objective of success with chemistry subject. In the absence of teaching-learning facilities and teaching methods, little can be achieved hence poor performance. Synergically, teaching-learning facilities, teaching methods, general factors, learners' attitudes and background knowledge acquired from primary schools account for 75.3% success in students' academic performance as detailed in table 4.15 above. The variation of 24.7% implies that other variables like school management or institutional governance (UNESCO, 2017), non-wage incentives (Sabina, Okibo, Nyang'au & Ondima, 2015; Otieno, 2021; Tumaini, 2015), and others account for the variation which is 31%. The non-financial incentives mentioned include career development, professional promotion in ranks, participation in decision-making, recognition and respect, effective supervision and effective communication, and generally all benefits or incentives given to the employee not necessarily being paid cash (Tumaini, 2015).

The presence of a well-stocked science laboratory in school has been associated with the high academic performance of students because; experiments help students to understand abstract and complex scientific knowledge (UNESCO, 2017). The concrete materials used in laboratories create impressive images of students' brains. The observation, recording, and writing of measurements taken during laboratory experiments, help learners to gain knowledge and skills to be applied in final examinations.

The researcher looked closely at the textbooks that had simplified lesson notes and experiments that would give students more insights into critical learning and inquisitiveness. Science is the systematic study of the nature and behaviour of material and the physical

universe, based on observations, experiments, and measurements, and the formulation of laws to describe facts in general (Aminah, Supriadi, & Magfirah, 2022). Teachers facilitate learning as co-travellers learning but the teacher is more experienced than the learner. Experiments in chemistry to be critical thinkers since some of the solutions are never disclosed during experiments but to observe and record the nature and behaviour of the substances. The scaffolding application helps to build resilience in critical thinking and problem-solving.

Primary school Background Knowledge and students' performance in chemistry

The factors that affect students' academic performance in chemistry have been identified as participants were interviewed and given a self-administered questionnaire. These identified factors affecting clustered together may include but are not limited to; physical facilities that include classrooms, laboratory rooms, latrines, playgrounds, general environment for shades, and roads. The teaching-learning facilities include; chemistry textbooks, laboratory apparatuses, chemicals and practical manuals. The teaching methods include but are not limited to teachers' knowledge and skills in teaching, and teachers' experience in teaching chemistry using English as a second language. In lack of English, language competencies have been often associated with why students in Zanzibar. The low level of understanding of chemistry concepts makes students fail at UCE. The general factors such as teachers' willingness to have consultation outside classrooms are ideally important. The teacher builds on learner's experience had a mean of 3.35 implying the general agreement of 85.6% of participants that their teachers can do recommendable work. This means that SESEMAT has actively achieved its three major goals; good lesson preparation, good lesson delivery, and active learner participation (UNESCO, 2017). "The teachers allow learners to talk during lesson presentation" got a mean of 3.11 implying the general agreement of the participants in

table 4.09 above. The variables are generally accepted as general factors. Table 4.11 presents Pearson correlation statistics using Bayesian statistics where 68.8% is the R^2, signifying teaching-learning facilities positively affect the student's academic performance. The variation is explained by other factors.

Conclusion

The ecological system theory remains relevant when discussing and presenting an argument that, "Teaching-Learning facilities are within the ecological system that influences students' academic performance". The ecological system theory provides an understanding of the structure and behaviour of an organisation, an institution, a community and a nation including its simple and complex set-up of interactions between its members (German, 2015). The ecological system theory focuses on the interrelationship and interactions of elements through their interconnectedness which not only helps to understand how but how they need each other for sustainable functionality. In the school system, one variable is not independent of the other as mentioned that students' academic performance is influenced by the English language since chemistry is written in English and answered in English.

School management and governance are mentioned among other variables that account for the 24.7% variation identified in table 4.15 above. The ecological system includes but is not limited to; the physical environment, school management and governance, physical facilities like classrooms, instructional materials including laboratory apparatuses and chemicals, teaching methods, teachers' knowledge and skills, and learners' motivation as inspired by the teachers and school management/administration. This arrangement starts from the micro-level to macro-level

Recommendations

The participants agree with the study that the government through several interventions have improved the learning of basic science subjects. The availability of textbooks, laboratory apparatuses, recruitment of laboratory technicians, and SESEMAT programme have equally plied an important role to improve chemistry. Research like Lating, (2006) emphasizes hybrid e-learning use in rural secondary schools where schools may not be able to acquire modern facilities. Rural secondary schools are always very poor with insufficient funds to purchase chemicals and other science laboratory equipment. This may bring the idea of proposing remote science laboratories (Tho & Yeung, 2014).

Teaching-Learning Facilities and students' performance in chemistry

The teaching-learning facilities like textbooks such as New Chemistry Certificate by Holderness & Lambert, J. As mentioned by participants both guiding practical lessons and theoretical lessons with clear examples illustrated. Through SESEMAT insets, more teaching-learning facilities are shared to help and equip teachers. Teachers are, therefore, encouraged to use textbooks and laboratories frequently since students are supporting their use.

Teaching Methods and Performance in Chemistry

The teachers should be trained on how to use English as a second language in the teaching of basic science subjects, especially chemistry. In Tanzania, it was identified by Hassani (2015) and In Uganda; it has been identified by UNESCO, (2017). Most students who fail chemistry fail to interpret questions and fail to get correct answers. The teaching-learning facilities help learners to utilize the five senses; eyes, ears, mouth, nose and hands. The observation and recording are key senses that hands and eyes must correctly be coordinated to help in writing the correct measurements and points.

