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**Challenges of the Implementation of New Senior Secondary School Chemistry Curriculum in Teaching and Learning in Public Secondary Schools in Malawi: A Case of Mulanje District**

By

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**Abstract**

The study sought to investigate challenges in the implementation of new senior secondary school chemistry curriculum in teaching and learning in Mulanje District, Malawi. The target population included head teachers, chemistry teachers and chemistry students. The sample size consisted of 10 headteachers, twenty (20) chemistry teachers, one hundred twenty (120) chemistry students, and one (1) Education Division Manager of Mulanje District. The study employed descriptive research design. Probability and non-probability were employed in the study for selecting the participants. Constructivists Theory was adopted in the study developed by Jerome Brunner, 1966. A questionnaire and interview schedules were the main instruments used for the data collection. Descriptive statistics was used to analyze data in frequencies and percentages using SPSS (Statistical Package of Social Sciences) version 21, by computing in the computer. The main findings of the study revealed that majority of the schools had inadequate teaching and learning materials like chemistry textbooks and mobile laboratory. Few schools had adequate teaching and learning materials in schools. Concerning number of chemistry teachers, the study revealed that majority of the schools had few chemistry teachers and in some schools, they had chemistry teachers. This implies that the government of Malawi in conjunction with the Ministry of Education Science and Technology need to train and recruit more chemistry teachers in order to reduce the challenges that affect the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Malawi. The study concluded that, both shortage of chemistry teachers and inadequate of teaching and learning materials and among others hindered the implementation of senior secondary school chemistry curriculum in teaching and learning in schools. The study recommended that the government should train and recruit more chemistry teachers, and provide adequate teaching and learning materials in schools for the successful implementation of the new senior secondary school's chemistry curriculum in teaching and learning in public secondary schools in Malawi.

**Key words:** Malawi, Challenges, chemistry curriculum, implementation of curriculum, teaching/learning, Mulanje, District

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### **Introduction**

Malawi is situated in the Southern part of African continent, with a total land area of 119,140 square Kilometers of which Lake Malawi covers 20.0%. It is a landlocked country lying South of the Equator. It is bordered by Zambia to the West, Tanzania to the North and Mozambique to the East and South. It has an estimated population of 17 million, with an annual growth rate of a 3.3%. The country became independent from British colonial rule in July 1964 and a Republic in July 1966 (Government of Malawi, 2006).

### **Background of the Problem**

Education is remarkably credited for national growth and development globally. As a science subject, chemistry curriculum incontrovertibly occupies a central locus in the contemporary society (American Chemical Society, 2017). It underpins almost every aspect of modern life. Essentially, the ultimate goal of studying chemistry curriculum is to enhance peoples'/students' understanding of the composition, structure, properties and changes of matter while under varied conditions. Generally, matter is anything that has mass and also takes up space. Matter commonly exists in solid, liquid or gaseous states.

Seemingly, chemistry curriculum education is yet to be attained even in other global countries ,for instance in Sweden, Broman, Ekborg & Jonels (2011) noted that many students regard chemistry as an irrelevant and meaningless subject; this arises from their misperception induced a drastic fall in the number of students pursuing chemistry curriculum based courses at higher levels thus substantiating the need for raising chemistry relevance by aligning its content to daily life and placing more emphasis on laboratory work. In Indonesia, Yasin, et al (2013) found that, majority of rural students were failing to master key chemistry curriculum concepts, and their low performance on laboratory-based questions appeared to indicate that the associated practical work was not done as part of the chemistry courses. The study revealed that some chemistry topics were not taught due to insufficient textbooks and chemistry teachers.

Furthermore, low competency at teachers, poverty for the majority of students, low enrolment in schools, and low competition among students in these rural senior high schools appeared to be common problems across rural settings. The local government recommended by providing a consolidated rural high school with qualified chemistry teachers, laboratories, and transportation to address factors negatively influenced students' achievements. Finally, it recommended that local rural school officials need to recruit and retain qualified teachers in isolated areas, by providing adequate teaching and learning materials including chemistry teachers.

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Similarly, a study conducted by Zarb et al, (2017) in Malta, revealed that some fundamental concepts of chemistry curriculum like kinetic theory, atomic structure, valences and equations should be taught separately at an earlier stage before tackling other ideas. Furthermore, it revealed that other teachers found it difficult to accept the new arrangement of content in a non-traditional way such as the way ionic bonding and covalent bonding are placed in a single topic specifically about bonding. This seems to show that although teachers welcome change, they too find it difficult to conceptualize, organizing ideas and teaching chemistry curriculum in a way which is different from the way they have always experienced the subject. Time factors and assessment-related matters were clearly major challenges in teaching and learning in chemistry curriculum. It also revealed that, teachers were not finding enough information related to assessment in the document describing the programme. Furthermore, it revealed that, teaching mixed ability groups of students especially in certain contexts remained one of the main challenges in the current system.

