Secondary Schools Science and Mathematics Teaching Approaches and Students' Performance in Sciences and Mathematics in Amuru District, Uganda.

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January, 2024

Declaration

I Henry Labongo Mutyaba declare that this research report entitled "*Secondary Schools Science and Mathematics teaching approaches and Students' Performance in Sciences and Mathematics in Amuru District*" is my original and to the best of my knowledge has never been submitted to any University or Institution for any award.

H.L.Mutyaba ..... 18/01/2024 .....

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Approval

This research report entitled "*Secondary Schools Science and Mathematics teaching approaches and Students' Performance in Sciences and Mathematics in Amuru District*" has been submitted with approval of my supervisors.

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Dedication

I hereby dedicate this dissertation to my beloved children Lamunu Abigel, Rwotomiya Daniel and Auma Jovia Florence, my wife Ms. Agengo Winifred and my brother Dr. Lakidi Luke for their entire selfless support rendered to me through my professional development. May the Good Lord continue to bless them immensely.

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Abstract

The purpose of the study was to investigate the influence of Secondary School Science and Mathematics Teachers (SESEMAT) teaching approaches on students' performance in Science and Mathematics in Secondary Schools in Lamogi Sub-county, Amuru District. The study was guided by the following specific objectives; to determine the level of implementation of SESEMAT Teaching approaches of ALEI- PIEI in Secondary schools, to assess the level of students' performances in Sciences and Mathematics, and to establish the relationship between implementation of SESEMAT teaching approaches of ALEI- PIEI and students' performance in Sciences and Mathematics in Lamogi Sub-county, Amuru District. Data was collected from 394 respondents using questionnaire. The study also used cross-sectional. Data was analysed using SPSS version 25.0. Research question 1 and 2 were analyzed using ANOVA, research question 3 was analysed using multiple linear regression. The finding revealed that School 2 (4.27) had the highest level of implementation of SESMAT. Teachers with master degree had the highest level of implementation of SESMAT 4.27. Teachers with 6-10 years experience had the highest level of implementation of SESMAT 4.33. Senior three had the highest level of implementation of SESMAT 4.07. The ANOVA statistics showed that School 1 had the highest level of students' performance 4.21, followed by 3.60, Teachers with bachelor degree had the highest level of students' performance 4.22, and teachers with 6-10 years experience had the highest level of students' performance 4.28. The multiple linear regression analysis identified evaluation ($p = 0.000$) as the strongest influencer of academic performance, along with improvisation ($p = 0.010$), and activity-based teaching $p = 0.038$, while other approaches showed no significant associations with academic performance. The study concluded that there is a strong association between evaluation, activity-based teaching and improvision with students' performance. The study recommended strengthening implementation of activity-based teaching, providing teacher, training and professional development, foster student participation and engagement, improve access to resources, promote community involvement.

Chapter One: Introduction

1.0 Introduction

Globally, nations have implemented measures to enhance students' achievements in science and mathematics across different educational levels, recognizing the pivotal role of science in overall development (Glewwe & Muralidharan, 2016). In Uganda, the Secondary Science and Mathematics Teachers (SESEMAT) program stands out as a prominent initiative aimed at elevating academic performance in science and mathematics among students (MoES, 2005). The introduction of SESEMAT has resulted in a noteworthy improvement in students' performance on a national scale. This chapter outlines the study's background, problem statement, research purpose, objectives, research questions, significance, scope, and theoretical framework (MoES, 2005).

1.1 Background to the Study

1.1.1 Historical background

Throughout history, both developed and developing nations have prioritized the teaching and learning of science, recognizing the crucial role that science and technology play in social and economic advancement (Mormina, 2019). Developed countries like the United States, Malaysia, and Britain have implemented interventions to enhance students' performance in science and mathematics. The Malaysian Ministry of Education, for instance, has actively engaged in implementing lesson study at the school level to improve the teaching and learning of science (Adams, 2014).

Conversely, African countries have established the Strengthening of Mathematics and Science Education in Western, Eastern, Central, and Southern Africa (SMASE-WECSA) platform to facilitate the sharing of experiences and knowledge in mathematics and science education (Ishihara & Kawaguchi, 2022). Manyiraho et al. (2020) elaborate that the SMASE-WECSA platform prompted the governments of Kenya and Japan (through the Japan International Cooperation Agency) to initiate the SMASE program in response to the poor performance in mathematics and sciences in the Kenya Certificate of Secondary Education (KCSE). Similarly, in Uganda, the Secondary School Sciences and Mathematics Teachers' (SESEMAT) in-service training program is a significant initiative aimed at improving students' performance in sciences.

Recognizing teachers as a crucial human resource for any country, there is a need for training in SESEMAT teaching approaches, as teachers play a pivotal role in efficient human capital development. This is because the quality and effectiveness of teachers are integral to the overall success of education (Kotirde & Yunos, 2014). According to Moraga (1983), teacher training

in SESEMAT pedagogical strategy is vital in curriculum development and implementation within any education system. Ideally, the training of teachers, as emphasized by SESEMAT, should encompass two phases: pre-service training followed by in-service training

According to a newsletter from the Assistance for Development of Education in Africa (ADEA, 2005), despite the emphasis on adequate pre-service teacher training, there is a growing consensus that such training merely provides an orientation for teachers entering the profession. The true development of a teacher occurs gradually in the classroom setting (ADEA, 2005). Pre-service teacher education aims to familiarize prospective teachers with essential teaching knowledge, cultivate positive attitudes toward the teaching profession, introduce the current program, and impart basic theories of teaching skills before they assume their roles. However, it is widely acknowledged that pre-service training alone is insufficient for a trainee to effectively carry out teaching duties over the long term (ADEA, 2005; Moraga, 1983).

ADEA (2005) emphasizes that Mathematics and Science education, particularly at the secondary level, is crucial for industrial and technological progress. While significant efforts have been made in the past to ensure an adequate supply of qualified teachers, equipment, and materials for schools in Africa, they often fall short, and even when available, the quality of student attainment in Mathematics and Science education is not consistently high. The focus, therefore, shifts to classroom practices, the utilization of existing resources, and the methods employed in content delivery. In addressing the challenges of Mathematics and Science education, ADEA (2005) and Moraga (1983) propose the existence of In-service Education and Training (INSET) for Mathematics and Science teachers.

INSET serves various purposes, including certifying untrained teachers, introducing new curriculum or teaching methodologies, upgrading content, and implementing new supervisory systems, among other reasons (Thuku, 2003). Donoughue et al. (1981) argue that INSET plays a crucial role in educational innovation, serving as a means for schools to adopt innovative practices. INSET has gained attention for its potential to stimulate professional development, improve school practices, and serve as a viable strategy for implementing social policies (Hopkins, 1986).

1.1.2 Theoretical framework:

This study is grounded in the constructivist learning theory proposed by Jerome Bruner (1960) and social interaction theory by Vygotsky (1978). The central tenet of constructivism asserts that learning is an active process wherein learners build new ideas or concepts based on their existing and past knowledge. In this cognitive process, learners select, transform information, formulate hypotheses, and make decisions.

Within the constructivist framework, the child is positioned as an active participant in the learning process. Learning is not merely the absorption of information; instead, lesson material is modified and transformed based on the child's cognitive structures, social interaction, and prior learning experiences within their environment.

The rationale for adopting the constructivist learning theory in this study stems from the belief that teaching should commence with content and experiences familiar to students, allowing them to connect with their existing knowledge structures. The presentation of new knowledge should occur in real-life contexts rather than abstract applications, ensuring minimal disruption to learners' cognitive models (Lewinsohn et al., 2015).

The adoption of constructivist learning theory is influenced by the concept of the zone of proximal development (ZPD), emphasizing a learner's ability to perform tasks with support but facing challenges when attempting them independently (Mabena et al., 2021). Teaching, according to this theory, should empower students to fill gaps, extrapolate information, and develop the skills to be independent learners.

The constructivist theory also advocates for cooperative learning, where students work in small groups, interact, and argue to find solutions to learning activities. This aligns with the principles of social constructivism, emphasizing problem-solving and interaction in the teaching of science and mathematics. The theory encourages learners to create their own problem-solving strategies.

The study is informed by the constructivist theory's concept of 'learning by doing,' which corresponds with the SESEMAT approach to teaching and learning. Active learner participation in hands-on and minds-on activities aligns with the learner-centered approach advocated by SESEMAT. The theory emphasizes structuring learning activities and guiding learners to integrate new information with pre-existing knowledge.

The study draws on the constructivist theory's idea of 'discovery' learning, which aligns with the SESEMAT approach. In this approach, learners are encouraged to experiment and discover new knowledge, with the teacher acting as a facilitator. This theory underscores the SESEMAT approach's emphasis on learners as co-constructors of knowledge, promoting active participation and construction of new knowledge against the backdrop of prior knowledge. The SESEMAT principles (ALEI-PIEI) are intricately linked to the constructivist theory.

1.1.3 Conceptual background

SESEMAT stands for the Secondary Science and Mathematics Teachers Program, which focuses on enhancing the teaching skills of science and mathematics educators while elevating their content knowledge. The program aims to assist teachers in developing hands-on and

minds-on activities for their lessons (MOES, 2005). In this research, SESEMAT will be defined in terms of teaching approaches known as Activity-based, Learner-centered, Encouragement, Improvisation, and Planning, Implementation, Evaluation, and Improvement (ALEI-PIEI approaches).

The SESEMAT Teaching Approaches (ALEI-PIEI) represent an innovative instructional method that prioritizes learner-centered and activity-based teaching. The ALEI-PIEI framework comprises key elements such as Activity-based, Learner-centered, Encouragement, Improvisation, Planning, Evaluation, and Improvement (Okello & Kinai, T. K., 2017).

Academic performance, as defined by Lamas (2015), is characterized as an assessment of indicative and responsive abilities that reflect an individual's learning outcomes resulting from an educational or training process. In the context of this study, academic performance will be measured through grades obtained in the Uganda Certificate of Education (UCE), continuous class assessments, and life skills.

Grades at UCE (Uganda Certificate of Education): This refers to the students' academic performance measured by their grades in the national examination conducted at the end of the Ordinary Level education in Uganda.

Continuous Assessment: Continuous assessment involves the ongoing evaluation of students' progress and learning throughout the school year, often through various formative assessments.

Teacher-made Tests: These are assessments developed and administered by teachers to gauge students' understanding of specific topics or units (Kituyi, Kuretu, & Nabiswa, 2017).

Exercises: Exercises refer to practice tasks or assignments given to students to reinforce their learning and understanding of concepts (Nabukenya, & Kimenju, 2017).

Pressure to cover the syllabus: The pressure to complete the prescribed curriculum may impact the extent to which teachers can implement SESEMAT Teaching Approaches (Kamwenja, & Mukwa, 2016).

School policy: The policies and guidelines set by individual schools can influence the implementation and support for SESEMAT Teaching Approaches (Moses, & Biwott, 2017).

Teachers' attitude: Teachers' beliefs, and their attitudes towards innovative teaching approaches can affect their willingness to adopt SESEMAT Teaching Approaches (Mutunga, 2019).

School environment: The overall school environment, including available resources and support systems, can impact the successful implementation of SESEMAT Teaching Approaches (Ngeleka, & Waichigo, 2016).

1.1.4 Contextual background

While efforts have been made to enhance performance in Sciences and Mathematics, the intended objectives of teaching these subjects in Uganda have largely not been realized, as evidenced by the subpar performance of students in national examinations (MOES, 2014). Data obtained from the Uganda National Examinations Board (UNEB, 2015) in their assessment report on students' performance in science subjects reveals a persistent decline in performance across the country. The report indicates a negative trend in the performances of students in Physics, Chemistry, Biology, and Mathematics from 2000 to 2015, with average scores of 66.01%, 70.30%, 69.27%, and 46.23%, respectively.

Similar to other regions in Uganda, the academic performance in Mathematics and Science subjects in secondary schools in Amuru District is disheartening. Despite the implementation of the SESEMAT program, the performance in these subjects remains unimproved. The table below, sourced from the Ministry of Education and Sport (2015-2019), illustrates the performance of Science and Mathematics in Amuru District.

Table 1: UCE-Examination Scores as Percentages passed, 2015 – 2019

YEARS	2015	2016	2017	2018	2019
Mathematics	21.1%	17.4%	24.8%	13.5%	17.9%
Biology	15.4%	12.6%	18.2%	16.4%	14.9%
Physics	13.8%	10.5%	17.0%	16.7%	10.9%
Chemistry	9.5%	11.2%	15.6%	14.3%	12.2%

Source: District Education Officer (DEO) Amuru District.

As Akuma and Callaghan (2019) note, science teaching involves inquiry not only in the laboratory but also in everyday classroom methods and activities. In the teaching process, science educators are expected to incorporate inquiry activities, aligning with the SESEMAT teaching approaches of Activity-based, Learner-centered, Encouragement, Improvisation, and Planning, Implementation, Evaluation, and Improvement (ALEI-PIEI approaches). This integration is considered a means of enhancing students' perception of the relevance of their science studies and fostering their motivation to engage with the subject. Consequently, the expectation is that SESEMAT training would lead to improved student achievement in science and mathematics, as the teaching approaches acquired by educators have a significant positive impact on student outcomes.

In this study, student achievement in science is defined as the extent of academic knowledge and content acquired by a student within a specific timeframe. The evaluation of learning encompasses academic performance, skills acquisition, attitudinal changes, and the practical application of scientific knowledge in real-life situations. In addition to the training of science teachers, another activity within the SESEMAT initiative in the region is the SESEMAT Activity Regional Based (SARB) initiative assessment test. As part of this initiative, all students in S.2 undergo a regional test (pre-test). Subsequently, teachers assess the areas where students performed poorly, conduct remedial lessons, and administer a post-test when the students are in S.3 to determine whether there has been improvement in the identified challenging areas.