Primary school Background Knowledge and students' performance in chemistry

Teachers' knowledge and skills to use learners' experience should be encouraged as one of the scaffolding strategies in helping learners to learn from the known to the unknown. Using pre-vocabulary teaching is identified among the best practices to be used in chemistry and other basic science subjects. However, English teachers and other subject teachers should be encouraged to use the English language as a second language to increase understanding of concepts that seem foreign in the environment of the learners.

The teacher's experience and technical knowledge in sharing learning experiences, and building on learners' experience increases the possibility.

`Contribution of the study

The knowledge acquired provides evidence that gender and my school have a negligent contribution to chemistry performance. Their influence may be deep on the nature of freedom at home and school. However, teaching-learning facilities, teaching methods, and quality education at the primary level all appear important to contribute 75.3% of success to academic performance. The ecological system theory explicitly presents five major systems that interact to form an ecological system that all co-contribute to the prosperity of its members in the ecosystem. Ecosystem refers to the interacting system that encompasses a community and its nonliving, physical environment. The ecosystem services include important environmental services but are not limited to cleaning air to breathe, clean water to drink, and fertile soils in which to grow crops, which ecosystems provide (Solomon, Berg & Martin, 2011). The five systems; microsystems, mesosystem, exosystem, macrosystem and chronosystem allow the learner to interact within an ecosystem (Ryan & Paquette, 2001). An ecological niche is the totality of an organism's adaptations, its use of resources, and the lifestyle into which it is fitted in its community. How the organism uses the resources in its

environment and how it relates with other organisms within the ecosystem is dependent on the adaptation and factors influencing adaptation.

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APPENDICES

Appendix 1: Students' Questionnaire

I am **Clive Maate** a student of Mbarara University of science and Technology (MUST) undertaking a research titled, "Teaching-Learning facilities and students' academic performance in chemistry in selected secondary schools in Kasese Municipality". Your contribution will be confidentially treated without disclosing your name but results will take a general view for purpose of administration and planning. Finally, results will be used to assess candidate's research ability for the award of Doctoral of philosophy of Mbarara University of Science and Technology.

Section A: Demographic Data

1. My School is ..... (*Write the name of your School*)
2. Gender: .....Male (M), ...Female (F)

   Previous performance in Primary schools
3. What score did you get in mathematic during PLE? .....
   D.1---, D.2...., C3...., C4....., C5...., C6....P7...., P8.....F9.....,
4. What score did you get in Science during PLE?.....
   D.1---, D.2...., C3...., C4....., C5...., C6....P7...., P8.....F9.....,
5. What score did you get in English during PLE? .....
   D.1---, D.2...., C3...., C4....., C5...., C6....P7...., P8.....F9.....,

   Learners' motivating factors/attitude
6. What is your career aspiration?
   Science Teacher....., Arts Teacher, ...Lawyer, ...Medical doctor, ...Nursing officer, ...Engineering, ...Accountant, ...Police/UPDF, ...others
7. Do you enjoy learning Chemistry? .....Yes, ...No
   a. If yes give some reasons., ...
      .....
   b. If NO give some reasons .....
      .....
8. Chemistry is a hard subject. .....I agree, ...I do not agree.

Section B: Teaching-Learning Facilities and Chemistry Performance

Key: 1(means Disagree), 2 (means Not sure), 3.(means Agree), 4.(means Strongly Agree)

Item	Item description	1	2	3	4
9.	Reference text books are frequently used in class	1	2	3	4
10.	Practical work is frequently used in science laboratories	1	2	3	4
11.	The school has laboratory assistant who helps in preparing practical lessons	1	2	3	4
12.	The school has adequate lab apparatus for chemistry	1	2	3	4
13.	The Lab apparatus are used frequently used by students to demonstrate observation skills	1	2	3	4
14.	Laboratory practical texts books are available to students	1	2	3	4

Section C: Teaching Methods and Chemistry Performance Levels

Key: 1(means Disagree), 2 (means Not sure), 3.(means Agree), 4.(means Strongly Agree)

Item	Item (description)	1	2	3	4
15.	Teachers personal knowledge and skills is very good in chemistry				
16.	The class has students who get above 80% in chemistry				
17.	Effectiveness of teaching chemistry is a result of students activeness				
18.	I participate in small groups discussing chemistry				
19.	I observe the processes of experiments in laboratories well				
20.	I write well what I observe during laboratory experiments				

Section D: Generalized Factors affecting Chemistry Performance

Key: 1(means Disagree), 2 (means Not sure), 3.(means Agree), 4.(means Strongly Agree)

Item	Item (description)	1	2	3	4
21.	The chemistry teacher builds on our previous knowledge when teaching				
22.	The chemistry teacher allows students talk during teaching-learning process				
23.	The teacher pre-teach new vocabularies before teaching content with hard chemistry vocabularies				
24.	The teacher uses pictures, charts, symbols, examples etc to explain concepts in chemistry				
25.	Teacher reviews previous done examinations and tests before giving new examinations				
26.	Chemistry teachers are available for consultation outside classroom teaching.				

Section E: Students Performance in Chemistry.

