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Effectiveness of Chemistry Curriculum Implementation in Public Secondary Schools in Likuyani Sub-County, Kakamega County, Kenya

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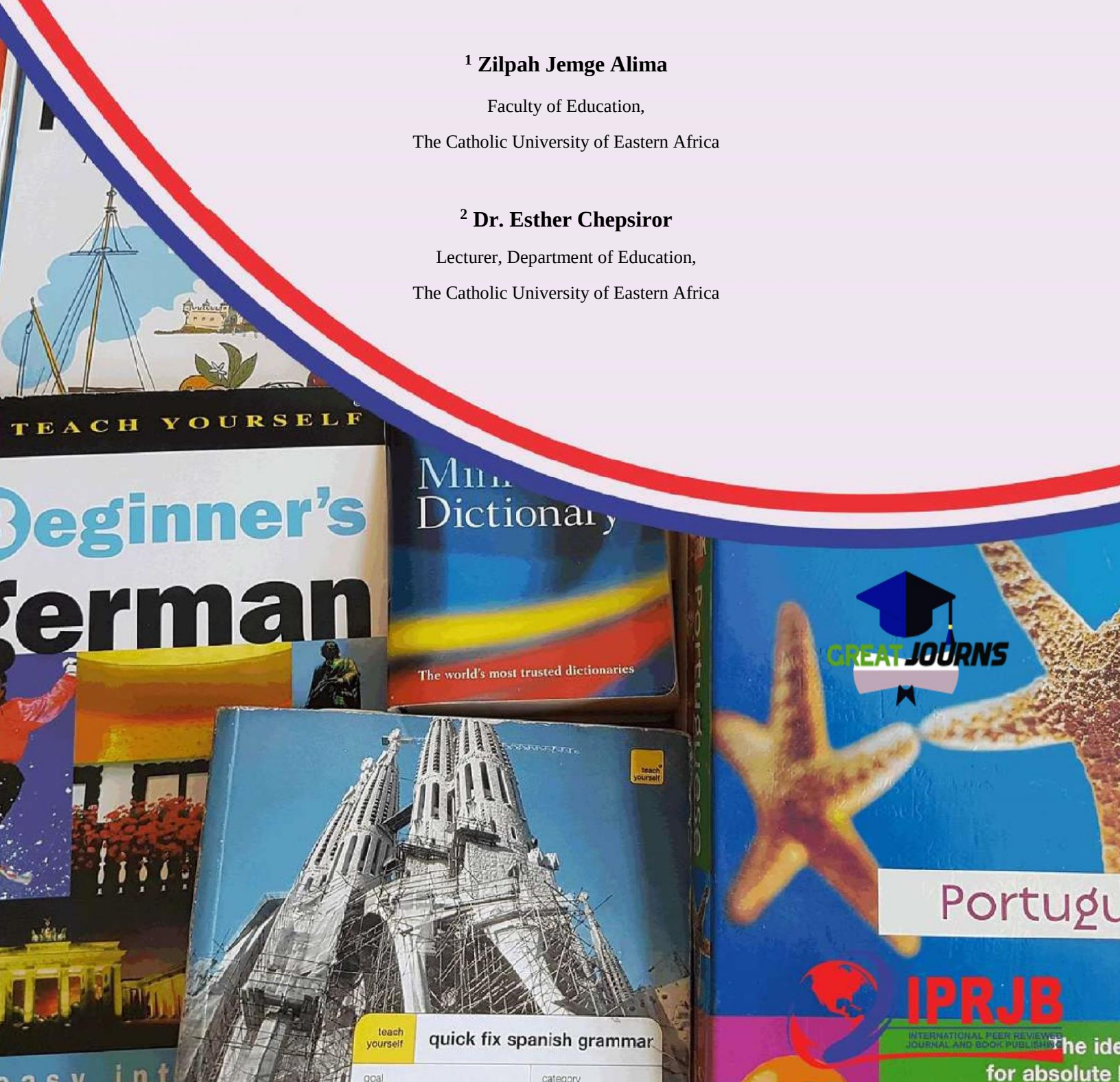

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ABSTRACT

This study investigated the effectiveness of chemistry curriculum implementation in public secondary schools in Likuyani Sub-County, Kakamega County, Kenya. Utilizing an explanatory sequential mixed methods research design, the study began with a quantitative ex-post facto analysis followed by qualitative grounded theory evaluation. The target population included all public secondary schools in the sub-county, with principals, chemistry teachers, and Form Four students serving as respondents. Stratified random sampling was employed to select 12 schools, and 366 students and 68 chemistry teachers were sampled using Yamane's formula. Data collection involved questionnaires for principals, teachers, and students, alongside lesson observation guides and observation guides for facilities. The findings revealed that curriculum implementation was extensive, with teachers displaying a solid understanding of the syllabus, assessment methods, and effective use of various teaching strategies. However, significant resource inadequacies were noted, including shortages in chemistry laboratories, laboratory technicians, apparatus, chemicals, and supplementary materials. ANOVA results indicated that both resource availability ($F(1,34) = 146.592$, $p < 0.05$) and teaching methods ($F(1,34) = 143.717$, $p < 0.05$) significantly influenced the quality of chemistry teaching, leading to the rejection of both null hypotheses. The study concluded that enhancing resource provision and refining teaching methods are critical for improving chemistry education outcomes in the region. The study underscores the need for strategic investments in educational resources and the adoption of innovative teaching approaches to foster better student performance in chemistry.