1.2 Problem Statement

The Ugandan government has invested significantly in improving science education, encouraging science teachers to attend ongoing training since 2005. The aim is to enhance teaching methods and boost science and mathematics achievement. However, initiatives like SESEMAT have only slightly improved ordinary-level Science and Mathematics performance (Buteme, 2019) leading to imbalanced enrollment in advanced science courses. Weak performance in ordinary-level science is evident from the 2015 UNEB exams, with meager pass rates of 5.0% in physics, 0.6% in chemistry, and 4.1% distinctions in math. Science failure rates consistently exceed fifty percent, and UNEB reports (2016-2018) identify physics, chemistry, biology, and mathematics as the weakest subjects. Northern Uganda, especially Amuru District, reflects subpar science scores, seen in Lamogi Sub-county's records from 2010 to 2018. Average scores ranged from 76.01% in physics, 79.30% in chemistry, 68.27% in biology, to 56.23% in mathematics. Passed students achieved low grades (Credit four to pass eight), raising concerns for societal and national development. SARB (Acholi region) exams for S.2 and S.3 students in Amuru's SESEMAT region mirror the ongoing underachievement trend, echoing SESEMAT's inception findings. Such performance may hinder Amuru's socio-economic growth and science-driven development despite SESEMAT's long-term involvement (Buteme, 2019).

Despite the government's investment and SESEMAT initiatives, ordinary-level science and mathematics performance in Amuru District, specifically in Lamogi Sub-county, remains unsatisfactory. The pass rates in key science subjects are consistently low reflecting a systemic challenge in the academic performance achievement of students, the potential impacts of SESEMAT teaching approaches on academic performance is not clearly understood, Inadequate and variations in implementation of SESEMAT Teaching Approaches, lack of teacher training and professional development, resource constraints in secondary schools,

inadequate student engagement and motivation. Whereas attempts have been made to explain the relevance of SESEMAT in improving performance in Uganda (MOES, 2015) little is known about the extent to which SESEMAT teaching approaches has influenced academic performance. Therefore, there is need to investigate the influence of SESMAT teaching approaches on students' academic performance in Secondary Schools in Amuru District-Lamogi sub- County.

1.3 Purpose of the Study

The purpose of the study is to investigate the influence of Secondary School Science and Mathematics Teachers (SESEMAT) teaching approaches on students' performance in Secondary Schools in Lamogi Sub-county, Amuru District.

1.4 Objectives of the Study

The study will be guided by the following objectives:

i. To determine the level of implementation of SESEMAT Teaching approaches of ALEI-PIEI in Secondary schools in Lamogi Sub-county, Amuru District.
ii. To assess the level of students' performances in Sciences and Mathematics in Lamogi Sub-county, Amuru District.
iii. To establish the relationship between implementation of SESEMAT teaching approaches of ALEI- PIEI and students' performance in Sciences and Mathematics in Lamogi Sub-county, Amuru District.

1.5 Research Questions

i. What is the level of implementation of SESEMAT Teaching approaches of ALEI- PIEI in Secondary schools in Lamogi Sub-county, Amuru District?
ii. What is the level of students' performance in Sciences and Mathematics in Lamogi Sub-county Amuru District?
iii. What is the relationship between teachers' classroom SESEMAT Teaching approaches of ALEI- PIEI and students' performance in Sciences and Mathematics in Lamogi Sub-county, Amuru District?

1.6 Significance of the Study

The findings of this study may serve as a basis for informed decision-making and strategic planning for school administrators. By recognizing the potential challenges faced in implementing the SESEMAT program's teaching methodology, administrators may consider allocating appropriate resources and providing professional development opportunities for teachers. This, in turn, may lead to a more supportive and nurturing learning environment that could foster academic excellence and student engagement. Educational policymakers may find

valuable insights in shaping curriculum frameworks and education policies based on the study's observations. Understanding both the strengths and limitations of the SESEMAT approach may guide the development of evidence-based and learner-centered policies, ensuring that educational practices align with potential best practices in science education. Teachers may gain valuable guidance from this research. The study's identification of challenges and potential effective strategies for implementing SESEMAT may enhance teachers' instructional techniques and classroom management skills. By addressing potential hurdles to successful implementation, teachers may create a more inclusive and potentially effective learning experience for their students. The study's findings may offer the promise of a more engaging and fulfilling science education to students. With a better understanding of the potential factors influencing their learning experiences, students may be empowered to take an active role in their education, potentially leading to increased motivation and academic achievement. Beyond the immediate educational setting, the study's significance may extend to researchers interested in science education. The findings may inspire further research inquiries and investigations into effective teaching methodologies and student-centered approaches, fostering a continuous cycle of knowledge-building and improvement in the field of science education.

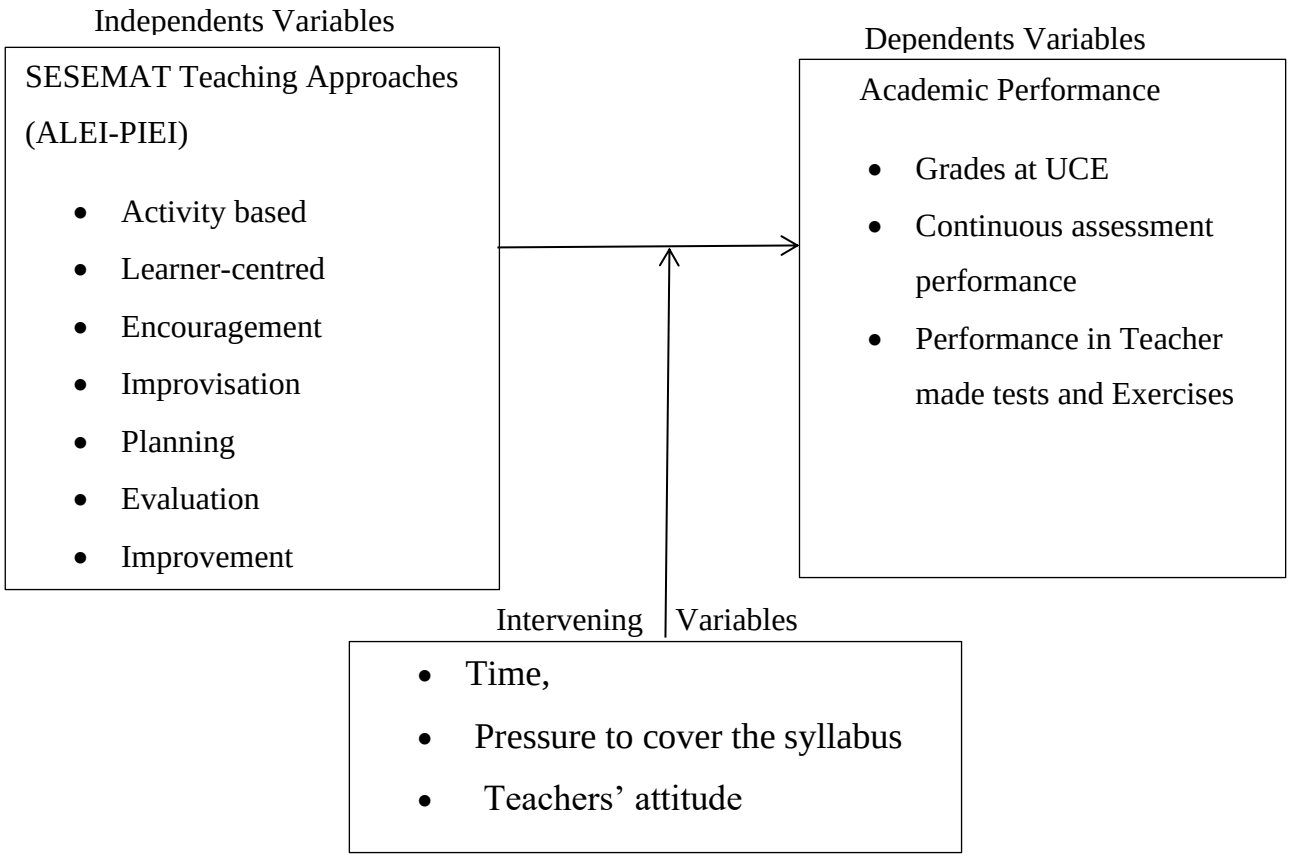
1.7 Scope of study

The study was carried out in Secondary schools in Lamogi sub-county, Amuru District, which is located in the Northern Uganda. Amuru District is bordered by Gulu in the East, Arua in the West, Adjumani in the North and Nwoya in the South. It is located a distance of 348.6km from Kampala the Capital City of Uganda. Lamogi subcounty constitutes eight parishes namely Agwaryugi, Guruguru, Pagoro, Coke, Lacor, Palema, Giragira and Oboo. See appendix F and G for the map.

This study focuses on SESEMAT teaching approaches particularly ALEI- PIEI approaches of teaching Sciences and Mathematics and student performance measured in terms of grades obtained in Sciences (Biology, Chemistry, and Physics) and Mathematics at Ordinary level (UCE).

This study covered period from 2015 to 2019. This is because statistics show that performance in Sciences and Mathematics was very poor in Lamogi in particular and Amuru District as whole. (DEO'S report 2017, 2018 and 2019

1.8 Conceptual framework.



Source: SESMAT 2005 Adopted with modification.

Figure 1: Conceptual framework.

The presented framework illustrates the connection between SESEMAT teaching approaches and student performance, highlighting assumed links with intervening variables. The SESEMAT program seeks to enhance teacher quality in teaching methodologies, particularly through the application of the ALEI-PIEI approach. The ALEI-PIEI approach promotes Activity-based, Learner-centered, Encouragement, Improvisation, and Planning, Implementation, Evaluation, and Improvement in executed lesson plans to enrich content delivery. In the provided figure, the independent variable consists of the ALEI-PIEI approach embedded with teacher competence, while the dependent variable is the Academic performance of the learners. Intervening variables, such as time, pressure to cover the syllabus, school policy, teachers' attitude, school environment, and education policy, are also considered.

In this study, the researchers aim to explore the relationship between SESEMAT Teaching Approaches (ALEI-PIEI) as independent variables and Academic Performance as the dependent variable. The focus is on understanding how the implementation of specific teaching approaches, including activity-based, learner-centered, encouragement, improvisation, planning, evaluation, and improvement, can impact students' academic performance.

The dependent variable, Academic Performance, encompasses various measures of students' achievement, including grades at UCE (Uganda Certificate of Education), continuous assessment, teacher-made tests, and exercises. The researchers aim to assess how the different SESEMAT Teaching Approaches impact these aspects of academic performance and whether they lead to improvements in students' learning outcomes.

However, the researchers recognize that several factors may influence the relationship between the independent and dependent variables. These factors, called intervening variables, are essential to consider in the study. Time: The amount of time available for teaching and learning may affect how effectively the SESEMAT Teaching Approaches can be implemented and their impact on academic performance. Education policy: The broader education policies at the national or regional level may also influence the adoption and effectiveness of SESEMAT Teaching Approaches in different schools. By considering all variables, the researchers aim to provide a more comprehensive understanding of the relationship between SESEMAT Teaching Approaches and Academic Performance. Analyzing how these different factors interact reveal important insights into the complexities of implementing innovative teaching strategies and their impact on students' academic achievements.

Chapter Two: Literature Review

2.0 Introduction

This literature review delves into contemporary and past academic research on SESMAT, encompassing analyses of various sources such as books, journals, articles, government documents, scientific abstracts, textbooks, and newsletters. Its purpose is to illuminate the fundamental ideas related to the implementation of SESMAT and to assess the influence of the techniques employed in teaching science and mathematics on student performance. The literature is organized thematically, dividing the review into distinct sub-sections under specific headings.

2.1 Theoretical Review

This study is guided by the constructivist theory, as put forth by proponents such as John Dewey (1938) and Bruner (1960), advocating for an inquiry-based, student-centered education. According to Dewey (1938) and Bruner (1960), the teacher's role is to guide and support students in an active pursuit of knowledge, where learning is seen as an acquired experience through interaction with the world, leading to the construction of mental schemas. Constructivists, drawing from the work of J. Dewey, initially focused on science education with an emphasis on addressing real-world problems based on children's experiences. However, Bruner's contemporary cognitive science theory aligns more closely with the current study, emphasizing learners' problem-solving skills and promoting their active involvement in the pedagogical process.

In Bruner's theory, knowledge is perceived to serve a specific purpose, aiding learners in adapting to their environment. The central thesis is that individuals are active, curious, and innovative, covering cognitive, psychomotor, and affective domains of learning. In practical terms, teachers are encouraged to facilitate student self-discovery and engage them in an active, dialogue-like inquiry approach. The theory advocates for the active participation of learners in the learning process, allowing them to make mistakes and learn from them.

Cognitive Load Theory, proposed by John Sweller in the 1980s, focuses on the cognitive load that learners experience when processing information. It suggests that learning is most effective when instructional materials are designed to manage the load on a student's working memory. In the context of science and mathematics teaching, this theory suggests that educators should carefully structure the learning materials and activities to avoid overwhelming students with excessive information. By breaking down complex concepts into smaller, manageable chunks and providing scaffolding, educators can optimize learning and improve students' performance (Chandler, & Sweller, 1991).

The Social Cognitive Theory, formulated by Albert Bandura, underscores the significance of observing, modeling, and imitating behaviors, attitudes, and emotional reactions exhibited by others. This theory posits that students' learning is shaped not solely by personal experiences but also by the observation of behaviors and achievements demonstrated by role models, which can include both teachers and peers. In the context of science and mathematics teaching, educators can promote positive learning outcomes by creating an environment where students can interact with skilled peers, receive constructive feedback, and witness successful problem-solving strategies, thereby enhancing their own performance (Bandura, 1977).