Key (1=poor, 2=Average, 3=good, 4= Very good)

27.	My Average performance in chemistry is Specific Key					
	Poor	Average	Good	Very good		
	F=9	P7-P8	C3-C6	D1-D2		

Thank you for the contributions

Appendix 2: Unstructured Interview Guide for Chemistry Teachers.

I am **Clive Maate** a student of Mbarara University of science and Technology (MUST) undertaking a research titled, "Teaching-Learning facilities and students' academic performance in chemistry in selected secondary schools in Kasese Municipality". Your contribution will be confidentially treated without disclosing your name but results will take a general view for purpose of administration and planning. Finally, results will be used to assess candidate's research ability for the award of Doctoral of philosophy of Mbarara University of Science and Technology.

1. Does the teaching-learning facilities affect students' academic performance in chemistry subject at this school?

   Probe question: what are these teaching-learning facilities?

   Probe question: How do the teaching-learning facilities affect students' academic performance in this school?

   Probe question: Does have the school get adequate teaching-learning facilities?

   ……

   ……

   Probe question: what are these teaching-learning facilities (outline the teaching-learning facilities)

2. What is the relationship between Teaching-Learning Facilities and students' performance in chemistry subject in this school?

   ……

   Probe question: how many learners do you sit in your chemistry laboratory?

   ……., ……

   Probe question: how many practical lessons do you conduct per week?

   ……..

   ……

   ……

3. What other Factors are affecting the students' performance in chemistry subject in this school?

   ……

   ……

Probe question may we rank the factors from low effective to higher effective?

Probe question Do you think these problems identified here may be similar to problems in central or Northern Uganda? (Explain)

Appendix 3: A table by Krejcie and Morgan (1970) to determine the Sample size

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Appendix 4: Summary of performance in science subjects within selected schools of Kasese Municipality for the years 2018 and 2019.

Kasese Municipality Record of STEM											
	2018										
School	1	2	3	4	5	6	7	8	9	10	Average
Mathematics	79.4	63.7	52.2	8	46	50	54.5	62	78.2	30	5
Biology	64.7	61.7	39.1	4	30	80	36.4	60	53.8	68	49
Physics	60.5	68.7	37	5	40	60	36.4	35	44.6	52	43
Chemistry	65.3	54.1	34.8	3	25	55	27.3	30	47.3	46	38
	2019										
Mathematics	94.15	42.9	59.4	6	50	60	80	52	81.2	58	58
Biology	97.4	30.1	78.1	3.5	35	55	30	40	55.7	96	52
Physics	81.9	34.1	25	4	45	40	60	41	42.6	62	43
Chemistry	96.4	30.1	31.3	5	20	70	40	23	46.6	93	45

Key List of Senior Secondary Schools

1. Kasese Senior Secondary School*
2. Kilembe Senior Secondary School*
3. Mount Rwenzori Girls*
4. Asamu Model Secondary School
5. Kasese Muslim Secondary school
6. Standard High Nyamwamba
7. Snow Heritage Secondary School
8. Maryland High School
9. Bright Academy SS
10. Rwenzori Christian Vocational Secondary School

Appendix 5: Statement on release of 2022 UCE Examination Results

STATEMENT ON RELEASE OF 2022 UCE EXAMINATION RESULTS

PERFORMANCE OF CANDIDATES in 2022, in selected subjects, is compared to the 2020 performance of candidates in the same subjects in Table below.

Table below: Comparison of 2022 and 2020 Candidates' Performance in Selected Subjects

Subject	2022				2020			
	No. of Cands.	Percentage at			No. of Cands.	Percentage at		
		2	6	8		2	6	8
English Lang.	345,444	0.7	46.8	84.82	329,447	1.3	42.8	78.2
Christ. Rel. Ed	224,644	8.6	57.2	85.2	224,695	12.6	64.2	87.9
Islam. Rel. Ed	41,092	22.8	73.3	91.2	35,550	18.1	66.6	87.4
History	344,304	9.0	54.1	72.2	328,550	7.0	53.3	73.4
Geography	345,301	3.3	66.8	85.7	329,380	1.9	55.8	80.4
Mathematics	345,471	5.2	36.9	64.2	329,453	3.9	37.9	67.2
Agriculture	198,035	8.6	73.2	89.2	184,102	7.2	60.4	85.9
Physics	345,259	1.7	21.0	57.8	329,303	1.2	19.1	53.2
Chemistry	345,205	2.5	19.3	58.7	329,292	1.4	13.0	45.3
Biology	345,275	0.2	26.9	63.7	332,524	0.7	28.2	64.3
Art (IPS)	102,097	2.7	87.7	99.9	95,588	1.7	76.1	99.7
Commerce	137,195	6.9	55.4	74.8	153,577	10.9	75.5	89.0

The Board examined Chinese Language for the first time in 2022. A total of **134 candidates** sat and 124 **(92.5%)** of them passed. The language is in addition to other major languages: French, German, Arabic, Latin and Kiswahili already being examined.

UGANDA NATIONAL EXAMINATIONS BO

Appendix 6: Respondents' Informed Consent Form

MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY

RESEARCH ETHICS COMMITTEE

P.O. Box 1410 Mbarara, Tel: +256-48-543-3795, Fax: +256-48-542-0782

E-mail: irc@must.ac.ug, mustirb@gmail.com

INFORMED CONSENT FORM

This document outlines the research study and expectations for potential participants. It should be written in layman terms and typed on MUST-REC letterhead.