Key words: - Chemistry Curriculum Implementation, Secondary Public Schools, Mixed-Methods Explanatory Design, Grounded Theory, Likuyani Sub-County

1.0 INTRODUCTION

Scientific knowledge is paramount in the current society because it allows us to solve practical problems and make informed decisions. Chemistry is a branch of science which forms part of the Kenyan secondary school curriculum. The changes that science and technology has brought to the environment have been so great that many people view the world as a marvel of man's mastery over the environment (Malala, Onderi and Ajowi, 2021). Chemistry plays important roles in the society such as providing career opportunities and improving standards of living. In provision of career opportunities, the subject is a prerequisite for enrolment into scientifically inclined careers such as medicine, engineering, pharmacy, biotechnology, agriculture and the like, in postsecondary educational institutions (Mwangi, 2016). Chemistry is mostly seen as a 'central science' because it is essential to master its concept of the structure of matter in all sciences. Essentially, chemistry acts as a gatekeeper to future research in a large number of sciences (Tai, Sadlar and Loehr, 2005).

Chemistry being a practical subject develops hands on skills in the learners which are vital in providing general knowledge and skills required for industrial applications. These skills are useful when the students proceed for further training at the university or technical training institutes to prepare them for the real world (Welle-Strand and Tjeldvoll, 2003; Tomasevic and Trevic, 2014). Similarly, as a practical subject, chemistry allows students to engage with the skills of science which can be used for solving everyday problems and contribute to national development (Abungu, Okere and Wachanga, 2014). In fact, chemistry is the bedrock required for any nation to attain technological and scientific breakthrough (Jegede, 2003).

The chemistry curriculum has been implemented in most schools in the world. Curriculum implementation entails putting into practice the officially presented courses of study, syllabuses and subjects (Gautam, 2015). The process ideally involves teachers delivering instruction and assessment through the use of specified resources provided in the curriculum. Successful curriculum implementation will be based on factors such as the learner, the teacher, instructional methods and teaching/learning resources and facilities (Njuki, 2018). Effective teaching of chemistry requires adequate teaching facilities and personnel including science laboratories, equipment, trained teachers of chemistry and technical staff. Research in teaching behavior indicates that there are teaching methods that influence students' achievements more positively than others (Wenglinsky, 2000). Wenglinsky further argues that there is a correlation between high academic achievement and of the students and the classroom practices of the teacher. A well implemented curriculum ensures the desired changes are observed. In addition, it would yield excellent results

of the stipulated objectives and of course meet the national goals of science and technology (Egolum & Onuigwen, 2023).

Despite being an important subject, the implementation of the chemistry curriculum has faced many challenges in the world. Stojanovski, Mijic and Vladimir (2020), the teaching of chemistry in North Macedonia is greatly affected by unqualified and unmotivated teachers, inadequate equipment in natural sciences workrooms, inadequately coordinated and unsystematic implementation of the introduction of modern teaching technology in education, continuous professional development of teachers, mutual cooperation of all the stake holders in the education process, and continuous support from the authorities and policy makers for gifted pupils and chemistry teachers at all levels.

According to Montes, Ferreira and Rodriguez (2018), implementation of the chemistry curriculum in Latin America is affected by the students' attitudes. In China, findings by Chen and Wei (2015) reveal that the implementation of the chemistry curriculum is greatly affected by the interaction of the teacher with chemistry curriculum materials. Chen and Wei argue that this interaction of the teacher with chemistry curriculum materials in a given social context, determine what happens in a classroom. Olesegun (2018), argues that implementation of the chemistry curriculum is affected by factors such as teachers' qualifications, teaching experience, gender. He recommends that teaching of chemistry should be limited to experienced chemistry lecturers. Achinugu (2018), found out that the implementation of the chemistry curriculum is affected by inadequate funding, poor motivation of teachers, lack of adequate time to cover the syllabus, inadequate laboratories and voluminous nature of the chemistry curriculum. Ssempala and Masingila (2019) showed that one factor that affects chemistry curriculum implementation is the teachers' reluctance to understand and practice of Inquiry-Based Instruction. This was attributed to the teachers' attitudes, their teaching experience, their motivation, availability of teaching materials, mode of assessment, class size, their pre service and in service training, peer support, and time constraints.

Muse et al (2018), argue that implementation of the chemistry curriculum in Kenya is greatly affected by both shortages of some essential teaching / learning materials and facilities and augmented teachers' workload. These teaching and learning materials and facilities include the laboratory, laboratory chemicals, apparatus and fittings. The ministry of education Science and Technology cites problems in secondary school education as poor performance in core subjects as Mathematics and sciences due to lack of text books, teacher shortage and poor teaching methodology (MOEST, 2005), all of which are essential for effective curriculum implementation.