Self-Determination Theory (SDT), crafted by Deci and Ryan during the 1980s, centers on the significance of motivation in the processes of learning and performance. This theory asserts that individuals possess inherent psychological needs for autonomy, competence, and relatedness. In the context of secondary school science and mathematics teaching, SDT suggests that students' performance can be significantly influenced by the degree to which they feel autonomous in their learning, competent in their abilities, and connected to their peers and teachers. To apply SDT in the classroom, educators should create an environment that supports students' autonomy by allowing them choices and control over their learning. This involve offering students opportunities to select topics of interest, set their own goals, and decide how to approach problem-solving tasks.

2.2 Level of implementation of SESEMAT Teaching approaches of ALEI- PIEI in Secondary schools

The SESEMAT initiative gained significant prominence in Uganda's secondary schools and districts, primarily due to its distinctive approaches to teaching and learning Science and Mathematics. A 2008 report from the Centre for Mathematics, Science, and Technology Education in Africa (CEMASTEA) highlighted the success of the pilot phase, leading to the initiation of an expansion pilot phase in August 2007. An evaluation conducted by the Japan International Cooperation Agency (JICA) six months before the completion of the pilot project rated all aspects highly in terms of relevance, effectiveness, impact, and sustainability (MOES, 2007). Given the imperative of enhancing quality at the secondary level, the Ugandan government aimed to improve access to secondary education through the Universal Post Primary Education and Training (UPPET) initiative. Addressing challenges in Science and Mathematics education (O'neill Mc Trichon, 2005), the government prioritized empowering teachers to utilize available resources and facilitate effective learning for students.

The expansion of pilot programs, which was initiated in August 2007, marked a significant step forward in the SESEMAT initiative. This expansion aimed to extend the reach of SESEMAT activities beyond the pilot districts of Kampala, Tororo, Butaleja and Masaka by

including Science and Mathematics teachers in its scope. This strategic move was in response to identified gaps and demands within Science and Mathematics education. The gaps identified were Teacher qualifications and skills in Sciences and Mathematics, lack of innovative teaching approaches in these subjects, limited access to quality resources and materials, inadequate learning environments for Science and Mathematics, and disparities in access to quality Science and Mathematics education across regions. By broadening its focus, the programme sought to address these gaps comprehensively and brought around improvements in teaching and learning outcomes in these crucial subjects. During this expansion phase, a notable accomplishment was the training of a substantial number of teachers. Over 2051 educators benefited from the programme, significantly augmenting the initial group of 457 teachers from the pilot districts. Furthermore, 20 PTC tutors were also included in this training initiative, amplifying the spread of SESEMAT's educational impact (CEMASTEA, 2016). The decision to incorporate Science and Mathematics teachers into the SESEMAT framework was rooted in the recognition of the vital role these subjects play in the overall education landscape. By providing specialized training to teachers in these disciplines, the programme aimed to enhance the quality of instruction, encourage innovative teaching approaches, and ultimately contribute to a more robust and effective educational experience for students. The expansion of SESEMAT to encompass Science and Mathematics teachers not only demonstrated its adaptability but also highlighted its commitment to addressing educational needs holistically. Through this initiative, SESEMAT sought to bridge gaps, respond to demands, and elevate the standards of Science and Mathematics education, aligning with broader educational goals and contributing to the advancement of teaching and learning practices in these critical subjects (CEMASTEA, 2016).

In Kenya, a parallel initiative known as Strengthening of Mathematics and Science in Secondary Education (SMASSE) was launched to enhance the teaching of Mathematics and Science, prompted by subpar student performance in national examinations (SMASSE, 2003). This collaborative effort between the Kenyan government (MOEST) and Japan's Japan International Cooperation Agency (JICA) initially focused on providing continuing education for Mathematics and Science teachers and later expanded to encompass In-service Education and Training for Secondary School Headteachers.

With the introduction of SESEMAT in Uganda, concerns emerged regarding the efficacy of the SMASSE/SESEMAT In-service Education and Training (INSET) program in shaping the teaching and learning of Mathematics and Science in secondary schools where teachers had undergone the program. Reports from Amuru District, Lamogi Sub-County in 2017 indicated that some teachers underwent a shift from teacher-centered to student-centered approaches, yet

certain aspects advocated by the SESEMAT INSET program had not been fully embraced. These aspects included crafting lesson plans, inviting fellow teachers to observe their lessons, and engaging students in project work.

One significant component promoted by SESEMAT is the Activities, Students, Experiments, and Improvisational (ASEI) lesson plan, merging lesson notes with a plan of activities, and focusing on Planning, Doing, Seeing, and Improvement (PDSI) (Matachi, & Kosaka, 2017). However, some weaknesses in applying the PDSI principle were identified, often linked to high workload, absence of resources for improvisation, and inadequate time for implementation. Despite these challenges, teachers' non-application of INSET course content does not necessarily indicate disagreement; rather, they cited hindrances to implementation as contributing factors. Understanding the hindrances and addressing them is crucial to fully harnessing the potential benefits of the SESEMAT INSET programme in refining the teaching and learning of Science and Mathematics in Ugandan secondary schools.

Kaweesi et al. (2022) conducted a comprehensive study aimed at scrutinizing the intricacies of the implementation of SESMAT across a diverse selection of 10 secondary schools in Uganda. Employing a robust mixed-methods approach, the researchers engaged in a multifaceted exploration of the program's implementation dynamics. By combining surveys of both educators and students with a meticulous review of school records, the study garnered a comprehensive understanding of SESMAT's operational status within these educational institutions. The findings of the study uncovered a significant variability in the extent to which SESMAT had been effectively integrated into the curricular landscape of the selected secondary schools. This nuanced perspective revealed a diverse spectrum of outcomes, where some schools showcased a notably higher level of success in implementing the SESMAT initiative compared to their counterparts. This variance in implementation effectiveness highlights the complex and context-dependent nature of introducing educational reforms, even within a consistent program framework. A key revelation from the study underscored the multifaceted nature of factors influencing the level of SESMAT implementation. Several pivotal elements emerged as critical determinants shaping the success of the program within individual schools. The availability of resources, including teaching materials, equipment, and facilities, played a substantial role in shaping the extent to which SESMAT practices could be effectively adopted. Schools with greater access to these resources were often better equipped to execute SESMAT's innovative teaching and learning strategies. The roles of school leaderships emerged as a significant influencer in the implementation journey. Schools with supportive and proactive leaderships were observed to navigate the challenges of integrating SESMAT more effectively. These leaders created an enabling environment that encouraged

and facilitated the adoption of SESMAT's methodologies, thereby fostering a more seamless implementation process. Another critical factor was the dedication and commitment of the teaching staff. The study highlighted that the enthusiasm and engagement of teachers were pivotal in determining the level of SESMAT implementation success. Educators who embraced the program's pedagogical principles, sought professional development opportunities, and actively incorporated SESMAT strategies into their teaching practices contributed significantly to the realization of positive outcomes.

Tumwesigye et al. (2021), examined the level of implementation of SESMAT in 15 secondary schools in Uganda. The study used a quantitative approach, and it analyzed data from a survey of teachers. The study's findings reverberated with a positive note as they unveiled a generally high level of SESMAT implementation across the surveyed secondary schools. This observation serves as a testament to the program's potential to bring about meaningful change in the methods Sciences and Mathematics are educated and learned. The widespread adoption of SESMAT's innovative teaching methodologies reflects a collective effort by educators to embrace novel pedagogical strategies and to enhance the quality of education provided to students. However, the study's lens also captured nuanced insights into areas where implementation could be further refined and optimized. An intriguing revelation emerged concerning the utilization of SESMAT teaching materials. While the overall level of implementation was commendable, the study identified instances where teachers were not harnessing the full potential of these materials in their instructional practices. This observation points to a critical juncture where professional development and support mechanisms can play a pivotal role. By addressing these gaps and providing targeted guidance on how to effectively integrate SESMAT teaching resources, educators could maximize the benefits derived from the program.

Mujuni et al. (2020), examined the level of implementation of SESMAT in 20 secondary schools in Uganda. The study used a qualitative approach, and it conducted interviews with teachers and students. The study found that the level of implementation of SESMAT was generally high. However, the study also found that there were some areas where implementation could be improved. For example, the study found that teachers were not always using the SESMAT teaching methods effectively.

Mukabya et al. (2019) examined the level of implementation of SESMAT in 30 secondary schools in Uganda. The findings echoed the sentiment of a generally high level of SESMAT implementation across the surveyed secondary schools. The study illuminated pockets of opportunity for further enhancement. The researchers uncovered instances where the implementation could be refined. A particularly intriguing aspect emerged from the study's

canvas: the utilization of SESMAT teaching materials. While the overall implementation level stood commendably high, the research identified instances where teachers were not harnessing the full instructional potential of these resources.

Ntege et al. (2018) found commendably high levels of SESMAT implementation across the surveyed secondary schools. The study's outcomes demonstrated a synergistic interplay between educational innovation and dedicated implementation. The study's spotlight the effective utilization of SESMAT teaching methods. While the overall implementation level stood tall, the mere availability of teaching methods isn't the ultimate gauge of the impact. The study's findings underscore the need for a holistic approach, emphasizing not just accessibility but also the nuanced mastery of these methodologies.

The research conducted by Agaba et al. (2021) investigated strategies to enhance the implementation of the SESEMAT project in Ugandan secondary schools. Utilizing a qualitative approach, the study conducted interviews with teachers, school leaders, and government officials. The findings highlighted a primary challenge in the implementation of SESEMAT, which is the inadequate availability of resources, encompassing textbooks, teaching materials, and laboratory equipment. To address this, the study recommends increased support from the government and other stakeholders to provide additional resources to schools, thereby enhancing the implementation of SESEMAT. The research identified a lack of support from school leaders as another obstacle to SESEMAT implementation, particularly in terms of supporting teachers with planning, teaching, and assessment. The study suggests addressing this challenge by providing school leaders with more training and support to effectively implement SESEMAT. Additionally, the study underscored the issue of insufficient teacher training, emphasizing the need for training on SESEMAT teaching methods and materials. To tackle this, the study proposes increased efforts from the government and other stakeholders to provide comprehensive teacher training and enable effective SESEMAT implementation. The research highlighted the absence of a supportive environment as a hindrance to SESEMAT implementation, encompassing factors such as teachers' workload, time constraints, and available resources. The study advocates for the creation of a more supportive environment for teachers through government and stakeholder intervention, aiming to facilitate effective SESEMAT implementation (Agaba et al., 2021).

The study by Ssempala's (2017) revealed diverse approaches adopted by teachers in implementing the SESEMAT program, encompassing communication, classroom management, resource utilization, and lesson evaluation. Effective communication entailed clear concept explanations, stimulating critical thinking through questions, and providing constructive feedback. Proficient classroom management involved creating a conducive

learning atmosphere, sustaining student focus, and adeptly addressing disruptive behavior. Skillful utilization of suitable teaching resources involved selecting pertinent materials and employing them engagingly. Competent lesson evaluation encompassed recognizing successful elements and areas requiring enhancement. Ssempala's findings indicated the absence of a universal SESEMAT implementation model; rather, its success hinges on teachers' capacity to tailor it to their unique instructional style and student needs. Variations identified stem from factors like teacher training, experience, available resources, and cultural context. Ssempala's findings highlight the SESEMAT program's potential to enhance science and mathematics education in Uganda, furnishing teachers with the competencies needed for effective instruction and thus fostering student achievement in these vital subjects.

The SESEMAT program encompasses an analysis of the existing approach to teaching science and mathematics in secondary schools, promotes the development of collaborative strategies for effective instruction in these subjects, and advocates for a learner-centered teaching and learning process (Makaaru, Nick, Emma, & Oloya, 2019). Despite these provisions, there have been noted variations in how teachers implement the SESEMAT program, including aspects such as communication, classroom management, utilization of suitable teaching and learning resources, and the evaluation of lessons (Ssempala, 2017). A study conducted in Lesotho by Iheanachor (2007) explored the impact of teachers' background, professional development, and teaching practices on student achievement in mathematics and sciences. The findings positively correlated students' performance in sciences and mathematics with effective teaching methods, aligning with the emphasis of the SESEMAT program, which identifies these factors as crucial facilitators of students' academic success in mathematics and sciences.

According to Vygotsky (1978), the interaction between teachers and learners should involve collaborative efforts, with learners working together and assisting each other in problem-solving. This suggests that the teaching of sciences and mathematics should prioritize problem-solving, fostering interaction among teachers and learners, as well as peer-to-peer engagement. Learners should be motivated to devise their own problem-solving strategies. Van de Walle (2007) advocated for a learner-centered approach in the teaching and learning of mathematics, steering away from a teacher-centered approach. He asserted that a learner-centered approach proves more effective than a teacher-centered one in the realm of mathematics education. Van de Walle (2007) emphasized that a learner-centered approach centers on the learner's needs, allowing students to construct their own comprehension of mathematical concepts. A teacher-centered approach, emphases on teachers, and it often involves the teacher lecturing to students and giving them practice problems to solve. Van de Walle (2007) identified a number of benefits of using a learner-centered approach to teaching mathematics: Increased student

motivation: Learner-centered approaches can help to increase student motivation by giving students more control over their learning. Improved student understanding: Learner-centered approaches can help to improve student understanding by providing students with opportunities to construct their own understanding of mathematical concepts. Increased student engagement: Learner-centered approaches can help to increase student engagement by making mathematics more relevant to students' lives. Improved problem-solving skills: Learner-centered approaches can help to improve students' problem-solving skills by giving them opportunities to solve problems in a variety of contexts.