Instructions

1. The wording of this document should be directed to the potential participant not MUST-REC.
2. If a technical term must be used, then define it the first time it is used and any acronyms or abbreviations used should be spelled out the first time they are used.
3. All the sections of this document must be completed without any editing or deletions.
4. Please use a typing font that is easily distinguishable from the questions of this form. Preferably the font size should be 12.

Study title– This should be the same as on all other documents related to the study.

Teaching-learning facilities and students academic performance in chemistry in selected secondary schools in Kasese Municipality.

Principal Investigator(s)

Maate Clive

Introduction

What you should know about this study:

1 You are being asked to join a research study.

Leave blank for REC office only:	REC OFFICE USE ONLY:
MUST-REC Stamp:	APPROVAL DATE: June 12, 2019
	APPROVED CONSENT IRB VERSION NUMBER;
	PI NAME: Clive Maate
	IRB NO: 1610/41-19

2. This consent form explains the research study and your part in the study.
3. Please read it carefully and take as much time as you need.
4. You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.

Brief background to the study

It is globally accepted that the utilization of laboratory facilities in chemistry teaching enables learners to develop problem solving skills and positive attitude, interest towards science learning. In developed continents, the governments in a bid to develop the education sector embarked on the provision of learning facilities to public schools so as to enhance teaching in all government schools in the state. Apart from this, the state government provided laboratory facilities to almost all government schools in the state for effective academic work (Oloruntegbe et al, 2010).

In developed countries, experience shows that if teaching learning facilities are available, students tend to have interest in learning; this will invariably lead to high performance (Nwagu, 2010). It is indicated that 95% of the students in the developed countries have higher levels of performing well in chemistry because they have access to teaching learning facilities compared with less than 50% of students who fail chemistry due to lack of access to school facilities. Remedies

In Africa, a close observation of the performance of secondary school chemistry students perhaps could be traced to lack of teaching learning facilities and a motivating learning environment of teachers and students in African countries. Most schools seems to lack the necessary facilities that could enhance effective teaching and learning of chemistry as a result little is expected from students in terms of academic performance (UNEC, 2010). Experience

Leave blank for REC office only: MUST-REC Stamp:	REC OFFICE USE ONLY: APPROVAL DATE: June 12, 2019 APPROVED CONSENT IRB VERSION NUMBER: June PI NAME: Chris Maiyo IRB NO: 16/04/19

shows that inadequate teaching learning facilities have some adverse effect on students' interest to learn chemistry in Africa. Hence, this may invariably affect their academic performance. In a situation where students are not having access to normal facilities like laboratory, library equipment and inadequate seats in the classroom it is observed that these could contribute to low performance of students in chemistry.

Purpose of the research project

Include a statement that the study involves research, estimated number of participants, an explanation of the purpose(s) of the research procedure and the expected duration of the subject's participation.

The major purpose of the study is to examine the relationship between teaching learning facilities and students' academic performance in chemistry in selected secondary schools in Kasese Municipality. The research will select 441 respondents derived from access population of 1756 participants. Data will be collected by the use of questionnaires for science teachers and students while the key interview guide will be given to head teachers and the Municipal education officer. The researcher will use these methods because data can be collected from the population within a short time. Collection of data will take30-40 minutes to respond to the questions.

Why you are being asked to participate?

Explain why you have selected the individual to participate in the study.

You are kindly asked to take part in the study on the relationship between teaching learning facilities and students' academic performance in chemistry in selected secondary schools in Kasese Municipality. You have been seen as an important person who can help in providing answers to the problem of this study

Procedures

Provide a description of the procedures to be followed and identification of any procedures that are experimental, clinical etc. If there is need for storage of biological (body) specimens, explain why, and include a statement requesting for consent to store the specimens and state the duration of storage.

Leave blank for REC office only:	REC OFFICE USE ONLY:
MUST-REC Stamp: RESEARCH ETHICS COMMITTEE MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY P.O. BOX 1410, MBARARA	APPROVAL DATE: June 12, 2019 APPROVED CONSENT IRB VERSION NUMBER: PI NAME: Claire Nabatt IRB NO: 16/04/19

Thanks for accepting to be part of this study. Your bibliography information will be recorded for accurate data recording. All the participants of the research will be briefed on the purpose to why the study is being carried. Then, they will be requested to consent on the form before the questionnaires are filled for appropriate answers from the given options

Risks or discomforts

Describe any reasonably foreseeable risks or discomforts-physical, psychological, social, legal or other associated with the procedure, and include information about their likelihood and seriousness. Discuss the procedures for protecting against or minimizing any potential risks to the subject. Discuss the risks in relation to the anticipated benefits to the subjects and to society.

There will be no any expected life threatening risks in the process of carrying out this study. No research procedure will be harm ful to you as a respondent in any way.

Benefits

Describe any benefits to the subject or other benefits that may reasonably be expected from the research. If the subject is not likely to benefit personally from the experimental protocol note this in the statement of benefits.

There has not been any study on teaching learning facilities on the general performance of students in chemistry.this study will be crucial at this point in time since the case of poor performanceare on rise as it will investigate how teaching facilities relate to students academic performance in chemistry and also come with the policy recommendations to reverse the situation.

The study will benefit both teachers, policy makers to know the importance of teaching learning facilities and how they can be provided to schools to facilitate teaching learning process.