1.1 Statement of the Problem

Despite the importance of chemistry in preparing students for scientific careers and national development, public secondary schools in Kakamega County's Likuyani sub-county face significant challenges in the implementation of the chemistry curriculum. Several researches have been done on chemistry as a subject. For instance, Khaombi (2016) conducted a study on Factors affecting K.C.S.E performance in chemistry in public secondary schools: a case of selected public secondary schools in Lugari Sub County, Kakamega County, Kenya, found out that students' attitudes, inadequate instructional materials and resources, underutilization of the available resources were the causes of low performance in chemistry. Khaombi (2016) majored on resources yet there are many other factors within the school which affect teaching and learning of chemistry. Another study conducted by Muse, Ndirangu and Imonje (2018) on School based factors influencing implementation of chemistry curriculum in public secondary schools in Garissa Sub County Kenya, revealed that both shortage of some essential teaching/learning materials and facilities and augmented teachers' workloads, affected the implementation of chemistry. Muse et al. (2018) however didn't do a comprehensive evaluation of the implementation of chemistry curriculum. The researcher in this study wishes to determine how the chemistry curriculum is being implemented in public secondary schools in Likuyani Sub County, Kakamega County and secondly for the purpose of bridging the gaps in the earlier studies.

1.2 Research Questions

1. To what extent has the chemistry curriculum been effectively implemented in public secondary schools in Likuyani sub county, Kenya?

2. To what extent are there adequate resources for effective implementation of the chemistry curriculum in public secondary schools in Likuyani sub county, Kenya?

1.3 Hypothesis

$H0_1$ There is no significant mean difference between availability of resources and quality teaching in chemistry in public secondary schools in Likuyani sub county, Kenya.

$H0_2$ There is no statistical significant mean difference between teaching methods and quality of teaching in chemistry in public secondary schools in Likuyani sub county, Kenya.

Scope and Delimitation of the Evaluation
This study sought to evaluate implementation of the chemistry curriculum that was implemented in 1986 in Likuyani sub county, Kenya. The study was carried out only in public secondary schools in the sub county. The teachers who took part in the study were teachers of chemistry and the students were form four students only.

1.4 Theoretical Framework

The theoretical framework for this study was based on Piaget's constructivism theory (1957), which posits that learners are not just consumers of information but also active producers of knowledge. According to Piaget, as individuals interact with their environment, they create and refine their own representations, contributing to their existing knowledge. This theory aligns with the study's focus on understanding how the chemistry curriculum has been implemented in public secondary schools in Likuyani Sub-County. The approach emphasizes the importance of engaging students in active learning experiences, where they develop their knowledge through hands-on activities and problem-solving. In the context of chemistry, this involves students engaging with experiments and real-world issues to construct meaningful knowledge.

However, for the effective implementation of the chemistry curriculum, adequate resources—such as laboratory facilities, teaching materials, and trained instructors—are essential. Piaget's theory also suggests that without a well-structured learning environment, students may struggle to grasp complex concepts, particularly in chemistry, which requires experimentation and critical thinking. Thus, the theory underscores the need for adequate resources and structured support for both teachers and students. A lack of resources, such as laboratories or chemicals, may hinder the implementation of the curriculum and impact the students' ability to actively engage and construct knowledge. This theory also highlights the importance of teacher guidance to facilitate students' learning while providing them with opportunities to reflect and build upon prior knowledge. The study will explore whether these necessary resources are available in Likuyani Sub-County to support the chemistry curriculum effectively.

11: Empirical Review

Chemistry is a practical subject and its implementation requires varied methods of teaching so that it is well implemented. Putting the syllabus into practice requires experimental investigations which in turn require additional teaching/learning resources.

In Malawi, a study was carried out by Musaiwa (2020) on 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. The study used the descriptive research design. The target population included head teachers, chemistry teachers and students and Education division manager in Mulanje District. The sample was selected using probability and non-probability sampling techniques where one head teacher, 20 chemistry teachers, 120 students

and the Education division manager were selected. The constructivists' theory by Jerome Bruner, 1966 was used. Data was collected by use of questionnaires and interview schedules. Data was analyzed using descriptive statistics. 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. It also revealed that majority of the schools had few teachers of chemistry. The study concluded that both shortage of chemistry teachers and inadequate teaching and learning materials hindered the implementation of the senior secondary chemistry curriculum. Musaiwa (2020) 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 public schools in Malawi. The study done by Musaiwa (2020) however did not explain how the selection of the sample was done, it just mentioned probability and non-probability sampling techniques. It was not specific on any particular method. The researcher in the current study intends to use stratified sampling technique, purposive sampling technique and simple random sampling technique.