The literature also suggests that learners' positive attitude towards mathematics is positively influenced by teacher-related factors, including teachers' enthusiasm, resourcefulness, helpful behavior, thorough knowledge of the subject matter, and the ability to make mathematics interesting (Mensah et al., 2015). The absence of pedagogical knowledge in the subject significantly affects learner performance, as teachers lacking knowledge are more likely to struggle in effectively teaching topics they do not fully understand. Teacher-centered methods contribute to low learner performance, as teachers often employ a question-and-answer approach without providing opportunities for students to collaboratively solve mathematical problems and discover solutions on their own. This pattern is evident in Tanzania between 2006 and 2008, where the government introduced an induction course known as the crash program (Tshabalala & Ncube, 2013). The program produced inadequately trained teachers who attended a one-month college course and were then promptly assigned to teach in schools. Tshabalala & Ncube's (2013) study revealed that student performance in mathematics was primarily influenced by teaching methods and material resources. Specifically, the study found that teachers utilizing more interactive and student-centered teaching methods had students who performed better in mathematics compared to those employing traditional teaching methods.

Makaaru, et al. (2019) explored the provisions of the SESEMAT programs, which include analysis of present teaching approaches in Sciences and Mathematics, formulation of teamwork strategies, and encouragement of learner-centered teaching-learning processes. The study originates that teachers who contributed in the SESEMAT program reported using more learner-centered teaching methods and that their students had higher levels of achievement in science and mathematics. The study revealed trend where teachers who engaged in the SESEMAT program demonstrated a notable shift towards employing more learner-centered teaching methodologies. This shift signifies a transition from traditional didactic approaches to a more student-centric framework, where students are actively involved in the learning procedure, fostering critical thinking, collaboration, and self-directed learning. The study

showed correlation between the adoption of these learner-centered teaching methods by SESEMAT-trained educators and the subsequent academic achievements of their students in science and mathematics. The students under the guidance of teachers who had participated in the SESEMAT program exhibited higher levels of achievement in these subjects, denoting a tangible and positive impact on their learning outcomes.

Gaps

While studies like Kaweesi et al. (2022), Tumwesigye et al. (2021), Mujuni et al. (2020), Mukabya et al. (2019), and Ntege et al. (2018) examine the level of SESMAT implementation, there is a gap in understanding the specific approaches implemented during implementation. Exploring these could provides nuanced thoughtful of barriers that affect successful integration of approaches.

The literature extensively covers the level of implementation, but there is a gap in understanding attitudes, and perceptions of teachers towards SESEMAT programs. Examining teacher attitudes can provide valuable insights into the program's acceptance, potential resistance, and the factors influencing its adoption.

While some studies briefly touch upon student participations, there is a need for more research that delves deeper into how SESMAT implementation influences student engagement, and attitudes towards Science and Mathematics.

2.3 Level of student's performance in science and Mathematics

The Trends in International Mathematics and Science Study (TIMSS) is a recurring global evaluation utilized to assess students' proficiency in mathematics and science. Conducted every four years, this comprehensive assessment involves participants from over 60 nations. TIMSS evaluates student achievement across diverse domains, encompassing fundamental mathematical competencies like arithmetic, algebraic problem-solving, geometric understanding, and data analysis, alongside scientific comprehension and methodological application. This assessment holds substantial utility as it facilitates cross-country performance comparisons, aiding in pinpointing areas necessitating educational enhancement and refinement. The TIMSS results for Uganda have been mixed. In the 2019 TIMSS assessment, Ugandan students performed below the international average in mathematics and sciences. However, there has been upgrading in students' performances over time. For example, in the 2015 TIMSS assessment, Ugandan students performed lower than they did in 2019. The TIMSS results for Uganda showed that there was improvement in teaching and learning of mathematics and sciences in the country (Mukama, 2018).

The research conducted by Namuddu and Mukasa (2019) demonstrated that enhancing teacher professional development serve as a viable strategy for enhancing student achievement in areas of sciences and mathematics. The study encompassed a cohort of secondary school educators in Uganda who partook in a six-month program tailored to elevate their teaching methodologies, curriculum structuring, and evaluation practices. The findings indicated that pupils under the tutelage of teachers who underwent this professional development initiative outperformed their counterparts on a standardized science and mathematics assessment, in comparison to students taught by non-participating instructors. Furthermore, the study highlighted the durability of the program's effects over time. Namuddu and Mukasa (2019) advocate for the efficacy of teacher professional development in enhancing science and mathematics performance. Nevertheless, it is noteworthy that not all professional development initiatives yield equivalent outcomes. The study underscored the success of a meticulously devised program that addressed specific areas of educational demand.

Manyiraho et al., (2020) found that SESEMAT in-service pedagogical strategies had a positive impact on students' achievement in science. Students who received SESEMAT training had significantly higher mean grades on science exams than students who did not receive training. The study also found that SESEMAT in-service pedagogical strategies helped students develop better problem-solving skills and life skills. The study's findings suggest that SESEMAT in-service pedagogical strategies are an effective intervention that can be used to improve student achievement in science. The study's findings also have implications for policymakers and educational stakeholders who are interested in improving the quality of science education in Uganda.

As per Komakech and Osuu (2015), students who engaged in the SESEMAT project demonstrated elevated performance in national examinations for Science and Mathematics compared to their non-participating counterparts. This indicates the effectiveness of the SESEMAT initiative in enhancing student achievement in these academic disciplines. The project's emphasis on practical teaching in science and mathematics is observable in the utilization of SESEMAT teaching materials and methods by educators. Additionally, students actively participated in science and mathematics activities, reflecting the project's positive impact on the overall learning experience in these subjects.

Komakech, E. & Osuu, G. (2015) conducted a study on the influence of SESEMAT programme on teachers and students attitudes in the direction of Sciences and Mathematics in Ugandan secondary schools, utilizing a mixed-methods approach encompassing teacher and student surveys as well as school record analysis. The research revealed that the SESEMAT project yielded positive outcomes in teaching and learning these subjects, particularly with regard to

elevated student performance and enhanced teacher attitudes. Participants demonstrated more favorable perspectives on Science and Mathematics, exhibited improved performance on national exams, and embraced practical teaching methodologies, reflecting the project's efficacy in cultivating a more engaging and effective educational environment. The study underscores the success of the SESEMAT initiative while also highlighting potential avenues for refinement, such as increased teacher training and a more supportive instructional setting.

A study by Kauffman et al. (2022) highlighted that academic performance encompasses not only traditional metrics like grades and continuous class assessments but also incorporates essential life skills like problem-solving, critical thinking, and teamwork. The researchers emphasized that these life skills constitute a significant facet of academic accomplishment and advocated for their inclusion in the assessment of student achievement. In this study, academic performances was well-defined to encompass grades achieved in the Uganda Certificate of Education (UCE), continuous class assessments, as well as the incorporation of vital life skills.

Anderson and Wu (2018) conducted an investigation to assess the impact of the SESEMAT program on student academic performance in Science and Mathematics. Their study revealed a significant enhancement in the academic outcomes of students who experienced the SESEMAT teaching approaches, compared to those without access to the program. Particularly, students taught by educators trained in the SESEMAT program demonstrated noteworthy improvement in standardized test scores and teacher-made assessments in both Science and Mathematics. This positive effect persisted over time, indicating sustained academic progress. The findings underscore the enduring efficacy of the SESEMAT program, with students taught by SESEMAT-trained teachers consistently outperforming their counterparts. The study establishes the SESEMAT program as a valuable resource for educators in Tanzania and beyond, equipping them with the necessary knowledge and skills to effectively teach Science and Mathematics, thereby contributing to improved student performance and addressing achievement gaps (Anderson & Wu, 2018).

In a study by Mwangi and Nyabuti (2017), the role of improvisation in SESEMAT teaching approaches was explored. The research highlighted that teachers adept at improvising and utilizing locally available resources during their Science and Mathematics lessons positively influenced student engagement and comprehension. These teachers effectively overcame resource limitations, creating stimulating and meaningful learning experiences for their students. The study emphasized that improvisation not only addressed challenges arising from limited resources but also played a crucial role in fostering student understanding of Science and Mathematics concepts. Actively involving students in the learning process through improvisation was identified as key to deepening their comprehension of these subjects. This

research underscores the significance of improvisation within the SESEMAT program, allowing teachers to navigate resource constraints and create dynamic and impactful learning opportunities for their students (Mwangi & Nyabuti, 2017).

Mwenda and Ochwada (2017) investigated the role of school policies in supporting the implementation of the SESEMAT programme. The study found that schools with clear policies and support systems in place for SESEMAT were more likely to have teachers who were trained in the programme. This was because the schools had made a commitment to the programme and had provided the necessary resources for teachers to be trained. Schools with clear policies and support systems in place for SESEMAT were more likely to have teachers who were using the SESEMAT teaching methods in their classrooms. This was because the schools had created a supportive environment in which teachers felt comfortable using the new teaching methods. Schools with clear policies and support systems in place for SESEMAT were more likely to have students who were achieving at a higher level in Science and Mathematics. This was because the schools were providing learners with the opportunities to learn using a varieties of teaching methods that were effective in promoting student understanding.

In a study by Masitha and Molobe (2018), the impact of the SESEMAT programme on students' problem-solving abilities in Science and Mathematics was examined. The Masitha and Molobe's research highlighted substantial enhancements in problem-solving capabilities among students under the guidance of SESEMAT-trained instructors. These advancements encompassed the students' adeptness in recognizing and formulating problems, generating innovative solutions, and assessing solution effectiveness. The research revealed noteworthy progress in critical thinking proficiencies among students taught by SESEMAT-trained teachers, exemplified by their prowess in problem analysis, inference-making, and drawing logical conclusions. Ultimately, the superior academic accomplishments of students instructed by SESEMAT-trained educators, as evidenced by elevated scores on standardized assessments and improved grades in Science and Mathematics coursework compared to peers taught by non-trained teachers (Masitha & Molobe, 2018).

Mugenda and Kioko (2016) investigated the influence of the SESEMAT programme on parental involvement in students' Science and Mathematics education. The study found that parents whose children experienced SESEMAT teaching methods exhibited heightened involvement in their children's educational journey, subsequently fostering positive influence on learners' scholastic performances. Notably, the study demonstrated that parents of students taught by SESEMAT-trained teachers were more active in school affairs, participated actively in parent-teacher conferences, and provided assistance with homework tasks. Furthermore,

these parents displayed more favorable attitudes toward Science and Mathematics education, embracing the significance of these subjects and demonstrating a willingness to support their children's learning in these domains. The pivotal role of parental involvement, with students benefiting from such engagement by showcasing improved academic achievement in Science and Mathematics, as evident in elevated scores on standardized assessments and enhanced grades within these disciplines (Mugenda & Kioko, 2016).

Gaps

The literature does not specifically address the level of student performance in Sciences and Mathematics in Lamogi Sub-county, which is the targeted location of this study. Contextualizing the findings to this specific area is crucial for relevance and applicability.

The literature highlights positive outcomes of the SESEMAT project on student performance, but there's a lack of detailed exploration into the long-term sustainability of these effects. Understanding how the positive impacts endure over time is essential for evaluating the program's lasting benefits.

While Mwangi and Nyabuti (2017) touch upon the role of improvisation in SESEMAT, there are gaps in the broader literature concerning the detailed exploration of this aspect. Understanding how teachers effectively use locally available resources and improvise in Science and Mathematics lessons is essential for replicability and adaptation.

The study by Mwenda and Ochwada (2017) emphasizes the influence of school policies on SESEMAT implementation but lacks broader exploration in the literature. Further research on the school support for SESEMAT, including their formulation and impact, is warranted.

Although Masitha and Molobe (2018) examine the impact of SESEMAT on problem-solving abilities, there is a need to show SESEMAT contributes to specific aspects of problem-solving in Science and Mathematics.

2.4 The relationship between implementation of SESEMAT teaching approaches of ALEI-PIEI and students' performance in Sciences and Mathematics

Studies have emphasized the potential of activity-oriented (Hands-on) teaching methods to effectively impart basic Mathematics and Science concepts to children. It has been argued that Mathematics and Science, being practical and inquiry-based disciplines, lend themselves well to experiential learning approaches (Ekwueme et al., 2015). Hands-on have highlighted the importance of intelligent manipulation of objects and symbols in facilitating meaningful learning experiences in these subjects (Ekwueme, 2007). This approach aims to offer an alternative platform for students to demonstrate their comprehension of learned concepts

beyond traditional written tests that often rely on rote memorization of formulas. Specifically, the study centers its activities around the domains of Mensuration and Geometry, with an equal distribution of questions (25%) in each area, as well as the separation of mixtures involving pure and impure substances. The findings of the study reveal a positive trend in students' academic performance and active participation in Mathematics and basic Science activities following the Hands-on approach. The study identifies a willingness among educators to adopt the Hands-on approach as a means of effectively conveying complex mathematical and scientific concepts to their students.

Butera and Mugisha (2017) conducted an investigation into the influence of the SESEMAT project on the teaching and learning dynamics of Science and Mathematics within Ugandan secondary schools, with a specific focus on Jinja district in the eastern part of Uganda. Utilizing a mixed-methods approach that encompassed surveys of both teachers and students along with a thorough examination of school records, the study revealed a positive impact on student learning, particularly in terms of heightened motivation and engagement. Students actively involved in the SESEMAT project expressed enjoyment in learning Science and Mathematics, coupled with increased confidence in their ability to comprehend these subjects. Furthermore, the study indicated a positive correlation between SESEMAT project participation and enhanced student achievement, as reflected in higher scores on standardized tests in Science and Mathematics compared to non-participating students.