In Zimbabwe, the study of Magweva (2017), revealed that there were shortages of apparatus in schools to cater for every individual learner to do separate task based on chemistry learning. Based on the findings, the study recommended that there is a need to improve the implementation of continuous assessment of chemistry curriculum. The Ministry of Primary and Secondary Education should run workshops nationwide that intensively equip the teachers and learners with pre-requisite skill and knowledge to implement continuous assessment effectively.

A study carried out by Cherop (2019) in Kenya, revealed that majority (70.0%) of the students found chemistry interesting; (68.0%) indicated that every student should learn chemistry; (86.0%) of the students revealed that language used in chemistry examinations is very difficult and confusing. Furthermore, majority (66.0%) of the respondents felt that girls do well in chemistry compared to boys; (95.0%) of them mentioned that there was presence of school policy regarding chemistry. Majority (66.0%) of the respondents were of the opinion that they had adequate chemistry textbooks in the schools. While (70.0%) were passionate about chemistry. It was concluded that students' perceptions, of gender, school policies, and career aspirations had influence on students' achievement in chemistry curriculum in teaching and learning. The study recommended that there is a need to make the language simpler used in this subject to enhance understanding among the students. Measures should be put in place to encourage boys in chemistry; and that teachers of chemistry should be sensitized to be supportive and encourage students to choose careers linked to chemistry curriculum in teaching and learning in public secondary schools.

According to Ituma (2012) knowledge of chemistry is required in the provision of services and production of quality goods. The subject is also a prerequisite for enrolment into scientifically inclined careers such as medicine, engineering, pharmacy, biotechnology, agriculture, and among others, in postsecondary educational institutions (Njagi, & Silas, 2015; Mwangi, 2016). In addition, chemistry curriculum knowledge somehow blends compatibly with some content of other science subjects such as agriculture, biology and physics hence contributing notably towards a more desirable comprehension of those subjects (Muse, Ndirangu & Imonje, 2018). Similarly, in Malawi, Mdolo and Doidge (2011) conducted a study on factors

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that affect the implementation of new biology curriculum in Malawi. The study revealed that, the pressure to cover the syllabus before the national examinations; lack of text books and laboratory equipment; lack of motivation among students; students' backgrounds; large classes; and inadequate fluency in English speaking were some of the factors affected the implementation of a new biology curriculum. The study concluded that, pressure to complete the syllabus before the national examinations, lack of resources; language of instruction; inadequate knowledge of the subject matter and poor pedagogical skills were some of the challenges/ factors affected the implementation of new biology using constructivist approaches in public secondary schools in Malawi.

Malawi, like other developing countries in Africa, is striving to provide the “ideal”, science education system, one that considers students active participation in the teaching and learning process over learner-centered approaches. In the midst of the current reforms in science education, Malawi as a nation had realized that science education is instrumental in achieving a developmental goal of becoming one of the developed economies of the world by 2020. Upon this realization, it became necessary to update existing science curricular to accommodate contemporary issues shaping and influencing the development of the nation. Chemistry curriculum was one of the subjects revised for relevance and to enable students (even those who do not intend to proceed to higher education) become self-reliant and competent enough to meet global challenges.

The education system is structured in such a manner that science subjects should be first presented to all learners at the secondary school level of the basic education curriculum and chemistry curriculum is among the science subjects (Government of Malawi, 2015). Some basic concepts of chemistry curriculum are taught at the primary school level, during this stage, those concepts are presented integrated in science subjects. At the secondary school level, the subject becomes autonomous. Its concepts, principles and skills are taught by experimental investigations and practical approach. This requires subject specific teaching, learning materials and facilities, such as the laboratory, apparatus, chemicals, safety equipment, inventory books, personnel and laboratory assistant (Government of Malawi,2015).

The new senior secondary school chemistry curriculum operational in Malawi was prepared in 2015 and made available for teachers in 2017(Government of Malawi, 2015/2017). The chemistry curriculum has completed 2-cycles (years) of implementation at the senior secondary school level. In preparing the chemistry curricular, it was imperative that grounds are prepared for the translation of the documents into syllabi, textbooks and classroom processes. To achieve the objectives, chemistry teachers have the important roles to play in the implementation of chemistry curriculum. Despite the importance of chemistry curriculum in the country's quest for technological development and roles of chemistry teachers on its implementation, there had been challenges and major concerns from parents, teachers and educators in the country in the implementation of chemistry curriculum (MManga, 2017).

According to MManga (2017) in his article reported that lack of chemistry teachers, inadequate knowledge of the new content, and inadequate of teaching materials like chemistry textbooks and laboratory chemicals were major challenges of the implementation of chemistry

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curriculum implementation in public secondary schools. The study recommended that for successful implementation of new senior secondary school chemistry curriculum, the Ministry of Education Science and Technology should orient science teachers for effective implementation of the curriculum.