In Tanzania, Rwehumbiza, Kabendera and Ateka (2023), carried out a study on Availability and Adequacy of teaching/learning Materials for the Implementation of Compulsory Science Curriculum in Public Secondary Schools in Bukoba District Council, Tanzania. Rwehumbiza et al (2023), considered that availability and adequacy of such resources in public secondary schools was a prerequisite for the implementation of compulsory science curriculum in BDC. The study adopted the convergent parallel mixed method research design. The qualitative strand employed phenomenology while the quantitative strand used cross-sectional design. The target population involved heads of schools, heads of science department (HoDs), science teachers, students, parents and a District Education Officer for Secondary Schools (DEOSS). Data was collected using questionnaires, interview guide, and observation schedule. Analysis of quantitative data was done using descriptive statistics such tables and charts. Qualitative data were organized into themes and presented in narrative form and direct quotes. The study found out that a few teaching/learning resources were adequately available as there was also inadequacy of most of the science teaching/learning materials in some of the public Secondary schools in BDC. The study recommended that School Principals must be fully involved in the budgeting process so as to express concrete estimates which reflect the actual needs of their schools.

In Kenya, Mwita and Yambo (2022) did a study on Availability and Use of Instructional Resources on the Implementation of the Competency-Based Curriculum by Grades 1, 2 and 3 in Public Primary Schools in Migori County. The objective of this study was to establish the effect of availability and use of instructional resources on the implementation of the competency-based curriculum by grades 1, 2 and 3 teachers in public primary schools in Migori County. The study adopted a descriptive survey design. The target population was 604 head-teachers, 1812 grade 1-3 teachers, and 8 sub-county quality assurance and standards officers from all the Sub-counties in Migori County. Data was collected by use of questionnaires and interview schedules. Validity of the instrument was tested by experts while a pilot test was done to test reliability. Internal consistency was determined by Cronbach's Alpha Coefficient. It yielded reliability coefficient of 0.704, and 0.690 for teachers and principals respectively. Data analysis was done using descriptive and inferential statistics. The findings showed a strong positive correlation significant at a 5% level of significance between the adequacy of the Teaching- Learning (T/L) resources and CBC implementation, as indicated by a Pearson's correlation coefficient of 0.593. The study recommended increase of number of CBC in-service training sessions and use more competent facilitators, mandatory training for all teachers.

Chemistry is a very key subject whose importance in the society cannot be over emphasized. Because of this paramount importance, it requires satisfactory implementation in schools. Many schools worldwide have done their best to implement the chemistry curriculum. However, the chemistry curriculum has been implemented to different extents in different countries and different schools.

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III: METHODOLOGY

3.1 Research Design

This study employed an explanatory sequential mixed methods research design. This involved a quantitative research followed by a qualitative research. For the quantitative evaluation, an ex-post facto design was used. For the qualitative evaluation, the grounded theory was used.

3.2 Population

The target population for this study was all the public secondary schools in Likuyani Sub-County, Kakamega County. This comprised of both day and boarding schools. The respondents comprised of all the principals, all teachers of chemistry and all form four students. The principals gave general and administrative information concerning the implementation of chemistry curriculum. The teachers of chemistry were chosen because they are the implementers of the chemistry curriculum and gave specific information concerning the implementation of chemistry curriculum. Form four students were chosen because they have been in contact with a better section of the curriculum and they were also the beneficiaries of the curriculum.

3.3 Sample and sampling procedures

The study selected 12 schools using the stratified random sampling technique because they were of different categories. The schools were categorized into three categories; single sex boys, single sex girls and mixed day secondary schools. The sample included four boys' schools, four girls' schools and four mixed day secondary schools. All the principals of the selected schools were purposively sampled to take part in the study. Only form four students took part in the study. 366 form four students were selected randomly across the schools proportionate to the number of candidates per school.

The researcher used the following formulae designed by Yamane (1967) in order to obtain teachers and student sample for the study.

$n= N/1+N(E)^2$

Where; n represents the sample size
N represents the total population
e represents the level of significance
1 represents a constant value

Using the formula, 68 teachers of chemistry were sampled. Among the 68 teachers of chemistry, 12 heads of subject were purposively sampled because they provide leadership in the subject. The remaining 54 were randomly sampled but proportionate to the number of chemistry teachers in a particular school.

3.4 Research Instruments

The following five instruments were used for the evaluation: questionnaires for principals, questionnaires for teachers and questionnaires for students were used under the quantitative strand, lesson observation schedule, and observation guide for facilities were used under the qualitative strand.

3.5 Validity of the Instruments

The validity of the instruments was checked by experts who read and gave feedback on the appropriateness of the questions, the respondents and the relevance of the questions to the research questions. They also checked if the language and instructions used are appropriate.

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3.6 Reliability of the Instruments

Reliability of the measuring instrument was determined through the split half method. In split half, a measure is split into two parts, each of them is treated as a separate scale and scored accordingly. Results of the findings were compared using the spearman's brown prophecy formula.