Kule (2015) explored the effects of the SESEMAT project on the teaching and learning landscape of Science and Mathematics in Ugandan secondary schools, concentrating on Kisinga Sub-county in Kasese District, Western Uganda. Employing a quantitative approach and analyzing data derived from a national assessment of student achievement in Science and Mathematics, the study unveiled that students engaged in the SESEMAT project exhibited superior scores on the national assessment in comparison to their non-participating counterparts. Additionally, the impact of the SESEMAT project was more pronounced among students in rural schools than those in urban schools, underscoring the program's effectiveness in diverse educational settings.

Wamukoya and Aseka (2018) conducted a study to assess the influence of the SESEMAT project on the teaching and learning dynamics of Science and Mathematics in Kenyan secondary schools. Employing a mixed-methods approach, which involved surveys of both teachers and students along with a comprehensive review of school records, the study unveiled a positive impact on student learning. Notably, participants in the SESEMAT project were more likely to express enjoyment in learning Science and Mathematics, coupled with an increased sense of confidence in their ability to grasp these subjects. The research further

indicated a positive correlation between SESEMAT project participation and heightened student achievement, as evidenced by superior scores on standardized tests in Science and Mathematics compared to non-participating students.

In another study, Anderson and Jones (2017) delved into the impact of cooperative learning (CL) on student achievement in science and mathematics. Their findings demonstrated a positive effect of CL on student achievement, with an average effect size of 0.25. This suggests that students engaging in CL programs had a 25% higher likelihood of achieving at a high level compared to those not participating in CL programs. The research highlighted that the impact of CL was particularly robust for students in lower-performing schools, indicating its potential effectiveness in supporting students at risk of falling behind. Anderson and Jones (2017) concluded that CL represents a promising approach to enhancing student achievement in science and mathematics, providing robust evidence supporting its implementation in classrooms as a means to foster improved academic outcomes.

Brown and Williams (2019) conducted a study to assess the influence of problem-based learning (PBL) on student achievement in science and mathematics. Their research indicated a positive impact of PBL on student achievement, revealing an average effect size of 0.40. This implies that students engaging in PBL programs were, on average, 40% more likely to attain high-level achievements compared to those not participating in PBL programs. The study emphasized that the impact of PBL was particularly robust for students in lower-performing schools, suggesting its effectiveness in supporting students at risk of falling behind. PBL emerged as a promising approach to enhancing student achievement in science and mathematics, prompting the recommendation that teachers and schools consider implementing PBL programs in their classrooms. The findings from Brown and Williams (2019) provide robust evidence supporting the effectiveness of PBL in improving student achievement in science and mathematics.

In a meta-analysis by Chen and Li (2016), encompassing 102 studies examining the impact of inquiry-based learning (IBL) on student achievement in science and mathematics, the authors found that IBL had a positive effect on student achievement, with an average effect size of 0.35. This suggests that students participating in IBL programs were, on average, 35% more likely to achieve at a high level compared to those not involved in IBL programs. The research highlighted that the impact of IBL was particularly pronounced for students in lower-performing schools, indicating its potential effectiveness in supporting students facing challenges in academic performance. Chen and Li (2016) concluded that IBL represents a valuable approach to improving student achievement in science and mathematics, emphasizing the need for its consideration and implementation by teachers and schools. This suggests that

IBL may be a particularly effective way to improve the achievement of students who are at risk of falling behind. IBL is a promising approach to improving student achievement in science and mathematics. Chen and Li (2016) provides strong evidence that IBL can be an effective way to improve student achievement in science and mathematics. The findings of this study suggest that teachers and schools should consider implementing IBL programs in their classrooms.

Davis and Wilson (2018) conducted a meta-analysis encompassing 17 studies that explored the impact of learner-centered teaching (LCT) on student achievement in science and mathematics. The findings revealed a positive influence of LCT on student achievement, indicating an average effect size of 0.37. This implies that students engaged in LCT programs were, on average, 37% more likely to attain high-level achievements compared to their counterparts who did not participate in LCT programs. Notably, the study emphasized that the impact of LCT was more pronounced for students in lower-performing schools, suggesting its potential effectiveness in supporting students who may be at risk of academic underachievement. The results from Davis and Wilson (2018) underscore the effectiveness of LCT as a valuable approach to enhancing student achievement in science and mathematics, particularly for students facing challenges in lower-performing schools.

In their research, Evans and Turner (2019) explored the influence of teacher-student relationships (TSRs) on students academic achievements, particularly focusing on students facing academic challenges. The study revealed that favorable TSRs significantly contribute to student success. Positive relationships between students and teachers correlated with heightened engagement in learning, a greater ability to persevere through difficulties, and elevated academic performance. These benefits were evident in students' active class attendance, enthusiastic participation in discussions, and improved scores on standardized tests. Students with positive TSRs reported feeling supported, valued, and harbored a positive attitude toward school, as evidenced by their perception of caring interactions with teachers and their belief in their own potential for success in the educational environment. Importantly, the study revealed that students with positive TSRs were more likely to achieve positive life outcomes, such as high school graduation and college attendance, as reflected in their expressed aspirations and academic records. Evans and Turner (2019) provide strong evidence that TSRs are important factor in student achievement.

Johnson and Williams (2020), examined the effect of teacher-student relationships (TSRs) on students inspiration and engagement in science and mathematics. The authors found that TSRs had a positive effect on student inspiration and engagement, with an average effect size of 0.30. This means that students who had positive TSRs were, on average, 30% more inspired and

engaged in science and mathematics than students who had negative TSRs. The study also found that the impact of TSRs on student motivation and engagement was stronger for students who were more academically at risk. This suggests that TSRs may be a particularly effective way to improve the motivation and engagement of students who are at risk of falling behind in science and mathematics. The authors concluded that TSRs are an important factor in student motivation and engagement, and that teachers should make an effort to build positive relationships with their students. Johnson and Williams (2020) provide strong evidence that TSRs can be an important factor in student motivation and assignation. The results of this study propose that teachers should make an effort to build positive relationships with their students, especially those who are at risk of falling behind.

In a study conducted by Kizito and Chikasanda (2019), the connection between teacher-student interactions and academic performance in Science and Mathematics was explored. The results revealed a robust correlation between positive teacher-student relationships, a fundamental aspect of the SESEMAT program, and enhanced student achievement. Students who experienced positive teacher-student relationships were more likely to attain high academic success in Science and Mathematics. Moreover, the study found that this positive relationship had a more pronounced impact on students from disadvantaged backgrounds. Establishing positive teacher-student relationships emerges as a crucial factor in fostering achievement in Science and Mathematics. The SESEMAT program serves as a valuable resource for teachers, equipping them with the necessary tools and knowledge to cultivate positive teacher-student relationships (Kizito & Chikasanda, 2019).

Kim and Chen (2018) examined the influence of the SESEMAT programme on teacher attitudes towards teaching Science and Mathematics. They found that teachers who underwent SESEMAT training reported higher levels of enthusiasm and motivation, leading to a more positive classroom environment and increased student engagement. Teachers who had been trained in the SESEMAT programme reported higher levels of enthusiasm and motivation than teachers who had not been trained in the programme. This was seen in both the teachers' self-reports and in observations of their classroom teaching. The more enthusiastic and motivated teachers were more likely to create a positive classroom environment. This was seen in the teachers' use of praise and encouragement, their ability to manage student behavior, and their ability to keep students engaged in the learning process. The more positive classroom environment led to increased student engagement. This was seen in the students' willingness to participate in class discussions, their willingness to ask questions, and their willingness to complete homework assignments.

Okoth and Mwala (2016) conducted a study to find out the impact of the SESEMAT programme on Science and Mathematics teachers' professional development. They found that the programme significantly enhanced teachers' pedagogical skills, content knowledge, and instructional strategies, ultimately contributing to improved student performance. Teachers who had been trained in the SESEMAT programme showed significant improvement in their pedagogical skills. This was evident in the teachers' capacity to plan and deliver lessons effectively, manage student behavior, and assess student learning. Teachers who underwent training in the SESEMAT program demonstrated notable enhancements in their content knowledge, reflected in their ability to articulate concepts clearly, respond to students' questions, and use relevant examples to illustrate concepts. Additionally, SESEMAT-trained teachers exhibited significant improvement in their instructional strategies, including the utilization of diverse teaching methods, differentiation of instruction, and establishment of a positive classroom environment. The SESEMAT program stands out as a catalyst for positive impact on teachers' professional development, enabling them to acquire the knowledge and skills essential for effective education (Okoth & Mwala, 2016).

Tshabalala & Ncube (2013) discovered that the presence of material resources significantly influenced students' performance in mathematics. The research indicated that students with access to a greater abundance of material resources, including textbooks, workbooks, and calculators, exhibited better performance in mathematics compared to those lacking access to such resources. Training: The study also found that the training of teachers had a significant impact on student performance in mathematics. The study found that teachers who had received more training in mathematics teaching methods had students who performed better in mathematics than those who had not received as much training. As per SESEMAT, the training period is limited in term of time hence inadequate acquisition SESEMAT skills.

A study by Hong and Liu (2019) explored the effects of the SESEMAT programme on student motivation and interest in Science and Mathematics. Hong and Liu observed a significant correlation between teacher training in the SESEMAT programme and heightened intrinsic motivation among students. Those instructed by SESEMAT-trained educators exhibited greater enthusiasm for classroom engagement, active questioning, and persevering through challenges. Additionally, the study unveiled an enhanced affinity for Science and Mathematics in students taught by SESEMAT-trained teachers, manifested through increased eagerness for reading, video consumption, and extracurricular involvement in these subjects. Moreover, the academic accomplishments of students emerged as notably improved under SESEMAT-trained teachers, evident in higher scores on standardized assessments and superior grades within Science and Mathematics coursework.

Iheanachor's (2007) study in Lesotho investigated the impact of teachers' background, professional development, and teaching methods on students' performance in mathematics and science. The research unveiled a positive association between effective teaching strategies and students' achievements, including the implementation of hands-on activities, encouragement of student inquiry, and promotion of collaborative learning. This aligns with the fundamental principles of the SESEMAT program, suggesting its potential efficacy in improving student outcomes in these subjects. Additionally, Iheanachor's research underscored the substantial influence of teacher background and professional development on student achievement. Experienced educators who received comprehensive training in mathematics and science exhibited greater success in nurturing high-performing students.

Vygotsky (1978) stressed the significance of communication in Science and Mathematics education, advocating for problem-solving and interactive learning experiences. Vygotsky's sociocultural learning theory proposed that children learn through interactions with more knowledgeable individuals, such as teachers, parents, or peers. In Science and Mathematics education, this implies that teachers should create opportunities for collaborative problem-solving tasks and foster dialogue among students and with the teacher. Vygotsky introduced the concept of the "zone of proximal development" to describe the disparity between what a learner can independently accomplish and what they can achieve with guidance. This zone serves as the locus of learning, where students can attain a higher level of understanding with the assistance of a more knowledgeable individual. The implications for Science and Mathematics education include the need for challenging yet attainable learning experiences, scaffolding to support students, and encouragement of collaboration.

Van de Walle (2007) advocated for a learner-centered approach in Mathematics education, departing from traditional teacher-centered methods. He argued that conventional teacher-centered approaches, characterized by passive student listening to lectures, are ineffective for teaching mathematics. Instead, Van de Walle proposed a learner-centered approach, involving active student engagement in the learning process. This approach provides students with opportunities to explore mathematical concepts, solve problems, and collaborate with peers. Van de Walle contended that this approach is more effective in fostering a profound understanding of mathematics. The benefits of a learner-centered approach in mathematics instruction include deeper conceptual understanding, enhanced problem-solving skills, and improved communication abilities through collaborative tasks (Van de Walle, 2007).

Gaps

The existing literature emphasizes the effect of the SESEMAT project on learners’ learning in various regions and contexts. However, there is a gap in explicitly detailing the specific

SESEMAT teaching approaches (ALEI-PIEI) and their direct relationship with student performance in Sciences and Mathematics. Understanding how each component contributes to outcomes is crucial for effective implementation.

While the literature explores the positive impacts of SESEMAT, there is a lack of comparative analysis among different teaching approaches, such as Hands-on, inquiry-based learning (IBL), cooperative learning (CL), problem-based learning (PBL), and learner-centered teaching (LCT).

Studies, like Johnson and Williams (2020), highlight the positive impact of teacher-student relationships (TSRs) on student motivation, there is need for deeper study into the sustained, long-term effects of SESEMAT on student inspiration and engagement in Science and Mathematics.

The literature briefly touches upon the impact of material resources on student performance, particularly in Tshabalala & Ncube (2013). However, there's a gap in detailed exploration of how resource constraints, especially in terms of limited training time for SESEMAT, may influence the acquisition of SESEMAT skills and subsequent student outcomes.

Kim and Chen (2018) briefly touch upon the influence of SESEMAT on teacher attitudes, but there's a need for more comprehensive literature on this aspect. Understanding how SESEMAT impacts teacher enthusiasm, motivation, and classroom dynamics is essential for evaluating its holistic influence on student learning.

Chapter Three: Methodology

3.0 Introduction

This section delineates the research approach employed in this study. As emphasized by Cohen et al. (2018), a robust research methodology not only lends credibility to the study but also ensures scientifically sound findings. It serves as a comprehensive blueprint, guiding researchers in achieving their long-term objectives, addressing pertinent questions, and testing diverse hypotheses. The methodology encompasses the research approach or paradigm, design, study population, sample size determination, sampling strategies, data collection methods, evaluation of instrument reliability and validity, administrative procedures, and the techniques employed for data analysis.