Incentives or rewards for participating

It is assumed that there are no costs to subjects enrolled in research protocols. Any payments to be made to the subject, e.g., travel expenses, token of appreciation for time spent, must also be stated, including when the payment will be made.

Your kindly requested to volunteer and participate in thestudy as there are no incentives/rewards to be given to participants.

Leave blank for REC office only:	REC OFFICE USE ONLY:
MUST-REC Stamp: RESEARCH ETHICS COMMITTEE, UNIVERSITY OF SCIENCE AND TECHNOLOGY, P.O. BOX 1410, MBARARA	APPROVAL DATE: June 12, 2019 APPROVED CONSENT IRB VERSION NUMBER: 1.0 PI NAME: Christ Mawa IRB NO: MUST-19

2. This consent form explains the research study and your part in the study.
3. Please read it carefully and take as much time as you need.
4. You are a volunteer. You can choose not to take part and if you join, you may quit at any time. There will be no penalty if you decide to quit the study.

Brief background to the study

It is globally accepted that the utilization of laboratory facilities in chemistry teaching enables learners to develop problem solving skills and positive attitude, interest towards science learning. In developed continents, the governments in a bid to develop the education sector embarked on the provision of learning facilities to public schools so as to enhance teaching in all government schools in the state. Apart from this, the state government provided laboratory facilities to almost all government schools in the state for effective academic work (Oloruntegbe et al, 2010).

In developed countries, experience shows that if teaching learning facilities are available, students tend to have interest in learning; this will invariably lead to high performance (Nwagu, 2010). It is indicated that 95% of the students in the developed countries have higher levels of performing well in chemistry because they have access to teaching learning facilities compared with less than 50% of students who fail chemistry due to lack of access to school facilities. Remedies

In Africa, a close observation of the performance of secondary school chemistry students perhaps could be traced to lack of teaching learning facilities and a motivating learning environment of teachers and students in African countries. Most schools seems to lack the necessary facilities that could enhance effective teaching and learning of chemistry as a result little is expected from students in terms of academic performance (UNEC, 2010). Experience

Leave blank for REC office only:	REC OFFICE USE ONLY:
MUST-REC Stamp:	APPROVAL DATE: June 12, 2019
	APPROVED CONSENT IRB VERSION NUMBER: June
	PI NAME: Chuwe Monica
	IRB NO: 16/04/19

RESEARCH ETHICS COMMITTEE
MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUCCEED WE MUST
P.O. BOX 1410, MBARARA

shows that inadequate teaching learning facilities have some adverse effect on students' interest to learn chemistry in Africa. Hence, this may invariably affect their academic performance. In a situation where students are not having access to normal facilities like laboratory, library equipment and inadequate seats in the classroom it is observed that these could contribute to low performance of students in chemistry.

Purpose of the research project

Include a statement that the study involves research, estimated number of participants, an explanation of the purpose(s) of the research procedure and the expected duration of the subject's participation.

The major purpose of the study is to examine the relationship between teaching learning facilities and students' academic performance in chemistry in selected secondary schools in Kasese Municipality. The research will select 441 respondents derived from access population of 1756 participants. Data will be collected by the use of questionnaires for science teachers and students while the key interview guide will be given to head teachers and the Municipal education officer. The researcher will use these methods because data can be collected from the population within a short time. Collection of data will take30-40 minutes to respond to the questions.

Why you are being asked to participate?

Explain why you have selected the individual to participate in the study.

You are kindly asked to take part in the study on the relationship between teaching learning facilities and students' academic performance in chemistry in selected secondary schools in Kasese Municipality. You have been seen as an important person who can help in providing answers to the problem of this study

Procedures

Provide a description of the procedures to be followed and identification of any procedures that are experimental, clinical etc. If there is need for storage of biological (body) specimens, explain why, and include a statement requesting for consent to store the specimens and state the duration of storage.

Leave blank for REC office only:	REC OFFICE USE ONLY:
MUST-REC Stamp:	APPROVAL DATE: June 12, 2019
	APPROVED CONSENT IRB VERSION NUMBER:
	PI NAME: Olive Maate
	IRB NO: 16/04/19

RESEARCH ETHICS COMMITTEE
MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUCCEED WE MUST
P.O. BOX 1410, MBARARA

Thanks for accepting to be part of this study. Your bibliography information will be recorded for accurate data recording. All the participants of the research will be briefed on the purpose to why the study is being carried. Then, they will be requested to consent on the form before the questionnaires are filled for appropriate answers from the given options

Risks or discomforts

Describe any reasonably foreseeable risks or discomforts-physical, psychological, social, legal or other associated with the procedure, and include information about their likelihood and seriousness. Discuss the procedures for protecting against or minimizing any potential risks to the subject. Discuss the risks in relation to the anticipated benefits to the subjects and to society.

There will be no any expected life threatening risks in the process of carrying out this study. No research procedure will be harm ful to you as a respondent in any way.

Benefits

Describe any benefits to the subject or other benefits that may reasonably be expected from the research. If the subject is not likely to benefit personally from the experimental protocol note this in the statement of benefits.

There has not been any study on teaching learning facilities on the general performance of students in chemistry.this study will be crucial at this point in time since the case of poor performanceare on rise as it will investigate how teaching facilities relate to students academic performance in chemistry and also come with the policy recommendations to reverse the situation.