The results achieved a correlation coefficient of 0.76 for the questionnaire administered to students

IV: PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Extent Chemistry Curriculum has been effectively Implemented

Teachers' Views on the Extent the Chemistry Curriculum has been Effectively Implemented

Teachers were asked to indicate the extent to which selected areas were adequately taught during in-service education and training sessions on chemistry. Table 1 shows teachers' rating of extent to which selected areas were well taught during in-service education and training sessions on chemistry

Table 1: Teachers' Views on the Extent the Chemistry Curriculum has been Effectively Implemented

Area	Very Inadequately Taught	Inadequately Taught	Adequately Taught	Very Adequately Taught
Lesson Planning	18	9	5	3
	(51.4%)	(25.7%)	(14.3%)	(8.3%)
Teaching Methods	11	15	6	3
	(31.4%)	(42.9%)	(17.1%)	(8.6%)
Conducting Experiments	13	14	4	4
	(37.1%)	(40.0%)	(11.4%)	(11.4%)
Formative Assessment	15	15	3	2
	(42.9%)	(42.9%)	(8.6%)	(5.7%)

The findings reveal significant gaps in the implementation of the chemistry curriculum during in-service education and training (INSET) for teachers in public secondary schools in Likuyani Sub-County. A substantial proportion of the teachers rated key instructional areas such as lesson planning, teaching methods, conducting experiments, and formative assessment as either "very inadequately taught" or "inadequately taught." For instance, 77.1% of respondents felt that lesson planning was not adequately addressed, while 74.3% cited inadequacies in teaching methods. Similarly, over 77% noted that training on conducting experiments was lacking, and 85.8% believed that formative assessment was inadequately covered. These findings suggest that the INSET programs, though intended to enhance teaching competencies, are not effectively equipping teachers with practical and pedagogical skills necessary for quality instruction in chemistry.

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4.2 Students' Views on the Extent to which Chemistry Curriculum has been Effectively Implemented

Teachers were next asked to indicate the extent to which they effectively perform certain tasks during chemistry lessons. Table 2 shows percentage distribution of teachers' rating of the extent they effectively perform certain tasks in their chemistry lesson.

Table 2: The Extent to which Teachers Effectively Perform Certain Tasks during Their Chemistry Lessons

Task	Level of Performance			
	Very Effective	Effective	Somewhat Effective	Very Ineffective
Developing students' high level cognitive abilities	12 (34.3%)	7 (20.0%)	10 (28.6%)	6 (17.1%)
Developing students' practical skills	15 (42.9%)	9 (25.7%)	8 (22.9%)	3 (8.6%)
Demonstrating skills	18 (51.4%)	10 (28.6%)	5 (14.3%)	2 (5.7%)
Conducting experiments	13 (37.1%)	9 (25.7%)	9 (25.7%)	4 (11.4%)
Using laboratory equipment	15 (42.9%)	12 (34.3%)	6 (17.1%)	2 (5.7%)
Constructing tests and conducting formative assessments	12 (34.3%)	10 (28.6%)	10 (28.6%)	3 (8.6%)
Grading students	11 (31.4%)	8 (22.9%)	8 (22.9%)	5 (14.3%)

The findings indicate that while a significant proportion of chemistry teachers in Likuyani Sub-County rated themselves as effective or very effective in performing various instructional tasks, there are still noticeable gaps in key competency areas. For example, only 54.3% of teachers rated themselves as "effective" or "very effective" in developing students' higher-order cognitive skills, while a considerable 45.7% rated themselves as either "somewhat effective" or "very ineffective." This implies a limitation in applying instructional strategies that foster analytical and critical thinking, which are essential in mastering scientific concepts. In contrast, teachers reported higher confidence in demonstrating skills (80% effective or very effective) and using laboratory equipment (77.2%), suggesting greater competence in practical-oriented tasks. Similarly, 68.6% of teachers rated themselves as effective or very effective in developing students' practical skills, a crucial component of the chemistry curriculum. However, the fact that over 30% still rated themselves as somewhat or very ineffective indicates room for improvement in this area.

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Regarding formative assessment and test construction, only 62.9% of teachers considered themselves effective, while the rest admitted limited proficiency. This gap could hinder effective feedback and learning support. Additionally, only 54.3% of teachers felt effective in grading, further indicating assessment-related challenges. These results underscore the need for targeted professional development, particularly in cognitive development strategies and assessment practices, to ensure holistic and quality teaching of chemistry.

4.3 Students' Views on the Extent to which Chemistry Curriculum has been Effectively Implemented

Students were provided statements to which they indicated the extent of implementation of the chemistry curriculum. The respondents were asked to indicate whether the extent was very often, often, sometimes or not at all. Table 3 shows the results.