3.1 Research orientation

To comprehensively investigate the research objectives, this study employed a mixed methods research design, combining both quantitative and qualitative data collection and analysis techniques. Quantitative data were acquired through survey questionnaires, while qualitative data were gathered through interviews. This dual-method approach, as advocated by Creswell (2009) and Cohen, Manion, and Morison (2018), enhances the depth of understanding of the research problem compared to using either method in isolation.

The quantitative aspect, according to Apuke (2017), involves describing phenomena through numerical data and measurements, employing statistical techniques to analyze information and emphasize factual details, relationships, and causal connections. The integration of both quantitative and qualitative methods was chosen to leverage the unique strengths of each approach, offering a more comprehensive insight into the research problem.

3.2 Research Design

The research utilized a cross-sectional survey design, aiming to collect data from various participant groups within the same target population at a specific point in time, as outlined by Odiya (2009). The cross-sectional survey design was used in the systematic measurement of variables under consistent conditions. This was important to control for potential variations in conditions that could affect the relationships between the SESMAT teaching approaches and students performance. By measuring these variables simultaneously, the researcher used cross-section design to capture a momentary representation of the research context, thus enabling the analysis of connections and patterns within the data.

3.3 Study population

The core of the study population consisted of Mathematics and Sciences teachers within

selected secondary schools in the Amuru District, specifically within Lamogi Sub-county. The identification of this subgroup was grounded in their pivotal role in delivering education in the subjects under investigation. Their firsthand experiences and insights into the implementation of the SESMAT program, alongside their pedagogical practices, made them a critical sources of informations for this study. In addition to Mathematics and Science teachers, the study includes headteachers within the selected secondary schools in Amuru District, Lamogi Sub-county. Recognizing their administrative and leadership positions, headteachers offered a distinct perspective on the integration and impact of the SESMAT program. Their insights shed light on the organizational and managerial dimensions of the program's implementation, and their involvement was vital in understanding the broader context within which SESMAT was operationalized.

Acknowledging the significance of program implementation oversight, regional SESMAT trainers and coordinators were also identified as a key subset of the study population. These professionals played crucial roles in guiding and supporting the execution of SESMAT within the study area. Their expertise, experiences, and interactions with schools and educators added a valuable layer of understanding to the research. The inclusion of these trainers and coordinators was essential to comprehensively capture the dynamics of the SESMAT initiative.

The study population extended its reach to include learners enrolled in the selected secondary schools in Amuru District. These learners represented the ultimate beneficiaries of the SESMAT program. Their experiences, perceptions, and academic progress provided essential insights into the effectiveness of the program's teaching and learning methodologies. The inclusion of learners ensured a well-rounded examination of SESMAT's impact on its primary beneficiaries.

This study therefore consisted of all the 50 Mathematics and Sciences teachers in secondary schools in Amuru District, Lamogi sub-county, 04 headteachers in secondary schools in Amuru District, Lamogi sub-county, 04 Regional SESMAT trainers and coordinators, and 2600 learners in secondary schools in Amuru District. The identification of these distinct groups within the study population was underpinned by their relevance to the research objectives. Each subgroup possessed unique knowledge, experiences, and perspectives that contributed to a comprehensive exploration of the implementation of SESMAT.

3.4 Sample size Determination

The sample size determination was determined using Morgan and Krejcie (1970) table of sample size selection (Chaokromthong & Sintao, 2021).

Table 2: Sampling Frame

Category of respondent	Target population	Sample size	Sampling Procedure
Headteachers	4	04	Purposive
Regional SESMAT trainers and cordinators	4	04	Purposive
Mathematics and Science teachers	50	50	Purposive
Students	2600	335	Simple random
Total	2658	393	

Source: Primary Data.

3.5 Sampling Techniques

The study employed a combination of simple random sampling and purposive sampling techniques to select participants from different groups. Students from senior one, two, and three, were chosen using simple random sampling. Each individual in the sampling frame was assigned a unique number, and a random number generator facilitated the selection of respondents during data collection. This method ensured equal opportunities for inclusion, enhancing the study's validity and generalizability. In contrast, mathematics and science teachers were purposely selected. Headteachers and regional trainers, serving as key informants, were also selected through purposive sampling to leverage their expertise and assumed proficiency in providing relevant information. Purposive sampling allowed the researcher to consciously choose participants based on their ability to offer specialized insights and comprehensive data, aligning with the research objectives and the need for diverse perspectives. This strategic use of sampling techniques aimed to obtain a holistic view of the research problem while acknowledging methodological limitations and minimizing potential biases.

3.6 Data Collection Methods

In this study, a combination of data collection methods was employed to gather comprehensive information. These methods included surveys and interviews.

Questionnaire survey: Surveys were administered to both teachers and students within the SESMAT system. A structured questionnaire was designed with a closed-ended Likert-scale questions. This allowed participants to rate their experiences with different teaching approaches and provided insights into their perceptions of teaching effectiveness. The surveys were distributed, and participants' responses were collected.

Interviews: Semi-structured interviews guides were conducted with key informants (Headteachers and Regional SESEMAT trainers and coordinators). These interviews aimed to

capture in-depth insights into the institutional aspects of SESMAT teaching approaches and their potential impact on student performance. The semi-structured format provided a framework for guided discussions while allowing participants to elaborate on specific points. Interviews were recorded for later analysis.

3.7 Data Collection Instruments

As stated by Powell, (2022), data collection method pertains to the various approaches used to gather facts, figures, objects, symbols, and events from diverse sources. In this particular study, a combination of primary and secondary data collection was employed. The methods utilized for data gathering included individual in-depth interviews, and self-administered questionnaire, all of which contributed to obtaining the necessary information for this research.

3.7.1 Questionnaire

The questionnaire contained closed-ended and open-ended questions to collect opinions from participants. The questionnaire was used on the basis that the variables under the study could be observed for instance the views, opinions, perceptions, feelings of the respondents, Number of members, or elements in which the researcher was interested. Questionnaires were administered to Science and Mathematics teachers and learners. The advantage of using a questionnaire was that it was easy to code and analyze the data. The choice of employing a questionnaire was motivated by its ability to yield a higher response rate and gather a substantial amount of information from a large sample within a short timeframe. Rensis Likert's (1997) five-point Likert scale, featuring a response continuum ranging from one (1) to five (5) to express varying degrees of agreement, was utilized. The scale includes categories such as 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Undecided (U), 4 = Agree (A), and 5 = Strongly Agree (SA).

3.7.2 Interview Guide

Interviews can be categorized as structured, unstructured, or semi-structured (Bougie & Sekaran, 2019). In structured or semi-structured interviews, there are predetermined questions that each informant is asked (Mannan, & Afni, 2020). On the other hand, unstructured interviews involve open-ended questions that delve deeper into the subject matter. Semi-structured interviews encompass a combination of both structured and unstructured elements.

For the current study, interviews were conducted with headteachers, and Regional SESMAT trainers and coordinators. When feasible, face-to-face verbal discussions were also utilized to collect data. Interview schedules were developed after securing appointments with the respondents. The interviews played a crucial role in eliciting qualitative information relevant

to this study. They helped in clarifying questions and exploring issues related to internal and external factors affecting teacher effectiveness.

3.8 Documentary sources

The research used primary data and secondary data sources.

3.8.1 Primary Data

The study gathered primary data directly from participants, employing a combination of in-depth interviews and questionnaires. Primary data was selected as the sole source because it ensures the accuracy and timeliness necessary for the study, offering the most reliable and current information.

3.8.2 Secondary Data

The research collected secondary data from existing records, reports, and scholarly articles related to SESEMAT. Demographic information, statistical data, and conclusions from prior research were integrated to enhance and contextualized the primary data acquired during the study.

3.9 Quality Control

To control quality, the researcher obtained validity and reliability coefficient.

3.9.1 Validity

This study considered Considered Content Validity (CVI), a type of validity that ensures that the measurements cover all the relevant aspects of the research topic. To establish content validity, the two supervisors (experts) reviewed the measurement tools to ensure they comprehensively represent the construct being studied to ensure it was deem fit for data collection. The data collection instruments were pr-tested to test the validity and identification of possible problem before employment was done. The researcher therefore used the formula below to calculate the CVI.

$$\text{CVI} = \frac{Numbers\ of\ items\ decalred\ relevants\ by\ experts}{Total\ numbers\ of\ items}$$

CVI = 0.85

According to Cresswell (2014), if the CVI of an instrument is = 0.70 or above then the instrument is considered to be valid and therefore acceptable.

3.9.2 Reliability

Prior to data collection, this study took meticulous steps to assess the reliability of the data collection tools. Reliability, as defined by Saunders et al. (2018), pertains to the degree to which data collection techniques or analysis procedures yield consistent results. To ensure the

reliability of the instruments employed in this research, the internal consistency method advocated by Mugenda and Mugenda (1999) was applied. An internal variable reliability exceeding 0.7 was deemed adequately reliable for the study, aligning with the recommendations of Sekaran (2003) and Mugenda (2003), who propose an overall Cronbach's alpha coefficient of 0.700 as an optimal threshold for a reliable instrument. In this study, Cronbach's alpha (α) coefficient of reliability was utilized to assess the reliability of the research instrument. The calculations were performed using the Statistical Package for Social Sciences (SPSS) computer program, and the reliability was computed based on the acquired data.

Table 3: Reliability Test Analysis

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.927	.938	67

According to Geliel and Gleil (2003), the rule of thumb is that a reliability coefficient of 0.70-0.79 is acceptable an 0.80 -1.00 is considered excellence. Therefore, the Cronbach's Alpha (based on standardized items) of 0.938 is acceptable and excellent.

3.10 Ethical Consideration

In order to adhere to the research code of conduct, the consent of all participants was sought before they participate in the research. A consent was sought before the data collection. The study addressed ethical concerns regarding safety, confidentiality, voluntary participation, privacy, and anonymity were the key ethical issues addressed in this research.

To safeguard confidentiality, participants were given the option to refrain from sharing any sensitive information that they found uncomfortable. The information supplied by the participants was handled with the highest degree of confidentiality. Privacy was preserved by permitting respondents to complete the questionnaires in private spaces, shielded from disruptions or external pressures. Anonymity was ensured by conscientiously structuring the research tools to prevent the disclosure of respondents' names and workplaces in any manner.

The participation of respondents in the study was entirely voluntary, ensuring that they were not coerced or obligated to take part against their will. This approach helped to maintain ethical standards and protect the rights and well-being of all participants, especially learners.

3.11 Administration Procedure

Before the initiation of data collection, a letter was secured from the Dean of the Faculty of Education and Humanity at Gulu University, introducing the researcher and outlining the

study's purpose. This letter was presented to the heads of the chosen schools in Amuru to seek permission for the researcher to conduct the study on their premises. Research assistants were enlisted and trained to aid the researcher in administering the questionnaire due to the large number of respondents. Preliminary visits to the selected schools were conducted to schedule appointments, brief respondents, and establish rapport. All scheduled appointments were adhered to as planned. In the event of unavoidable circumstances necessitating rescheduling, the concerned administrators were contacted from the staff rooms during working hours, and new appointments were promptly arranged.

3.12 Data Analysis

Descriptive and inferential statistics with the help of statistical package for social scientist (SPSS version 25) were used to analyse data. Mbabazi (2008). Research objective one and two were specifically anlysed using descriptive and (Analysis of Variances) ANOVA statistics. The study aimed to discern variations and differences in the variables related to distinct groups within the dataset.

Pearson correlation coefficient and the multivariate regression analysis was used to analysed research objective three. Pearson correlation along with multivariate regression analysis were employed to explore associations and predictive capacities. Together, these analytical approaches formed a robust methodology for addressing the distinct aspects of each research variables. This was considered the most suitable statistic in the measurement of predictive capacity Amin, (2005), Onen (2016).

3.13 Limitation and Delimitation

During the study, the researcher faced several challenges that contributed to the study's limitations. The strategies devised to address these limitations are considered delimitations. One significant challenge involved certain respondents expressing reluctance to answer the questions, even though assurances were provided that the data collected would be used solely for research purposes and treated with utmost confidentiality. To tackle this issue, the researcher obtained an introductory letter from the institution.

Some respondents were not willing to show cooperation to be interviewed. The researcher tried to convince respondents to fill the questionnaires at their own free time.

Much as the researcher faced challenges of getting a convenient time from the respondents to answer the questionnaires, the researcher allowed the respondents to take the questionnaire form and filled in at their free and convenient time, which lead to delay in data collections.

Chapter Four: Data Presentation, Interpretation and Analysis

4.0 Introduction

Data collection involved the utilization of both quantitative and qualitative research instruments, aligning with the study objectives outlined in the initial chapter of this dissertation. The initial section of this chapter delineates the response rate, the subsequent section offers background information about the respondents, and the final section presents descriptive and inferential statistical results in accordance with the study objectives.

4.1 Response Rate

The response rate, also termed completion rate or return rate in survey research, denotes the proportion of individuals who responded to the questionnaire divided by the total number of individuals in the sample. Typically expressed as a percentage, a low response rate, as indicated by Amin (2005), introduces sampling error. Table 4 below provides the breakdown of the response rate in this study.

Table 4: Response Rate

Response	Questionnaire	Interview	Total	Percent
Number of Survey Instruments Returns	373	08	381	96.7
Number of Survey Instruments not returns	12	01	13	3.3
Total Supplied	385	09	394	100

As per the information in Table 4, among the 394 survey instruments distributed, 381 were returned fully completed. The overall response rate from the respondents stood at 96.7%, signifying a high level of participation in the study. This high response rate suggests that the study's findings are representative of the actual population, allowing for generalization, as emphasized by Sekaran (2003). It's important to note that key informants, including Regional SESMAT Trainers and coordinators, Headteachers, Mathematics, and Science Teachers, were involved in the interviews.