Mulanje District is one of the 28 districts in Malawi and is found in the Southern region of Malawi. The country has two types of government secondary schools, such as Conventional Secondary Schools (CSSs) and Community Day Secondary Schools (CDSSs) (Mdolo, 2010). There are also other private secondary schools in Malawi, however, this study (Mini Project) focused in CSSs and CDSSs especially, in Mulanje District. According to Mdolo (2010), the major difference between these secondary schools is resources, both physical and human. Some CSSs have qualified chemistry teachers and adequate infrastructures that include science laboratories and furnished libraries. On the other hand, in CDSSs most teachers are not science teachers and there are no science laboratories except in a few cases where there may be mobile laboratory equipment. Libraries are just small rooms where books are kept and lent to students. The CDSSs and the quality of education offered in these schools are considered inferior to CSSs. Therefore, this study (Mini-Project) focused in Mulanje District, because it has many CDSSs than CSSs and in some CDSSs have no qualified chemistry teachers, textbooks, chemicals and mobile laboratory. Sometimes it comes to an extent that a language or humanity teacher can be assigned to teach chemistry curriculum which is a very big challenge of the implementation of the new senior secondary school chemistry curriculum in teaching and learning.

According to Bankole and Oludipe (2020) assert that chemistry curriculum is the mother of all science subjects that is making essential contributions towards human life, society, industry and civilization. The data available on performance of candidates in seniors' secondary schools in Malawi 2019 attested to the poor achievements in chemistry curriculum examination results (Malawi National Examination Board, 2019).Mulanje District was one of the district which performed below average in chemistry curriculum in National Examinations of 2019. Therefore, this Mini Project investigated challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District in 2018.

In 2019 new senior secondary school chemistry curriculum was put into practice to National Examination Board in which chemistry students sat for the first time to write their national examination in Malawi. However, students were expected to prepare this chemistry curriculum examination by reading or covering the work from Form 1 to Form 4 as preparation for the national examination. Unfortunately, the outcome was not satisfactory to the public. This can be attributed to as one of the challenges of lack of chemistry teachers, teaching and learning materials in schools, and among others. "This could be one of the reasons why students did not perform satisfactory in chemistry curriculum in schools."

### **Statement of the Problem**

Generally, there are challenges in the implementation of new senior secondary school chemistry curriculum in teaching and learning in Malawi. Some studies had been carried out on secondary



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schools in Malawi but in different areas in different aspect. For instance, a study by Mdolo and Doidge (2011) revealed that, the pressure to cover the syllabus before the national examinations; lack of text books and laboratory equipment; lack of motivation among students; students' backgrounds; large classes; and inadequate fluency in English public speaking were some of the factors affected the implementation of a new biology curriculum in Malawi. A report article by MManga (2017) and chemistry curriculum outcome results of 2019 indicated a major concern from parents, teachers, and educators in Malawi. While no any study in the area was found to address the challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Malawi. With references to the above evidences, therefore, this study, (Mini Project), sought to investigate challenges of the implementation of new senior secondary school chemistry curriculum in public secondary schools in Mulanje District, Malawi to fill the gap.

### **Research Questions**

The study was guided by the following two research questions:

1. What are the challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi?
2. What strategies can be made to curb the challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi?

### **Significance of the Study**

The findings of this study inform curriculum developers and implementers on challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Malawi and find out the strategies of improvement.

It is beneficial to the Government of Malawi and Ministry of Education Science and Technology to train chemistry curriculum teachers, and provide adequate chemistry curriculum textbooks in public secondary schools for teachers and students.

### **Scope and Delimitation of the Study**

The study focused on Mulanje District which is on the Eastern side of Malawi. Furthermore, it was confined on head teachers, chemistry teachers, chemistry students and Education Division Manager of the district. On the delimitations of the study, it was set out to cover only Mulanje District as it was not possible to carry out research in the entire country due to cost implications hence was a mini project study. Finally, it was only confined in public secondary schools within the district not as private schools because they have their own ways of resourcing teaching and learning materials for the implementation of chemistry curriculum in their schools.

### **Theoretical Framework**

The study was guided by the constructivist theory developed by Jerome Brunner in 1966. According to the theory, learning is an active process during which the learners construct new

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ideas based on their current or background experiences and knowledge. The theory advocates for active participation of learners in the learning process rather than being passive receivers of knowledge. The learners should be involved in physical action; hands-on experience that engages their mind as well as their brain (Bruner, 1966).

The theory has limitations in that; some concepts require direct instruction rather than being constructed from past experiences or background experiences. In addition, some learners may unknowingly misrelate some of the new knowledge to unrelated past experiences thereby misunderstanding the newly encountered content altogether. Review of related literature covered an overview of challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools. Furthermore, strategies for curbing the challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Malawi are many.