Table 3: Students' Views on the Extent to which Chemistry Curriculum has been Effectively Implemented

Statements	Very Often	Often	Sometimes	Not at All
Teachers attend lessons on time	149 (55.1%)	105 (38.8%)	11 (4.1%)	5 (2.0%)
Teachers miss some lessons	11 (4.1%)	17 (6.1%)	116 (42.9%)	127 (46.9%)
Teachers use varied methods in teaching chemistry	166 (61.2%)	66 (24.5%)	17 (6.1%)	22 (8.2%)
Teachers demonstrate experiments to students before they let them do on our own under their supervision	193 (71.4%)	28 (10.2%)	22 (8.2%)	28 (10.2%)
Teachers incorporate teaching aids to enhance lessons	78 (28.6%)	99 (36.7%)	61 (22.4%)	33 (12.2%)
Teachers asses students regularly to check if they grasped the concepts	149 (55.1%)	61 (22.4%)	44 (16.3%)	17 (6.1%)
Teachers attend remedial lessons	193 (71.4%)	44 (16.3%)	11 (4.1%)	22 (8.2%)
Teachers mark and correct students assignments.	160 (59.2%)	66 (24.5%)	22 (8.2%)	22 (8.2%)
Teachers incorporate ICT in teaching to enhance learning	22 (8.2%)	78 (28.6%)	83 (30.6%)	89 (32.7%)
Teachers complete the chemistry syllabus in time.	210 (77.6%)	11 (4.1%)	33 (12.2%)	17 (6.1%)
Teachers use group work during my lessons	105 (38.8%)	94 (34.7%)	66 (24.5%)	5 (2.0%)
Teachers give time to learners to read content from the course books and answer questions thereafter.	122 (44.9%)	94 (34.7%)	33 (12.2%)	22 (8.2%)
Teachers summarize the lesson by highlighting important points	166 (61.2%)	72 (26.5%)	22 (8.2%)	11 (4.1%)
Teachers give students follow up activities	116 (42.9%)	78 (28.6%)	50 (18.4%)	28 (10.2%)
Teachers constantly assist the slow learners	122 (44.9%)	61 (22.4%)	39 (14.3%)	50 (18.3%)
Teachers motivate students to like chemistry	210 (77.6%)	28 (10.2%)	17 (6.1%)	17 (6.1%)

The findings from students' responses reveal generally positive perceptions regarding the implementation of the chemistry curriculum, though some critical gaps remain. A majority of students (93.9%) indicated that teachers attend lessons on time, which demonstrates strong professional commitment. However, 49% also reported that teachers sometimes or do not miss lessons at all, suggesting some inconsistencies in lesson delivery. Varied teaching methods are reportedly used by most teachers (85.7%), and 71.4% of students noted that teachers often demonstrate

experiments before supervised student practice. However, only 65.3% reported that teaching aids were incorporated "often" or "very often," indicating underutilization of instructional resources critical for simplifying abstract scientific concepts.

Assessment practices appear relatively strong, with 77.5% stating that teachers regularly assess their understanding, and 83.7% confirming that assignments are marked and corrected. Yet, the integration of ICT in teaching is notably low, with only 36.8% acknowledging frequent use. This digital gap undermines the development of 21st-century skills and contradicts educational reforms promoting ICT integration, as emphasized by UNESCO (2015).

Moreover, while 77.6% believe that the syllabus is completed on time and that teachers motivate them to enjoy chemistry, fewer students felt teachers consistently used group work (73.5%) or assisted slow learners (67.3%). This suggests a need for more inclusive pedagogical strategies. In conclusion, while chemistry teachers demonstrate strong instructional commitment and classroom management, there is a critical need to strengthen ICT use, differentiated instruction, and the consistent application of teaching aids to improve curriculum implementation comprehensively.

4.4 Principals' Views on the Extent to which Chemistry Curriculum has been Effectively Implemented

Further, the principals were provided statements to which they indicated the extent of implementation of the chemistry curriculum. The respondents were asked to indicate whether the extent was to a large extent, to some extent, only a little or not at all. Table 4 shows the results.

Table 4: Principals' Views on the Extent to which Chemistry Curriculum has been Effectively Implemented

Statements	To a Large Extent	To Some Extent	Only a Little	Not at All
Teachers understand the content of the syllabus	10 (83.3)	1 (8.3%)	0	1 (8.3%)
Teachers understand the assessment method	8 (66.7%)	3 (25.0%)	0	1 (8.3%)
Teachers prepare and follow chemistry schemes of work every term	1 (8.3%)	10 (83.3%)	0	1 (8.3%)
Teachers prepare and use lesson plans for every chemistry lesson	1 (8.3%)	4 (33.3%)	5 (41.7%)	2 (16.7%)
Teachers attend lessons on time	5 (41.7%)	6 (50.0%)	0	1 (8.3%)
Teachers miss some lessons	1 (8.3%)	1 (8.3%)	7 (58.3%)	3 (25.0%)
Teachers use varied methods in teaching chemistry	6 (50.0%)	5 (41.7%)	0	1 (8.3%)
Teachers demonstrate experiments to students before they let them do on our own under their supervision	7 (58.3%)	3 (25.0%)	0	2 (16.7%)
Teachers incorporate teaching aids to enhance lessons	5 (41.7%)	5 (41.7%)	1 (8.3%)	1 (8.3%)
Teachers asses students regularly to check if they grasped the concepts	2 (16.7%)	8 (66.7%)	2 (16.7%)	0
Teachers attend remedial lessons	7 (58.3%)	3 (25.0%)	0	2 (16.7%)
Teachers mark and correct students' assignments.	4 (33.3%)	7 (58.3%)	1 (8.3%)	0
Teachers incorporate ICT in teaching to enhance learning	2 (16.7%)	5 (41.7%)	4 (33.3%)	1 (8.3%)
Teachers complete the chemistry syllabus in time.	3 (25.0%)	7 (58.3%)	1 (8.3%)	1 (8.3%)