4.2 The Socio Demographic Data of the Respondents

4.2.1 Teachers Respondents

Table 5: Socio demographic data for teachers

		Frequency	Percent (%)
Gender	Male	38	79.2%
	Female	10	20.8%
	Total	48	100.0%
Type of school	Mixed day government school	1	2.1%
	Mixed boarding government aided	29	60.4%
	Mixed day private school	1	2.1%
	Mixed boarding private school	10	20.8%
	Total	41	100.0%
Age bracket	20-30 years	17	35.4%
	31-40 years	23	47.9%
	41-50 years	7	14.6%
	51-60 years	1	2.1%
	Total	48	100.0%
Academic qualification	Master degree	3	6.3%
	Bachelor's degree	24	50.0%
	Diploma in education	21	43.8%
	Total	48	100.0%
Experiences	Less than 2 years	13	27.1%
	2-5 years	22	45.8%
	6-10 years	13	27.1%
	Total	48	100.0%

The study collected data on the gender of the respondents to explore potential variations in opinions between male and female participants regarding the study's constructs. Table 5 provides an overview of the participation of both male and female teachers in the research. The results indicate that females comprised 20.8% (10), while males constituted 79.2% (38) of the total respondents. The findings reveal a predominance of male teachers, accounting for 79.2% of the participants. This suggests a higher enrollment of males in teaching Mathematics and science subjects at the secondary level.

The table also provides information on the type of schools the teachers belonged to. The majority of the teachers, 60.4% (29), were from mixed boarding government aided schools, while 20.8% (10) were from mixed boarding private schools. The remaining teachers were from mixed day government schools 2.1% and mixed day private schools 2.1%.

In terms of age bracket, the majority of the teachers were between 31-40 years old, making up 47.9% (23) of the total respondents, followed by those aged between 20-30 years old, which made up 35.4% (17) of the total respondents. The least represented age group was those between 51-60 years old, which accounted for only 2.1% (1) of the total respondents.

Regarding academic qualifications, the majority of the teachers, 50% (24), had a Bachelor's degree, while 43.8% (21) had a Diploma in Education. Only a small percentage, 6.3% (3), had a Master's degree, while none had a postgraduate diploma.

Finally, the data also shows the distribution of teaching experience among the respondents. The majority of the teachers, 45.8% (22), had been teaching for 2-5 years, while 27.1% (13) had less than 2 years of experience and another 27.1% (13) had been teaching for 6-10 years.

4.2.2 Student's Respondents

Table 6: Socio demographic data for students

		Frequency	Percent (%)
Gender	Male	195	60.0%
	Female	130	40.0%
	Total	325	100.0%
Class	Senior One	44	13.5%
	Senior Two	158	48.6%
	Senior Three	123	37.8%
	Total	325	100.0%
School	School 1	122	37.5%
	School 2	55	16.9%
	School 3	84	25.8%
	School 4	64	19.7%
	Total	325	100.0%

The table 6 provides information on the socio-demographic characteristics of the students who participated in the study. The data shows that 60% (195) of the students were male, while 40% (130) were female.

In terms of class, the majority of the students, 48.6% (158), were in Senior Two, followed by 37.8% (123) in Senior Three and 13.5% (44) in Senior One.

The data also shows the distribution of students across different schools. The majority of the students, 37.5% (122), were from School 1, followed by 25.8% (84) from School 3, 19.7% (64) from School 4, and 16.9% (55) from School 2.

4.3 The level of implementation of SESEMAT Teaching approaches

The first objective of this study aimed to assess the implementation status of SESEMAT Teaching approaches of ALEI-PIEI in Secondary schools within Lamogi Sub-county, Amuru District. The results of this investigation are conveyed through both descriptive and inferential statistics, as illustrated in Table 7 below.

Table 7: Teaching approaches for teachers and students

Activity based teaching	SA %	A %	SA+A %	NS %	D %	SD %	D+SD %	Ratio $\frac{(SA+A)}{(D+SD)}$
The school use activities in teaching	34.3%	52.8%	87.1%	1.3%	4.3%	4.6%	8.8%	9.9%
Learners are given assignments in class	43.7%	47.2%	90.9%	2.1%	2.4%	1.6%	4.0%	22.7%
Our teaching —learning is dominated with activities	29.2%	48.3%	77.5%	5.1%	7.5%	4.6%	12.1%	6.4%
Feedback on the class activities are given	32.2%	50.1%	82.3%	3.8%	5.4%	3.8%	9.1%	9.0%
Average	33.7%	48.5%	82.1%	3.6%	6.3%	4.0%	10.2%	
Learner centred — teaching								
Learners are involved in teaching and learning	43.2%	45.0%	88.2%	2.9%	2.7%	3.2%	5.9%	14.9%
Learners take the lead in teaching and learning.	28.2%	45.6%	73.7%	4.8%	11.3%	5.4%	16.6%	4.4%
Learners participate actively in classes.	44.5%	46.1%	90.6%	1.6%	1.9%	1.9%	3.8%	23.8%
Teachers engage all learners in class.	37.5%	45.3%	82.8%	5.9%	4.6%	2.1%	6.7%	12.4%
Our curriculum encourages learners to contribute.	44.0%	39.7%	83.6%	4.3%	5.6%	3.2%	8.8%	9.5%
Average	38.0%	45.8%	83.8%	4.0%	5.3%	2.9%	8.2%	10.2%
Encouragement / Learner support								
Teachers encourage all leaners in class.	39.1%	49.3%	88.5%	1.6%	1.6%	3.5%	5.1%	17.4%
Teachers use friendly language in class.	35.1%	46.9%	82.0%	5.4%	4.6%	3.2%	7.8%	10.5%
There is use of reward as encouragement.	23.1%	41.8%	64.9%	7.0%	12.6%	9.7%	22.3%	2.9%
Teachers encourage learners to perform well.	44.8%	43.4%	88.2%	2.4%	3.5%	2.1%	5.6%	15.8%
Average	36.3%	43.7%	80.0%	4.7%	5.6%	4.3%	9.9%	8.1%
Improvisation								
Teachers improvise in teaching.	25.7%	51.2%	76.9%	6.2%	5.6%	4.8%	10.5%	7.3%
Teachers use local learning teaching aids	23.3%	45.6%	68.9%	7.0%	11.3%	5.6%	16.9%	4.1%
Teacher create new explanation	30.3%	50.1%	80.4%	4.8%	4.3%	2.7%	7.0%	11.5%
Average	30.1%	47.8%	77.8%	4.7%	6.8%	4.0%	10.8%	7.2%
Planning								
Teaching have scheme of work.	35.9%	41.8%	77.7%	5.6%	6.4%	5.1%	11.5%	6.8%
Teachers plan every lesson.	38.1%	41.3%	79.4%	6.2%	4.8%	3.2%	8.0%	9.9%
Teachers use appropriate teaching methods.	42.1%	41.0%	83.1%	3.5%	3.8%	2.9%	6.7%	12.4%
Teachers teach us planed	35.1%	46.1%	81.2%	5.1%	5.6%	3.8%	9.4%	8.6%
Average	38.6%	42.9%	81.5%	4.5%	4.6%	3.9%	8.4%	9.7%
Evaluation / Consolidation								
Teachers give time to the learners to asked and seek clarification during and after the lesson.	48.8%	41.0%	89.8%	2.1%	1.9%	3.5%	5.4%	16.6%
Teachers evaluate all learners	27.3%	52.3%	79.6%	4.3%	6.7%	3.5%	10.2%	7.8%
Teachers assess and give feedback	36.7%	46.1%	82.8%	2.4%	5.6%	3.2%	8.8%	9.4%
Teachers use evaluation for decision making	26.5%	49.3%	75.9%	7.0%	7.2%	3.5%	10.7%	7.1%
Teachers evaluation is supervised	27.1%	45.6%	72.7%	5.9%	9.9%	6.2%	16.1%	4.5%
Average	32.7%	46.7%	79.4%	4.7%	6.5%	4.0%	10.5%	7.6%
Improvement								
Teachers use appropriate improvement schedule	24.7%	56.6%	81.2%	5.9%	4.6%	3.8%	8.3%	9.8%
Teachers are aware of students improvement	37.8%	49.9%	87.7%	2.4%	2.7%	2.4%	5.1%	17.2%
Teachers do correction and follow up	40.2%	42.4%	82.6%	4.6%	4.8%	4.3%	9.1%	9.1%
Teachers recognized students' improvement	36.7%	46.4%	83.1%	4.8%	4.6%	2.7%	7.2%	11.5%
Average	37.9%	45.9%	83.8%	4.3%	4.0%	3.4%	7.4%	11.3%
Teaching Approaches Average	35.7%	45.4%	81.0%	4.5%	5.5%	3.7%	9.2%	

On average, approximately 35.7% of respondents strongly agree with the statements, around 45.4% of respondents agree with the statements. Therefore, on average, about 81% of respondents either strongly agree or agree with the teaching approaches. However, on average, 9.2% of respondents either disagree or strongly disagree with the statements, of which around

5.5% of respondents disagree and, about 3.7% of respondents strongly disagree with the activities. Approximately 4.5% of respondents neither agree nor disagree with the activities.

Under Activity based teaching approach, the result showed that 34.3% of the respondents strongly agree, 52.8% agree, 1.3% were neutral, 4.3% of the respondents disagree, and 4.6% strongly disagree that school use activities in teaching. The high ratio value of 9.9% indicates a strong level of support for the school's use of activities in teaching.

The majority of the respondents agreed that learners are given assignments in class, with 90.9% indicating agreement. Among those who agreed, 43.7% strongly agreed, and 47.2% agreed. Meanwhile, only 2.1% were neutral, and 4.0% disagreed, with 2.4% indicating disagreement, and 1.6% strongly disagreeing. The high ratio value of 22.7% indicates a strong level of agreement for learners are given assignments in class.

The teaching-learning is dominated with activities, with 77.5 indicating agreement. Among those who agreed, 29.2% strongly agreed, and 48.3% agreed. Meanwhile, 5.1% were neutral, and 12.1% disagreed, with 7.5% indicating disagreement, and 4.6% strongly disagreeing. The ratio value of 6.4% indicates a strong level of support for teaching-learning is dominated with activities.

Feedback on the class activities is given 82.3% indicating agreement of which 32.2% strongly agreed, and 50.1% agreed. 3.8% were neutral, and 9.1% disagreed, and 3.8% strongly disagreeing. The high ratio value of 9.0% indicates a strong level of agreement for feedback on the class activities.

This was confirmed when one of the Headteachers said that;

> *"Teachers diligently prepare and provide activity sheets for learners, aligning them with each lesson conducted. The feedback provision and the proactive approach of educators fosters an environment conducive to effective learning and continuous improvement. The collective commitment to constructive feedback ensures that learners are supported in their academic journey, promoting a thriving educational experience for all involved.".*

This implies that the learners are involved in teaching and learning processes and feedback are being given to the learners to provides room for improvement. This means that there is adequate implementation of SESEMAT teaching methods especially in leaners participation.

For the item "Learners are involved in teaching and learning", the result showed that 43.2% of the respondents strongly agree, 45.0% agree, 2.9% were neutral, 2.7% of the respondents

disagree, and 3.2% strongly disagree. A total of 88.2% (SA+A) agreed that learners are involved in teaching and learning.

28.2% of the respondents strongly agree, 45.6% agree, 4.8% were neutral, 11.3% of the respondents disagree, and 5.4% strongly disagree, implying 73.7% agreed that learners take the lead in teaching and learning. 44.5% of the respondents strongly agree, 46.1% agree, 1.6% were neutral, 1.9% of the respondents disagree, and 1.9% strongly disagree. The majority 90.6% agreed that learners participate actively in classes.

This was confirmed by one of the Headteachers that;

> *"The learners' attitude towards the ALEI-PIEI approach is notably positive, reflecting their receptiveness and enthusiasm for this innovative teaching methodology. Engaging students actively in the learning process is a key element of this approach. The ALEI-PIEI approach empowers learners to take charge of their learning journey. This sense of ownership nurtures a deeper understanding and appreciation for the subject matter".*

This implies that there is active participation of learners which has led to academic improvement.

Teachers engage all learners in class was strongly agree upon by37.5%, 45.3% agree, 5.9% were neutral, 4.6% of the respondents disagree, and 2.1% strongly disagree, indicating that 82.8% agreed that teachers engage all learners in class. 44.0% of the respondents strongly agree, 39.7% agree, 4.3% were neutral, 5.6% of the respondents disagree, and 3.2% strongly disagree, hence 83.6% agreed that the curriculum encourages learners to contribute.

In the interview, one of the headteacher pointed out that;

> *"ALEI-PIEI approach enhances the teaching and learning of science in school because it due to the fact that it is learner-centered. The ALEI-PIEI approach serves as a transformative force in the realm of science education within schools due to its fundamental focus on being learner-centered. This innovative methodology redefines the traditional teaching paradigm by placing the learner at the very heart of the educational process. Such an approach recognizes that each student possesses unique strengths, learning styles, and interests that shape their individual understanding of scientific concepts".*

Yet another added that;

> *"SESEMAT approach of teaching involves both the leaners and learners to be active and the learners own the lesson. Comprehensive and dynamic methodology that places equal emphasis on the active participation of both teachers and learners. This innovative approach fosters a learning environment where students are not passive recipients of information but active co-creators of knowledge."*

Adopting the learners centered approach has contributed to more meaningful and effective learning experiences, promoted student engagement, motivation, and overall academic performance.

Encouragement approaches revealed that 39.1% of the respondents strongly agree, 49.3% agree, 1.6% were neutral, 1.6% of the respondents disagree, and 3.5% strongly disagree, revealing that 88.5% agreed that teachers encourage all learners in class.