## **Review of Related Literature**

### **Overview of Chemistry Curriculum Implementation**

Various authors understand the concept of curriculum implementation differently. According to Chaudhary (2015) defines curriculum implementation entails putting into practice the officially prescribed courses of the study, syllabuses and subjects. The process involves helping learners acquire knowledge or experiences. It is important to note that the implementation of chemistry curriculum cannot take place without learners and availability of teaching materials and subject teachers. Therefore, they are the central figures in the curriculum implementation process. Implementation takes place as the learner acquires the planned or intended experiences, knowledge, skills, ideas and attitudes that are aimed at enabling the same learner to function effectively in the society. Viewed from this perspective, curriculum implementation also refers to the stage when the curriculum itself, as an educational program me, is put into effective. Putting the curriculum into operation requires an implementing agent, for instance a teacher.

In addition, Kyalo (2016) indicated that learning experiences in chemistry are: content, practical work, projects, group discussions, excursions and field work. The subject also has the application element of its knowledge. This enables learners to utilize the acquired knowledge in everyday life within the contemporary society. Just like other science subjects, chemistry has both theoretical and practical aspects which complement each other during the teaching and learning process (Mwangi, 2016). Whereas the subject's theoretical aspects can be studied by traditional methods, and its practical content entails conducting experiments.

According to Okono, Sati, & Awuor (2015) teaching of chemistry by experimentation pedagogical approach contributes to effective instruction by the teachers and improves mastery of scientific concepts by the learners. The approach also aids ascertainment of scientific facts, concepts and principles and help in nurturing the learners' scientific process skills (Kaping'ei and Rutto, 2014). Experiments can be done in two main ways, that is, class experiments and demonstrations. Whereas class experiments are learner centered and entail the students

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performing the experiments, recording observation made, by themselves either individually or in groups. Demonstration experiments are carried out by the teacher as the students observe.

### **Challenge of the Implementation of New Senior Secondary School Chemistry Curriculum in Teaching and Learning in Public Secondary Schools**

A lot of factors that act as challenges to the implementation of the new senior secondary school chemistry curriculum had been identified in literature with various scholars in different countries in the world. Some of the challenges of the implementation of this chemistry curriculum as given in the literature are from different perspectives countries, such as from global, regional and local including Malawi.

In Ireland, Childs (2014) indicated that effective implementation of chemistry education is threatened by factors such as transition between levels of education, science background of students, diversity of the student body, problems of science language, and cognitive level of students. In addition, scientific misconceptions among students, impact of Information Technology (IT) on instruction, and ignorance of chemistry education research amongst most lecturers also affected the implementation of chemistry curriculum in teaching and learning.

In China, the main problem facing implementation of chemistry curriculum is adaptation of curriculum materials by teachers. In particular, factors such as a chemistry teacher's pedagogical content knowledge, external examinations, time constraints, instructional resources, size of class, belief concerning science, and peer coaching had a significant influence on the adaptation of chemistry curriculum materials by the teachers (Chen & Wei, 2015).

Similarly, in China, a study conducted by Wei(2020) concluded that the Senior High School Chemistry curriculum has become increasingly demanding during the period under study and the newly emergent senior high school chemistry curriculum is more challenging than its predecessors. The study recommended that chemistry curriculum developers need to learn the ways from the study in handling the issues of learning and teaching objectives in the process of developing chemistry curricula. Furthermore, based on the study, school chemistry teachers should be aware of the subject-matter changes occurring in the recently developed chemistry curricula.

In South Africa, implementation of chemistry curriculum is influenced by: inadequate of practical lessons, shortage of laboratory facilities and relevant textbooks. Other challenges are: teacher unprofessionalism while on the job, poor attendance of teachers to in-service training courses, workshops and seminars, lack of laboratory attendants or presence of unqualified teachers in schools, and absence of lack of laboratory safety equipment for first aid intervention in the case of accidents (Ijidike & Oyelana, 2015).

In Nigeria, ineffective implementation of the chemistry curriculum was as a result of inadequate funding, poor teacher motivation, partial curriculum coverage, lack of laboratory, inadequate of teaching and learning materials, lack of chemistry teachers, and voluminous nature of chemistry curriculum content (Achimugu, 2016).

In addition, Neji, Okwetang & Njaa (2014) reported that laboratory facilities in most Nigerian secondary schools were due to inadequate for effective teaching of chemistry



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curriculum. This is corresponding to the study of MManga (2017) in Malawi, in his article reported that lack of chemistry teachers, inadequate knowledge of the new content, and inadequate of teaching materials like chemistry textbooks and laboratory chemicals were major challenges to the curriculum implementation in public secondary schools.