Teachers use group work during my lessons	1 (8.3%)	9 (75.0%)	1 (8.3%)	1 (8.3%)
Teachers give time to learners to read content from the course books and answer questions thereafter.	7 (58.3%)	3 (25.0%)	0	2 (16.7%)
Teachers summarize the lesson by highlighting important points	3 (25.0%)	6 (50.0%)	2 (16.7%)	1 (8.3%)
Teachers give students follow up activities	1 (8.3%)	7 (58.3%)	3 (25.0%)	1 (8.3%)
Teachers constantly assist the slow learners	0	8 (66.7%)	4 (33.3%)	0
Teachers motivate students to like chemistry	3 (25.0%)	4 (33.3%)	4 (33.3%)	1 (8.3%)

The findings reveal a mixed level of chemistry curriculum implementation in public secondary schools in Likuyani Sub-County from the principals' perspective. While the majority of teachers demonstrate a solid understanding of the syllabus (83.3%) and assessment methods (66.7%), only a minority consistently use essential teaching tools such as lesson plans (8.3%) and schemes of work (8.3%) to guide their instructional practices. This inconsistency suggests that while content knowledge may be present, pedagogical planning and execution are lacking.

The findings further indicate that while lesson attendance is generally satisfactory, with 91.7% of teachers attending lessons either always or most of the time, comprising less than half (41.7%) prepare lesson plans or incorporate ICT tools into lessons, which are crucial in modern teaching. Similarly, the moderate use of varied teaching methods (50%) and group work (8.3%) reflects a traditional, less interactive pedagogical approach.

The study also shows that while a majority of teachers regularly assess students and offer remedial lessons, formative strategies such as giving follow-up activities (only 8.3%) and consistently assisting slow learners (0%) are notably weak. This suggests gaps in differentiated instruction and inclusive practices. Overall, although there is a foundational implementation of the curriculum in terms of content delivery and assessment, the absence of structured planning, interactive methods, and support for diverse learners indicates partial and uneven implementation. These findings emphasize the need for targeted professional development and infrastructural support to promote full and effective implementation of the chemistry curriculum.

4.5 Extent of Adequacy of Resources for Effective Implementation of the Chemistry Curriculum

The study also sought to determine whether there are adequate resources for effective implementation of the chemistry curriculum in public secondary schools in Likuyani Sub-County. The respondents were provided statements to which they indicated the inadequacy of resources. The respondents were asked to indicate whether the resources were available and adequate, available and inadequate or not available. Table 5 shows the results.

Table 5: Extent of Adequacy of Resources for Effective Implementation of the Chemistry Curriculum

Statements	Inadequate	Not Available	Adequate
Chemistry syllabus	312 (98.0%)	6 (2.0%)	0
Course books	259 (81.6%)	39 (12.2%)	19 (6.1%)
Supplementary books	123 (38.8%)	156 (49.0%)	39 (12.2%)
Laboratory	266 (83.7%)	45 (14.3%)	6 (2.0%)
Laboratory technician	259 (81.6%)	59 (18.4%)	0
Laboratory apparatus	273 (85.7%)	45 (14.3%)	0

Laboratory chemicals	259 (81.6%)	59 (18.4%)	0
Laboratory fittings	175 (55.1%)	97 (30.6%)	45 (14.3%)
Water supply	188 (59.2%)	65 (20.4%)	65 (20.4%)
Charts	175 (55.1%)	104 (32.7%)	39 (12.2%)
Writing board	312 (98.0%)	6 (2.0%)	0
Lab tables	259 (81.6%)	45 (14.3%)	13 (4.1%)
Lab stools	279 (87.8%)	19 (6.1%)	19 (6.1%)
First aid kit	130 (40.8%)	110 (34.7%)	78 (24.5%)
Fire extinguisher	214 (67.3%)	97 (30.6%)	6 (2.0%)

The findings indicate a significant inadequacy in the resources required for effective implementation of the chemistry curriculum in public secondary schools in Likuyani Sub-County. For instance, 98% of respondents indicated that the chemistry syllabus was available, but the actual teaching and learning resources required for effective implementation were largely inadequate or unavailable. Notably, over 80% of the respondents reported inadequacy in essential resources such as laboratories (83.7%), course books (81.6%), laboratory chemicals (81.6%), and laboratory technicians (81.6%). Similarly, supplementary books, lab fittings, charts, and fire safety equipment were reported to be either inadequate or not available.