The study will benefit both teachers, policy makers to know the importance of teaching learning facilities and how they can be provided to schools to facilitate teaching learning process.

Incentives or rewards for participating

It is assumed that there are no costs to subjects enrolled in research protocols. Any payments to be made to the subject, e.g., travel expenses, token of appreciation for time spent, must also be stated, including when the payment will be made.

Your kindly requested to volunteer and participate in thestudy as there are no incentives/rewards to be given to participants.

Leave blank for REC office only: MUST-REC Stamp:	REC OFFICE USE ONLY: APPROVAL DATE: APPROVED CONSENT IRB VERSION NUMBER: PI NAME: IRB NO:

RESEARCH ETHICS COMMITTEE
UNIVERSITY OF SCIENCE AND TECHNOLOGY
P.O. BOX 1413, MBARARA

Protecting data confidentiality
Provide a statement describing the extent, if any, to which confidentiality or records identifying the subjects will be maintained. If data is in form of tape recordings, photographs, movies or videotapes, researcher should describe period of time they will be retained before destruction. Showing or playing of such data must be disclosed, including instructional purposes.

The questionnaire will not include the names of respondents but only codes will instead be used to identify the respondents. The data collected will not be revealed to any other person a part from the researcher. Their privacy as respondents will be maintained during the process of data collection

Protecting subject privacy during data collection
Describe how the privacy of the participant will be ensured during the process of data collection.

The researcher will try all possible means to conduct interviews in a more friendly conducive environment and confidentiality will be totally maintained.

Right to refuse or withdraw
Include a statement that participation is voluntary and that refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled.

As a respondent, your participation is voluntary and you're free to withdraw from the study at any time you wish. No penalty will be attached to it

What happens if you leave the study?
Include a statement that the subject may discontinue participation at any time without penalty or loss of benefits

You may discontinue participating in this study at any time you wish and there will be no accusations brought on. The participation will be purely voluntary

Who do I ask/call if I have questions or a problem?
Include contact for the researcher and Chairperson, MUST-REC.

Respondents will contact the researcher in case of any problem or clarification during and after the researchstudy

Leave blank for REC office only:	REC OFFICE USE ONLY:
MUST-REC Stamp:	APPROVAL DATE: June 10 2019
	APPROVED CONSENT IRB VERSION NUMBER: 1
	PI NAME: Chrine Nyaaki
	IRB NO: 1610.19

RESEARCH ETHICS COMMITTEE
MASWA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUCCEED WE MUST
P.O. BOX 1410, MBARARA

Mr. Maate Clive Tel 0772331629/0706331629

clivemaate@yahoo.com

Dr. Francis Bajunirwe

Chairman, MUST-REC

P.O. Box 1410 Mbarara

Tel: 0485433795

What does your signature or thumbprint on this consent form mean?