### **Teaching and Learning Materials and Implementation of Chemistry Curriculum**

The practical nature of chemistry curriculum singles it out as a resource intensive subject. Its curriculum implementation therefore, demands for variation of pedagogical approaches and use of subject specific teaching/learning materials and facilities such as the laboratory, chemicals, apparatus, safety equipment and laboratory fittings. It also requires a laboratory assistant, and this is in addition to the regular instructional resources used in teaching of other subjects. According to Blonder and Naaman (2019) in Israel, found that in countries where chemistry studies at the high-school level are not mandatory, innovative pedagogies are more likely to replace the traditional chemistry teaching methods where it is taught according to the structure of the subject based on basic concepts that underlie the curriculum. The study concluded by providing an additional support to the importance of the professional development of science and chemistry teachers. It recommended that the autonomy that was given to them should influence the quality of science teaching and students' achievements.

While acknowledging the position given in Mwangi (2016) that some chemistry practical's can as well as be performed in classrooms and or just outside. It is important to reiterate that laboratory remains the most convenient venue for carrying out any chemistry experiment. This is because; the facility has a special design and possesses the appropriate infrastructure for this purpose, as such it is a mandatory requirement for effective implementation of chemistry curriculum.

According to Ejidike and Oyelana (2015) shortage of laboratories contributed to ineffective chemistry teaching in schools. To enhance the conduciveness of the laboratory for teaching and learning, the facility should have adequate water supply system, enough furniture, good ventilation, and a stock of instructional materials such as chemicals, apparatus, operational equipment, charts and models. According to Gatana (2011) inadequacy of chemical materials and apparatus in the school laboratories contributed to low performance in chemistry. Additionally, Chepkorir, Cheptonui & Chemutai (2014) concurred that for students to master chemical reactions, they need to mix the chemicals and observe subsequent reactions. The laboratory safety measures should also be in place through the supply of first aid kits, lab coats, gloves, and charts showing laboratory rules.

### **Teachers' Workload and Implementation of New Senior Secondary Chemistry Curriculum**

According to Okono et al (2015) the number of lessons which a teacher handles affects their preparedness for each class and between classes daily. This is because teachers have other duties apart from teaching which also requires time in order to be accomplished. Such duties include: managing behaviour of students, planning for lessons, assessment of learning, counseling students, marking assignments, resources improvisation and among others. High lesson load can

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affect syllabus coverage and chemistry curriculum implementation in the sense that, teachers with more lessons may resort to carrying out only few experiments as compared to their colleagues with fewer lessons.

Ndirangu, Nyagah and Kimani (2017) established that, there was a partial level of implementation of learner-centered practical activities in teaching and science subjects despite the teachers having attended to an in-service training programme about the same. This was largely blamed on the heavy teaching loads shouldered by the science teachers.

This statement is anchored by the report article of MManga (2017) who reported that the new senior secondary school chemistry curriculum in teaching and learning is overloaded with more teaching activities, deep in scope, and difficult to understand to the students. In principle, teaching chemistry by using learner-centered experiments demands prior preparation and even trial of the experiment by the teachers prior to actual execution of the lesson.

High number of lessons amounts to heavy workload, may compel the teacher against will to keep away from experimentation-based teaching, while deliberately opting for lecture method during implementation of chemistry curriculum. Furthermore, length of a lesson, time between lessons, teacher's second subject and position of responsibility may impact on chemistry curriculum implementation. The recommended allocation in terms of lessons for Kenyan teachers is 27 (Okono, et al, 2015).

On concerning teachers' workload, and implementation of chemistry curriculum, Muse, Ndirangu and Imonje (2018) in Kenya, found that (72.7%) of the chemistry teachers taught another practical based subject; either biology or physics. Majority (68.2%) of the teachers held positions of responsibility in addition to chemistry teaching. The study concluded that, both shortage of some essential teaching and learning materials facilities and augmented teacher's workload hindered perfect implementation of chemistry subject's curriculum. The study recommended that, chemistry teachers should greatly emphasize on the use of experimentation pedagogical approach in which, their learners must directly engage in practical work by using the available teaching and learning material facilities.

### **Strategies for Curbing the Challenges of the Implementation of New Senior Secondary School Chemistry Curriculum in Teaching and Learning in Public Secondary Schools**

From experience no meaningful teaching and learning can take place without resources materials, and this implies to curriculum implementation as well. Some of the ways of improving the implementation of new senior secondary school chemistry curriculum in public secondary schools as given in the literature include:

#### **Availability of Teaching and Learning Materials**

Chaudhary (2015) pointed out that, for the officially designed curriculum to be fully implemented, as per plan, the government or Ministry of Education should supply schools with adequate resource materials such as textbooks, teaching/learning aids and stationary in order to enable teachers play their role satisfactorily in the curriculum implementation process. The study recommended that the central government needs to provide physical facilities such as

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classrooms, laboratories, workshops, libraries and sports fields in order to create an environment in which implementation can take place. The availability and quality of resource materials and appropriate facilities have a great influence on curriculum implementation.