These findings are consistent with previous studies that underscore the importance of adequate resources in curriculum implementation. For example, Musaiwa (2020) in Malawi found that a lack of qualified chemistry teachers and insufficient materials hindered the successful implementation of the new senior secondary school chemistry curriculum. Similarly, the study by Rwehumbiza et al. (2023) in Tanzania revealed that the inadequacy of teaching and learning materials impeded the implementation of the compulsory science curriculum. These findings reinforce the idea that the availability of essential teaching resources directly affects curriculum delivery.

In Kenyan Gitao (2022) and Mwita & Yambo (2022) emphasized that timely yet insufficient provision of materials impacts curriculum implementation negatively. The strong correlation between resource adequacy and curriculum implementation effectiveness, as found by Mwita &Yambo (2022), further affirms the findings in Likuyani Sub-County.

In addition, the study used the lesson observation schedule to determine how the curriculum is implemented in class. Four main indicators were used in the lesson observation, which included introduction of the lessons, development of the lessons, methods of teaching and teaching/learning aids, and assessment methods. With regard to introduction, it was observed and highly rated that there was "*review of previous lesson/content related to current lessons*", however it was poorly rated that "*lesson objectives were stated*". In terms of lesson development, it was observed that there was "*mastery of content in line with the syllabus*", "*students' questions were well answered*", "*follow up activities were given*", "*lessons were summarized by highlighting key points*" and "*the lessons were covered within time*". However, it was observed that there was no plan in "*teaching with lesson notes and lesson plans*". Concerning the methods of teaching and teaching/learning aids, it was observed that there was "*use of appropriate teaching methods*", there was "*use of appropriate teaching and learning aids*", there was "*use of varied teaching methods*", and there was "*conducting of chemistry experiments*". Lastly, concerning assessment methods, it was observed that "*assignments and written exercises were given during lessons*", and "*there was marking of the assignments and exercises in class*".

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4.6 Hypothesis Testing

The study tested the first hypothesis that there is no significant mean difference between availability of resources and quality teaching using one-way analysis of variance (ANOVA). The findings are shown in Table 6.

Table 6: Availability of Resources and Quality of Teaching in Chemistry (ANOVA)

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between groups	42.153	1	42.153	146.592	.000
Within groups	17.817	34	0.143		

The ANOVA results in table 18 show F(1,34) = 146.592 is significant with p value = 0.000<0.05. This result implies that the availability of resources is a significant predictor of quality of teaching chemistry in public secondary schools in Likuyani Sub-County. Consequently, from the findings, it is deducible that public secondary schools in Likuyani Sub-County have to focus on ensuring that chemistry teachers are not only qualified and trained, but that they are provided with the appropriate and necessary tools with which to achieve high teaching and learning outcomes in the subject. The null hypothesis that there is no significant mean difference between chemistry availability of resources and quality was rejected.

The study also tested the second hypothesis that there is no significant statistical mean difference between teaching methods and quality of teaching. The researcher used one-way analysis of variance (ANOVA). The findings are shown in Table 7

Table 7: Teaching Methods and Students' Performance in Chemistry (ANOVA)

Source	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	44.433	1	44.433	143.717	.000
Within Groups	16.252	34	.233		

The ANOVA results in table 7 show F(1,34) = 143.717 is significant with p value = 0.000<0.05. This result implies that the teaching methods is a significant predictor of students' performance in public secondary schools in Likuyani Sub-County. The findings are an indication that students' performance in chemistry relies on the appropriateness of teaching methods utilized by teachers. This means therefore, that teachers need to develop techniques that will allow them to disseminate chemistry concepts in a way that they are grasped, retained and understood well by the students, which would ultimately lead to high performance in the subject. The null hypothesis that there is no significant statistical mean difference between different teaching methods and quality of teaching was rejected.

V: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Study

The study evaluated the extent to which the chemistry curriculum had been effectively implemented and assessed the adequacy of resources for its implementation in public secondary schools in Likuyani Sub-County, Kenya. A sequential explanatory mixed-methods design guided the research, with data collected through class observations, and questionnaires and observation guides. Descriptive statistics and inferential tests were used to analyze the data. The findings indicated that the chemistry curriculum was generally well implemented, with teachers demonstrating syllabus mastery, using varied teaching methods, and employing teaching aids and demonstrations. However, the schools were underfunded, with insufficient laboratories, chemicals, infrastructure, and safety equipment. The study highlighted that while the curriculum was relevant and well-paced, the lack of resources hindered effective implementation, with challenges such as inadequate teacher training, overcrowded classrooms, and technical difficulties.

5.2 Conclusion

On the basis of the findings of this study, the following conclusions are made. The study concluded that there was a positive and significant relationship between availability of resources and the quality of teaching in chemistry. The study also concluded that there was a positive and significant relationship between teaching methods and students' performance in chemistry

5.3 Recommendations

I. The ministry should ensure that public secondary schools are equipped with the necessary laboratory facilities, equipment, and chemicals, and allocate sufficient funds to maintain and upgrade these resources regularly.
II. Teachers should adopt a variety of teaching methods, such as inquiry-based learning, flipped classrooms, and the use of ICT tools, to make chemistry lessons more engaging and interactive

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