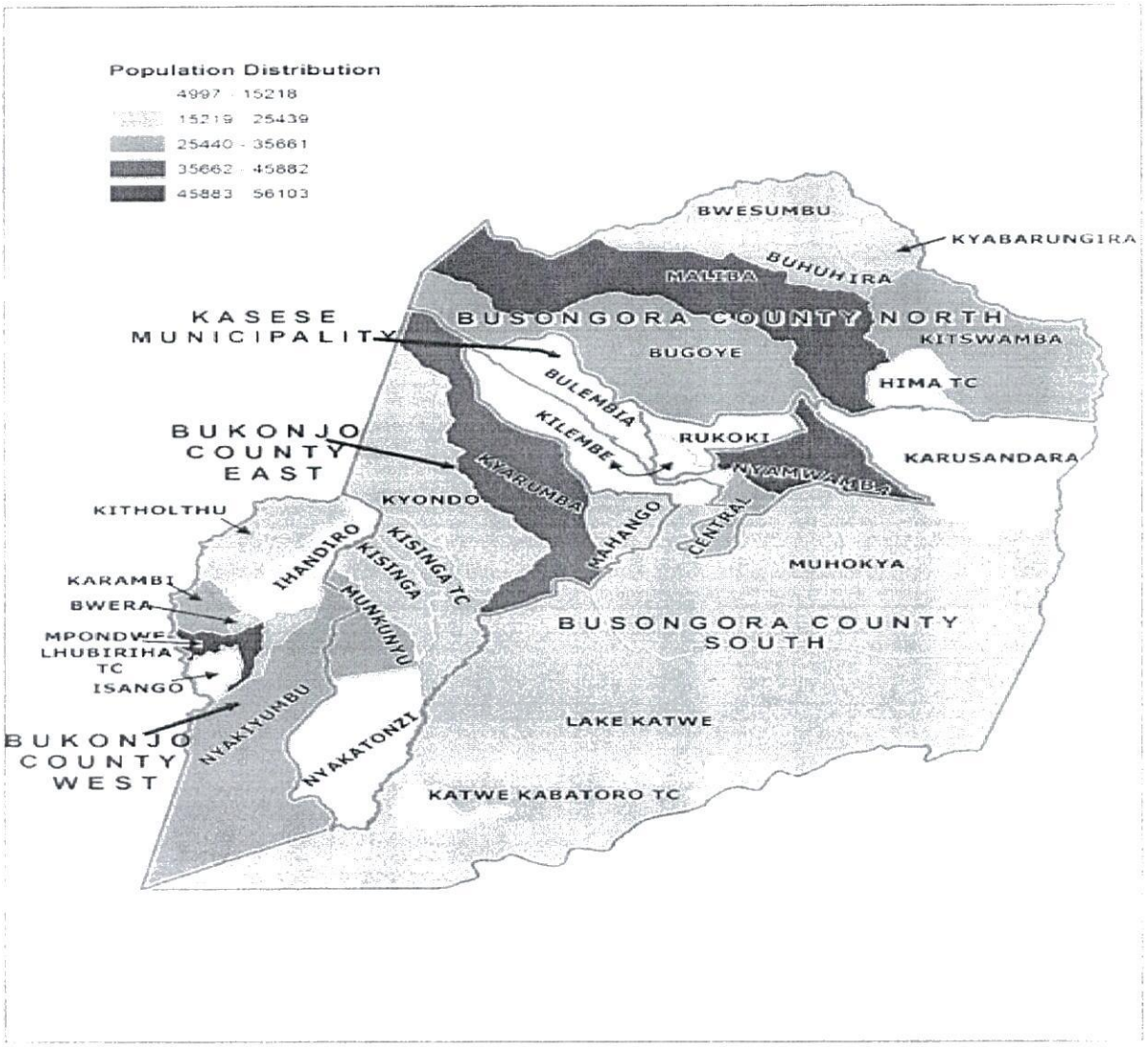
Your signature on this form means

- You have been informed about this study's purpose, procedures, possible benefits and risks
- You have been given the chance to ask questions before you sign
- You have voluntarily agreed to be in this study

Name of adult participant	Signature of participant or Legally authorized representative	Date
Name of person obtaining consent	Signature	Date
Print Name of witness	Signature or thumbprint or mark	Dat

Leave blank for REC office only: MUST-REC Stamp:	REC OFFICE USE ONLY: APPROVAL DATE: June 12, 2019 APPROVED CONSENT IRB VERSION NUMBER: 1 PI NAME: Clive Maate IRB NO: 16/VI/19

Appendix 7: Map of Kasese District Showing the Location of Kasese Municipality



Appendix 8: The Comparison of Students Performance in Chemistry Subject and Other Science Subjects in Uganda.

ject	2019					2018		
	No. of Cands	0.6	36.0	77.2	No. of Cands	0.7	42.1	80.3
		2	6	8		2	6	8
lish Lang	332,837	0.6	36.0	77.2	330,058	0.7	42.1	80.3
stian Rel. Ed	230,977	4.4	40.5	72.3	228,394	4.9	42.3	75.3
n Rel. Ed	33,807	12.2	60.9	85.4	31,953	19.4	67.5	87.6
ory	332,885	2.7	37.2	59.2	329,112	4.5	46.1	67.8
graphy	331,814	3.8	66.6	85.3	329,929	1.5	44.8	71.0
nematics	332,983	3.9	32.6	60.7	330,080	4.4	33.3	60.7
culture	192,819	1.8	42.4	75.0	198,443	0.9	34.2	67.3
sics	332,620	0.6	14.2	46.8	329,611	0.7	15.9	51.7
nistry	332,638	1.4	15.5	54.6	329,713	1.1	14.2	46.5
ogy	332,708	0.5	31.5	70.0	329,828	0.7	23.5	53.5
IPS)	88,497	1.0	82.7	99.9	80,109	1.2	66.0	99.2
mmerce	171,847	2.8	36.1	54.9	188,185	5.5	45.6	63.7

Appendix 9: Introductory Letter from the Office of the President

THE REPUBLIC OF UGANDA

OFFICE OF THE PRESIDENT

PARLIAMENT BUILDING P.O BOX 7168 KAMPALA. TELEPHONES: 254881/6, 343934, 343926, 343943, 233717, 344026, 230048, FAX: 235455/258
Email: secretary@op.go.ug. Website: www.officeofthepresident.go.ug

HRM 93/11/02

July 2nd, 2019

The Resident District Commissioner,
KASESE DISTRICT

INTRODUCTION OF MR. MAATE CLIVE-STUDENT AT MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY.

This is to introduce to you the above named person who is a student at Mbarara University of Science and Technology. He is carrying out research in your area of jurisdiction, Kasese District. This is a partial requirement for him to complete his Doctorate Degree.

For security reasons while in Kasese, he has requested this office for official introduction letter to avoid being misinterpreted by security while in the area.

The purpose of this letter therefore, is to introduce him to you and request you to render him any necessary assistance as deemed fit.

Atuheire Herbert B.
FOR: SECRETARY, OFFICE OF THE PRESIDENT

Copy to: Mr. Maate Clive

Appendix 10: Introduction Letter from The Dean Faculty of Science

MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY
P.O. Box 1410, Mbarara Uganda Tel: +256 4856 60208, Fax: +256 4854 20782
FACULTY OF SCIENCE
OFFICE OF THE DEAN

July 8, 2019

TO WHOM IT MAY CONCERN

CLIVE MAATE REG. NUMBER 2016/PhD/024/PS

The above named person is a postgraduate student of Faculty of Science based at the department of Educational Foundations and Psychology of Mbarara University of Science and Technology.

He is currently pursuing a PhD degree and his topic is titled: "**teaching-iearning facilities and students' academic performance in chemistry in selected secondary schools in kasese municipality**". He would like to collect data for the main study.

Kindly render him all the assistance he deserves.