### **Availability of Qualified Chemistry Teachers and Knowledge of Subject Matter**

Stenhouse (2015) identifies the teacher as the agent in the curriculum implementation process. She argues that implementation is the manner in which the teacher selects and mixes the various aspects of knowledge contained in a curriculum document or syllabus. Implementation takes place when the teacher-construct syllabus, the teacher's personality, the teaching materials and the environment interact with the learner. Curriculum implementation therefore, refers to how the planned or officially designed course of study is translated by teachers into syllabuses, schemes of work and lessons to be delivered to students.

Implementation of chemistry curriculum means putting the prescribed chemistry syllabus into actual practice. This entails, use of experimental investigations to develop in learners the scientific concepts, principles and skills meant for learning. Acquisition of knowledge by discovery is highly encouraged (Muse, Ndirangu & Imonje, 2018).

According to Ituma (2012) knowledge of chemistry is required in the provision of in-service training. The subject is also a prerequisite for enrolment into scientifically inclined careers such as medicine, engineering, pharmacy, biotechnology, agriculture and the like, in postsecondary educational institutions (Njagi & Silas, 2015; Mwangi, 2016). Knowledge of chemistry blends with some content of other science subjects such as agriculture, biology and physics hence contributing notably towards a more desirable comprehension of those subjects (Muse, Ndirangu, & Imonje, 2018).

In Malawi, Chakwera (2005) argues that textbooks provide teachers with a more structured and comprehensive presentation of the subject matter than would otherwise be available to them. In the absence of inadequacy of textbooks, the teacher becomes the custodian of the knowledge and skills for most students who take national examination. Malawi as a developing nation is in need of scientifically literate citizenry in chemistry to be able to develop and transform her to the level of developed nations. Indeed chemistry teachers, trained teachers and adequate of teaching materials are needed to address the aspiration of the chemistry curriculum to be among the first economically developed countries in the world by the year 2020.

Evidence in literature shows that, low level of implementation of chemistry curriculum is traceable to some challenges such as inadequate and unqualified chemistry teachers, shallow knowledge of chemistry teachers; lack of laboratory, poor preparations of textbooks, inadequate equipment/materials for science teaching, poor motivation of teachers and lack of in-service training, (Ogar & Aniefiok, 2012, Chaudhary, 2015, Achimugu, 2016, & MManga 2017). Therefore, these challenges signaled that the implementation of the new senior secondary school chemistry curriculum in public secondary schools in teaching and learning is facing more challenges in Malawi.

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### **In-service Training**

Commenting on the importance of in-service training before the introduction of the chemistry curriculum, Ogar & Aniefiok (2012) emphasized that professional development prepares teachers for implementation by placing classroom practice in the larger context of school practice and the educational career of learners. In the discussion of the challenges of implementing a teacher discussion chemistry curriculum in Nigeria, hinted on the importance of adequate teacher training because the success of curriculum implementation is dependent on teachers' ability to translate the written curriculum into classroom learning experiences.

According to Ituma (2012) knowledge of chemistry is required in the provision of in-service training. The subject is also a prerequisite for enrolment into scientifically inclined careers such as medicine, engineering, pharmacy, biotechnology, agriculture and the like, in postsecondary educational institutions (Njagi & Silas, 2015; Mwangi, 2016). the knowledge of chemistry blends with some content of other science subjects such as agriculture, biology and physics hence contributing notably towards a more desirable comprehension of those subjects (Muse, Ndirangu, & Imonje, 2018).

### **Research Methodology**

In this study, descriptive survey design was employed. The target population included all head teachers, teachers, students and Education Division Manager of Mulanje District. According to Mulanje District Statistics Educational Plan (2020), there are 28 public secondary schools in Mulanje District consisting with the target population of 420 teachers, 28 head teachers and 8,958 students in the district. Probability and non-probability procedures were used to select the participants in the study. Out of 28 head teachers, 10 were purposively selected because of the role they play in actual implementation of the new senior secondary school of chemistry curriculum in schools. Out of 420 teachers, 20 chemistry teachers were randomly selected because they are the key players in the implementation of the new senior secondary school chemistry curriculum in teaching and learning in schools. Out of 8,958 students, 120 chemistry students were selected using simple random sampling technique to avoid biases and they were the ones who were involved in chemistry curriculum in teaching and learning. One (1) Education Division Manager was purposively selected because is the overall of the schools and knowledgeable about the challenges of the implementation of the new senior secondary school chemistry curriculum. Ten (10) public secondary schools were selected using simple random sampling procedure. A total sample size of 151 respondents participated in the study on challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi.

This study used both qualitative and quantitative research instruments. Interview schedules were used to collect qualitative data and were organized into themes and presented in narratives form. All quantitative data obtained from questionnaires were cleaned, coded and keyed into computer Software Statistical Package for Social Sciences (SPSS) program version 20.0, to generate frequencies and percentages that summarized data.

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The researcher adhered to the possible standards that guide educational research. She ensured that every step in the study was scientifically, professionally, scholarly and ethically carried out. In this study, the researcher equally abided by all legal procedures that guide conduct of research both in Kenya and Malawi. In Kenya, the researcher sought approval and permission of the Catholic University of Eastern Africa (CUEA), and in Malawi. The researcher obtained full consent and approval to conduct research from Mulanje District, which is under SHED, before going to the field for data collection. The researcher sought for the informed consent of the respondents, explaining to them the reason for the study and how the information they provide would be used only for academic purposes in this study, ensuring that they participate in the study voluntarily.

### **Findings of the Study**

This section presents the background information of the respondents and the analysis of the findings on the challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools. Furthermore, it sought to find out strategies for curbing the challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools.

### **Demographic Information of the Respondents**

In order to understand the respondents who participated in the study, each respondent was asked to provide their personal data. Head teachers, chemistry teachers and chemistry students were asked to indicate their gender and highest education level attended. The chemistry students were asked to indicate their gender and frequency of availability of teaching/learning materials facilities in schools and availability of chemistry teachers.

**Table 1: Respondents by gender**

Gender	Head Teachers		Chemistry Teachers		Chemistry Students	
	(F)	(%)	(F)	(%)	(F)	(%)
Male	7	70.0	15	75.0	85	70.8
Female	3	30.0	5	25.0	35	29.2
<b>Total</b>	<b>10</b>	<b>100.0</b>	<b>20</b>	<b>100.0</b>	<b>120</b>	<b>100.0</b>

Source: Author Data

From the findings in Table 1, it was revealed that 70.0% of the head teachers were male, while 30.0% were female. This implies that an effort towards eradicating gender-based inequality in education within Mulanje District is gradually yielding in schools. Occupation of leadership positions by women is essential in giving hope to the female students as it motivates them against surrendering in their quest for self-actualization.

The findings also revealed that 75.0% of the chemistry teachers were male, while 25.0% were female. This indicates that Mulanje District's chemistry teaching force was male dominated



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in that for every ten chemistry teachers, only one is female. The prevailing male dominance in chemistry teaching staff needs deconstruction as it portrays the subject as masculine. This may silently promote emergence and rise of dissatisfaction towards the subject by some female learners due to the shortage of role models. However, according to Owolabi and Adedayo (2012) a teacher's gender has no impact on their ability to impart knowledge to students provided s/he is knowledgeable and skilful in the subject area.

Furthermore, the findings also revealed that 70.8% of the students were male, while 29.2% were female. This slightly higher number of male students than female one signifies a rise in access to chemistry curriculum educational opportunities by the boy child in Mulanje District. In order to realize education for all, both male and female chemistry students must be educated indiscriminately. The results presented in Table 2 show the highest level of education attained by both the head teachers and chemistry teachers.

**Table 2: Head teachers and chemistry teachers by education level**

Highest Education level	Head Teachers		Chemistry Teachers	
	(F)	(%)	(F)	(%)
M.Ed	---	---	---	---
B.Ed	8	80.0	17	85.0
BSc	2	20.0	3	15.0
Dip.Ed.	-----	-----	---	-----
<b>Total</b>	<b>10</b>	<b>100.0</b>	<b>20</b>	<b>100.0</b>

Source: Author Data

The data in Table 2 showed that none of the head teachers and chemistry teachers held Master's degree. This implies that all head teachers and chemistry teachers of the public secondary schools had no Master's degree in education. Majority 80.0% of the head teachers and 85.0% of the chemistry teachers respectively held Bachelor's degree. This implies that all the heads and chemistry teachers of public secondary schools had at least university education. Heads of learning institutions need to requisite competencies for satisfactory supervision of chemistry curriculum implementation. According to Kigwilu and Githinji (2015), hiring of highly qualified teachers guarantees effective chemistry curriculum in teaching and learning.

Furthermore, the findings also revealed that 20.0% of the head teachers and 15.0% of chemistry teachers had a Bachelor of Science degree and none of them had a Diploma in education. As such, all the chemistry teachers satisfied the required professional competence for teaching the subject. According to Orado (2009) qualified chemistry teachers possess an in depth understanding of subject matter and be knowledgeable. This is required for a clear and convincing explanation of chemistry facts, concepts, principles and theories to learners.

This section presents results on challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools and

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on teacher’s responses on the availability and adequacy of teaching / learning materials in particular mobile laboratory, chemistry textbooks and chemistry teachers in schools. The results presented findings showed on whether chemistry textbooks and, mobile laboratories equipment were available/ adequacy, and available but inadequacy in schools for the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools.