Yours faithfully

Assoc.prof. Julius B. Lejju
D E A N

e-mail: dean.science@must.ac.ug website

Appendix 11: Introduction Letter from The District Education Officer Kasese District

+256 392 888 974
EDUCATION OFFICE
Tel:
56)772580216/703580216

KASESE DISTRICT LOCAL GOVERNME
P. O. BOX 250,
KASESE
UGANDA

In any correspondence on this subject please quote.....

Date: 22nd July, 2019

To All Head teachers
Secondary Schools
Kasese Municipal Council.

INTRODUCTORY LETTER TO Mr. CLIVE MAATE

The above subject matter, refers.
The bearer as above, is a PhD degree student and on his research exercise.
His topic is *'' teaching-learning facilities and students' academic performance in Chemistry in selected Secondary Schools in Kasese Municipality''.*

The purpose of this letter is to request you to support him by all means in order to access/get the relevant data from your Institution.

Thank you in advance.

DISTRICT EDUCATION OFFICER
KASESE DISTRICT LOCAL GOVERNMENT

George. S. Mainja
DISTRICT EDUCATION OFFICER

Appendix 12: REC Approval Letter

MBARARA UNIVERSITY OF SCIENCE AND TECHNOLOGY
P.O. Box 1410, Mbarara Uganda Tel: +256 485433795; Fax: +256 4854 20782
RESEARCH ETHICS COMMITTEE
E-mail: sec.rec@must.ac.ug

Ref: MUREC 1/7 Date June 12, 2019

Mr. Clive Maata
Postgraduate Student

Re: **Submitted Protocol on "Teaching-learning facilities and students' academic performance in Chemistry in selected secondary schools in Kasese Municipality" 16/04-19**

Mbarara University of Science & Technology
P. O. Box 1410, Mbarara
RESEARCH ETHICS COMMITTEE
11 JUN 2020
APPROVED
VALID UNTIL DATE SHOWN ABOVE

Type: [√] Initial Application
[ ] Protocol Amendment
[ ] Letter of Amendment (LOA)
[ ] Continuing Review
[ ] Material Transfer Agreement
[ ] Other, specify: _____

Reference is made to the above protocol which was resubmitted to the Research Ethics Committee for reconsideration and approval.

It is noted that you have attended to the concerns earlier raised by the Committee.

I am pleased to inform you that your study has been approved for a period of one year from **June 12, 2019** up to **June 11, 2020.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigator must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for review and approval **prior** to the activation of the changes. The REC application number assigned to the research should be cited in any correspondence.
3. Reports of unanticipated problems involving risks to participants or other must be submitted to the REC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for REC review.
4. Only approved consent forms are used in enrolment of participants. All consent forms signed by subjects and/or witness should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Regulations require review of an approved study not less than once per 12-month period. **Therefore, a continuing review application must be submitted to REC <u>eight weeks</u> prior to the above expiration date of June 11, 2020 in order to continue the study beyond the approved period.**
   Failure to submit a continuing review application in timely fashion may result in suspension or termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.

6. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of documents approved in the application:

Document	Language	Version
Proposal	English	2
Protocol form	English	2
Data Collection tools	English	June 2019
Consent form	English	June 2019

I wish you all the best.

Dr. Francis Bajunirwe
CHAIR,
MUST RESEARCH ETHICS COMMITTEE



Appendix 13: UNCST Approval Letter

Uganda National Council for Science and Technology

Established by Act of Parliament of the Republic of Uganda

Our Ref: SS 5043

7th October 2019

Mr. Maate Clive
Principal Investigator
C/o Mbarara University of Science and Technology
Mbarara

Dear Mr. Clive,

Re: Research Approval: Teaching – Learning Facilities and Students Academic Performance in Chemistry in Selected Secondary Schools in Kasese Municipality

I am pleased to inform you that on **13/08/2019**, the Uganda National Council for Science and Technology (UNCST) approved the above referenced research project. The Approval of the research project is for the period of **13/08/2019** to **13/08/2020**.

Your research registration number with the UNCST is **SS 5043.** Please, cite this number in all your future correspondences with UNCST in respect of the above research project.

As Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the research protocol or the consent form (where applicable) must be submitted to the designated Research Ethics Committee (REC) or Lead Agency for re-review and approval <u>prior</u> to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local REC for review with copies to the National Drug Authority.
4. Unanticipated problems involving risks to research subjects/participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for UNCST notification after review by the REC.
5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all study records.

LOCATION/CORRESPONDENCE

Plot 6 Kimera Road, Ntinda
P. O. Box 6884
KAMPALA, UGANDA

COMMUNICATION

TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: http://www.uncst.go.ug

6. An annual progress report and approval letter of continuation from the REC must be submitted electronically to UNCST. Failure to do so may result in termination of the research project.

Below is a list of documents approved with this application:

	Document Title	Language	Version	Version Date
1	Research proposal	English	N/A	June 2019
2	Informed consent form	English	N/A	June 2019
3	Questionnaire for students and other science subject teachers	English	N/A	June 2019
4	Interview guide for municipal education officer, head teachers and chemistry teachers	English	N/A	June 2019
5	Observation checklist	English	N/A	June 2019

Yours sincerely,

Isaac Makumbwa
Ag. Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Cc: Chair, Mbarara University of Science and Technology Research Ethic Committee

CORRESPONDENCE

COMMUNICATION
TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: http://www.uncst.go.ug