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**RQ 1: Challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools**

**Table 3: Teachers’ responses on teaching and learning materials on the implementation of new senior secondary school chemistry curriculum**

	Chemistry textbooks		Mobile laboratories equipment	
	(F)	(%)	(F)	(%)
Available and Adequate	7	35.0	5	25.0
Available but inadequate	13	65.0	15	75.0
<b>Total</b>	<b>20</b>	<b>100.0</b>	<b>20</b>	<b>100.0</b>

Source: Data by the Author

The findings in Table 3 indicate that chemistry textbooks were available by 35.0% of teachers’ responses and mobile laboratories equipment were available and adequate by 25.0% of the teachers. Chemistry textbooks were available but inadequate by 65.0% responses of the teachers. Mobile laboratories equipment were available but inadequate by 75.0% of the teacher’s responses. This means that most of the teaching/ learning materials were available but inadequate in schools. Furthermore, the study revealed that majority of the schools do not have adequate mobile laboratory and chemistry textbooks, and this indicates some of the challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi. The results presented in Table 4 were the students’ responses on the availability and unavailability of chemistry teachers and chemistry textbooks. In addition, results available of chemistry teachers but inadequate of chemistry textbooks in public secondary schools.

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**Table 4: Students' responses on teaching and learning materials on chemistry**

	Chemistry teachers		Chemistry textbooks	
	(F)	(%)	(F)	(%)
Available and adequate	35	29.2	35	29.2
Available but inadequate	85	70.8	85	70.8
<b>Total</b>	<b>120</b>	<b>100.0</b>	<b>120</b>	<b>100.0</b>

Source: Field Data

The findings in Table 4 showed that most of the students by 29.2% of the students responded that chemistry teachers were available and adequate as well as chemistry textbooks responded by 29.2% of the students. Furthermore, 70.8% of the students responded that chemistry teachers were available but shortages in schools as well as chemistry textbooks were available but inadequate in schools. This implies that most of the chemistry textbooks were available but were inadequate in schools. The study revealed that majority of the schools does not have adequate chemistry textbooks and chemistry teachers in schools. This implies that these were some of the challenges that affected in the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi.

**RQ 2: Strategies for curbing the challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning**

This section presents interview schedules of the Education Division Manager and Head teachers. The study revealed that majority by 100.0% of the Education Division Manager revealed that there is a need for the government of Malawi to train and recruit more chemistry curriculum teachers and post them in schools where there are no chemistry teachers in order to impart knowledge and skills to the learners. It was also reported that there were inadequate of teaching materials especially, chemistry textbooks and laboratory chemicals were the main challenges in most schools. Majority of the head teachers by 100.0% responded that there is a need for the Ministry of Education Science and Technology to organize workshops for chemistry teachers and provide adequate chemistry textbooks in schools to curb the challenges of the implementation of the new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi.

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### **Discussion of the Findings**

This section presents discussions of the findings of the study relating to other studies done by other scholars from different countries in the world. Based on the findings of the study, the first research question, sought to find out challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools. The findings of the study revealed that, lack of chemistry teachers, chemistry textbooks, chemicals, and mobile laboratories, among other teaching materials were the main challenges in most public secondary schools. These findings are related to studies of Ejidike & Oyelana (2015) in South Africa, Achimugu (2016) in Nigeria, Cheni & Wei (2017) in China, ( Mdolo, 2010, & MManga, 2017) in Malawi, whose findings revealed that there were lack of chemistry teachers, laboratory chemicals, and in-service training of chemistry teachers. The second research question sought to find out strategies for curbing the challenges of the implementation of new senior secondary school chemistry curriculum in teaching and learning in public secondary schools in Mulanje District, Malawi. The findings of the study concluded that the government of Malawi or Ministry of Education Science and Technology should provide adequate teaching and learning materials in schools like chemistry textbooks, chemicals, and mobile laboratories and also train more chemistry teachers. The findings are related to the study of Ogar and Aniefiok (2012) in Nigeria, who found that it is important to have in-service training before introducing chemistry curriculum. Similarly, it is also related to the study of Ituma (2012) whose finding was that knowledge of chemistry is required in the provision of in-service training of chemistry teachers.

### **Conclusions and Recommendations**

Based on the conclusions of the study, the first research question concluded that, there should be more chemistry teachers and availability of teaching and learning materials in schools for the implementation of chemistry curriculum. It was recommended that there is a need for the government or Ministry of Education Science and Technology to train chemistry teachers and provide in-service training for all science teachers. There is a need for the provision of adequate teaching materials in most schools for the implementation of new senior secondary school chemistry curriculum for the better improvement in teaching and learning for quality education in Malawi. The second research question also concluded that the government or Ministry of Education Science and Technology should train and recruit more chemistry teachers and provide adequate chemical laboratories in schools. It was recommended that both government and Ministry of Education Science and Technology need to take into action for the resolutions of the challenges hindering in the implementation of new senior secondary school in chemistry curriculum in public secondary schools in Malawi.

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