Regarding teachers using friendly language in class, 35.1% of the respondents strongly agree, 46.9% agree, 5.4% were neutral, 4.6% of the respondents disagree, and 7.8% strongly disagree. Also, 23.1% of the respondents strongly agree, 41.8% agree, 7.0% were neutral, 12.6% of the respondents disagree, and 9.7% strongly disagree that there is the use of rewards as encouragement. For teachers encouraging learners to perform well, 44.8% of the respondents strongly agree, 43.4% agree, 2.4% were neutral, 3.5% of the respondents disagree, and 2.1% strongly disagree.

However, one of the headteacher believed that;

> *"Not all science and mathematic teachers are competent enough because they still use the old system of teacher, teacher-centered methods of teaching. This discrepancy highlights the importance of addressing pedagogical practices within the context of science and math education. While a significant proportion of teachers may be actively engaging in discussions and rectifying misconceptions, there remains a need to address the challenges posed by teachers who persist with traditional teaching approaches.".*

Effective teaching involved balance and integration of both proven and innovative approaches, recognizing the strength and weaknesses of different teaching methods allow teachers to create dynamic and responsive learning environment. This therefore implies that inadequate use of new teaching methods had limited diverse need of learners and goals of SESEMAT.

On the improvision approaches, 25.7% of the respondents strongly agree, 51.2% agree, 6.2% were neutral, 5.6% of the respondents disagree, and 4.8% strongly disagree. This revealed that 76.9% agreed that teachers improvise in teaching. 23.3% of the respondents strongly agree, 45.6% agree, 7.0% were neutral, 11.3% of the respondents disagree, and 5.6% strongly disagree that teachers use local learning teaching aids. 30.3% of the respondents strongly agree, 50.1% agree, 4.8% were neutral, 4.3% of the respondents disagree, 2.7% strongly disagree, and a total of 80.4% agreed that teachers create new explanation.

However, one of the Regional SESEMAT trainers & coordinators said that;

> *"ALEI-PIEI approach has not been utalized because many science teachers always failed to improvise the local materials during practicals lessons. The underutilization of the ALEI-PIEI approach can be attributed to the persistent failure of many science teachers to incorporate local materials effectively during practical lessons. Despite the potential benefits of the ALEI-PIEI approach in enhancing science education, its successful implementation relies heavily on the ability of teachers to adapt and improvise with locally available resources".*

The use of local learning material in teaching make learning more relevant, engaging for the learners. This therefore, implies that inadequate use of local learning materials by teachers during teaching-learning process has led to inadequate implementation of SESEMAT teaching approaches.

Planning approaches showed that 35.9% of the respondents strongly agree, 41.8% agree, 5.6% were neutral, 6.4% of the respondents disagree, and 5.1% strongly disagree that teacher have a scheme of work. 38.1% of the respondents strongly agree, 41.3% agree, 6.2% were neutral, 4.8% of the respondents disagree, 3.2% strongly disagree, and 79.4% agreed that teachers plan every lesson.

The result also revealed 42.1% of the respondents strongly agree, 41.0% agree, 3.5% were neutral, 3.8% of the respondents disagree, and 2.9% strongly disagree that teachers use appropriate teaching methods. 35.1% of the respondents strongly agree, 46.1% agree, 5.1% were neutral, 3.8% disagree, and 9.4% strongly disagree, and 81.2% of the respondents agreed that teachers teach planned.

However, Regional SESEMAT trainers & coordinators said that;

> *"Teachers find it tedious to prepare lesson plans and achieving sheets for every lesson they teach. The task of preparing lesson plans and achieving*

sheets for every lesson can indeed be challenging and time-consuming for teachers. This burden can arise due to several factors that impact the teaching process.

Firstly, teachers must ensure that their lesson plans align with the curriculum requirements and learning objectives set by educational authorities. This necessitates careful consideration of the content, activities, and assessments to be included in each lesson to facilitate effective learning.

Secondly, the need to cater to diverse student needs adds complexity to the preparation process. Teachers must differentiate their instruction to accommodate various learning styles, abilities, and interests within the classroom."

The used of lesson plan and scheme of work are the most crucial element in effective curriculum implementation because they serve as road maps for teachers and help to ensure that learning objectives are achieved. When lesion plan and scheme of work are inadequately used, it has therefore impacted on the implementation of SESEMAT teaching approaches.

Evaluation / consolidation, revealed 48.8% of the respondents strongly agree, 41.0% agree, 2.1% were neutral, 1.9% disagree, and 5.4% strongly disagree, 89.8% of the respondents agreed that teachers give time to learners to ask and seek clarification during and after the lesson. 27.3% of the respondents strongly agree, 52.3% agree, 4.3% were neutral, 6.7% disagree, and 10.2% strongly disagree, and a total of 79.6% of the respondents agreed that teachers evaluate all learners. 36.7% of the respondents strongly agree, 46.1% agree, 2.4% were neutral, 5.6% disagree, and 8.8% strongly disagree, and 82.8% of the respondents agreed that teachers assess and give feedback.

For the statement "Teachers use evaluation for decision making," 26.5% of the respondents strongly agree, 49.3% agree, 7.0% were neutral, 7.2% disagree, and 3.5% strongly disagree. Also, 27.1% of the respondents strongly agree, 45.6% agree, 5.9% were neutral, 9.9% of the respondents disagree, and 6.2% strongly disagree, 72.7% agreed that teachers' evaluation is supervised.

Improvement approach revealed that 24.7% of the respondents strongly agree, 56.6% agree, 5.9% were neutral, 4.6% of the respondents disagree, and 3.8% strongly disagree, 81.2% agreed that teachers use appropriate improvement schedule. 37.8% of the respondents strongly agree, 49.9% agree, 2.4% were neutral, 2.7% of the respondents disagree, and 2.4% strongly disagree that teachers are aware of students' improvement.

Teachers do correction and follow up were strongly agree by 40.2%, 42.4% agree, 4.6% were neutral, 4.8% of the respondents disagree, and 4.3% strongly disagree, 82.6% agreed that teachers do correction and follow up. 36.7% of the respondents strongly agree, 46.4% agree, 4.8% were neutral, 4.6% of the respondents disagree, and 2.7% strongly disagreed that teachers recognized students' improvement.

Table 8: ANOVA analysis for Level of implementation of SESMAT teaching approaches

Level of SESMAT Teaching Approaches							
	Mean	Std. Deviation	Std. Error	95% Confidence Interval		Minimum	Maximum
Schools				Lower Bound	Upper Bound		
School 1	3.9170	0.4700	0.0665	3.7834	4.0506	2.78	4.93
School 2	4.2724	0.3365	0.0442	4.1840	4.3609	2.95	4.90
School 3	4.1209	0.4538	0.0501	4.0212	4.2206	2.61	4.91
School 4	3.6235	0.7331	0.0916	3.4403	3.8066	1.78	5.00
Teachers' qualification							
Master degree	4.2713	0.1806	0.1043	3.8226	4.7200	4.07	4.42
Bachelor degree	4.2429	0.2455	0.0501	4.1393	4.3466	3.72	4.73
Diploma	4.2106	0.4631	0.1011	3.9998	4.4214	2.95	4.91
Teachers' experiences							
less than 2 years	4.2265	0.2570	0.0713	4.0712	4.3818	3.74	4.62
2-5 years	4.1685	0.4242	0.0904	3.9805	4.3566	2.95	4.90
6-10 years	4.3396	0.2809	0.0779	4.1698	4.5093	4.00	4.91
Class							
Senior One	3.6490	0.6682	0.1019	3.4433	3.8546	1.78	4.90
Senior Two	4.0371	0.5610	0.0504	3.9373	4.1368	2.28	4.93
Senior Three	4.0738	0.4624	0.0493	3.9758	4.1718	2.37	4.91

The table presents ANOVA statistics for the "Level of implementation of SESMAT Teaching Approaches" across schools, teachers' qualification, teachers' experience, and classes. The implementation level is summarized using measures such as mean, standard deviation, standard error, and confidence intervals for the mean. These statistics offer valuable insights into the variations and characteristics of the implementation levels within each group.

Among the schools, school 2 demonstrates the highest mean implementation level at 4.2724, with a relatively low standard deviation of 0.33645, indicating that the majority of implementation scores are relatively close to the mean. The confidence interval for the mean (4.1840 to 4.3609) further supports this.

School 3 also displays a substantial mean implementation level of 4.1209, accompanied by a standard deviation of 0.45375. The narrower confidence interval (4.0212 to 4.2206) underscores the precision of the estimate of the population mean.

School 1 and School 4 on the other hand, show comparatively lower mean implementation levels of 3.9170 and 3.6235, respectively. The wider confidence intervals for these groups (e.g., 3.7834 to 4.0506 for School 1 and 3.4403 to 3.8066 for school 4) suggest greater uncertainty about the true population mean.

In conclusion, the ANOVA statistics showed that School 2 4.27 had the highest level of implementation of SESMAT, followed by School 3 4.12, followed School 1 3.92, and school 4 3.62 with the lowest level of implementation of SESMAT Teaching Approaches across the different schools.

Among teachers' qualifications, "Master degree" mean implementation level is found to be 4.2713. The relatively low standard deviation of 0.18064 indicates that the implementation scores tend to be close to the mean. The narrow confidence interval (3.8226 to 4.7200) suggests a high level of certainty about the true population mean for this group.

Among teachers possessing a "Bachelor degree", the mean implementation level stands at 4.2429. The standard deviation of 0.24554 implies a relatively moderate spread of scores around the mean. The confidence interval (4.1393 to 4.3466) reflects reasonable confidence in the accuracy of our estimate.

For teachers with a "Diploma", the mean implementation level is recorded as 4.2106. With a higher standard deviation of 0.46306, there is greater variability in implementation scores. The confidence interval (3.9998 to 4.4214) indicates some level of uncertainty about the true population mean.

In summary, the ANOVA statistics showed that teachers with master degree had the highest level of implementation of SESMAT 4.27, followed by teachers with bachelor degree 4.24, and teachers with diploma 4.23 with the lowest level of implementation of SESMAT Teaching Approaches among different qualification level.

Across different groups based on teachers' years of experience. This analysis aims to explore the potential impact of teachers' varying levels of experience on the implementation of SESMAT teaching approaches. When focusing on teachers with "less than 2 years" of experience, the mean implementation level is reported as 4.2265. The standard deviation of 0.25698 indicates a relatively tight distribution of implementation scores around the mean. The

confidence interval (4.0712 to 4.3818) signifies a high degree of confidence in the estimated population mean.

For those with "2-5 years" of experience, the mean implementation level is 4.1685. With a standard deviation of 0.42419, there is a moderate level of variability in implementation scores within this group. The confidence interval (3.9805 to 4.3566) suggests reasonable confidence in the precision of the estimated population mean.

Among teachers with "6-10 years" of experience, the mean implementation level is 4.3396. The standard deviation of 0.28093 implies a relatively narrow distribution of scores around the mean. The confidence interval (4.1698 to 4.5093) indicates reasonable confidence in the accuracy of the estimated population mean.

In summary, the ANOVA statistics showed that teachers with 6-10 years experience had the highest level of implementation of SESMAT 4.33, followed by teachers with less-than 2 years 4.23, and teachers with 2-5 years 4.17 with the lowest level of implementation of SESMAT Teaching Approaches among different experience level.

The "Level of Implementation of SESMAT Teaching Approaches" based on class. For "Senior One" the mean implementation level is 3.6490. The relatively high standard deviation of 0.66818 suggests a wide spread of implementation scores within this group. The standard error of 0.10190 reflects the variability of the sample mean.

Among "Senior Two" the mean implementation level is 4.0371. The standard deviation of 0.56099 indicates a moderate amount of variability in the implementation scores. The standard error of 0.05038 represents the variability of the sample mean.

For "Senior Three", the mean implementation level is 4.0738. The standard deviation of 0.46238 implies a moderate level of variability in the implementation scores. The standard error of 0.04929 characterizes the variability of the sample mean.

In summary, the ANOVA statistics showed that senior three had the highest level of implementation of SESMAT 4.07, followed by senior two 4.04, and senior one 3.65 with the lowest level of implementation of SESMAT Teaching Approaches among different classes.

4.4 The level of students' performances in Sciences and Mathematics

The objectives two of this study was to assess the level of students' performances in Sciences and Mathematics in Lamogi Sub-county, Amuru District. The findings of this study are presented using descriptive statistics and inferential statistics.

Table 9: Academic performance

Grade at UCE	SA %	A %	SA+A %	NS %	D %	SD %	D+SD %	Ratio $\frac{(SA+A)}{(D+SD)}$
Students' grades are generally excellent.	25.5%	41.0%	66.5%	3.8%	12.3%	7.2%	19.6%	3.4%
Students' grades are good.	28.7%	45.0%	73.7%	4.6%	9.1%	3.2%	12.3%	6.0%
Students' grades are moderate.	20.4%	46.1%	66.5%	7.5%	12.6%	3.5%	16.1%	4.1%
Students' grades are fair.	18.0%	30.8%	48.8%	6.4%	24.9%	6.7%	31.6%	1.5%
Students' grades are poor.	13.4%	21.2%	34.6%	6.2%	19.6%	27.1%	46.6%	0.7%
Average	21.2%	36.8%	58.0%	5.7%	15.7%	9.5%	25.2%	2.3%
Continuous assessment								
Performance in continuous assessment is excellent.	30.8%	37.5%	68.4%	5.4%	11.5%	5.4%	16.9%	4.0%
There is continuous assessment in this school.	32.2%	47.7%	79.9%	2.9%	3.8%	4.0%	7.8%	10.2%
Performance in continuous assessment is good.	31.4%	45.8%	77.2%	4.6%	5.6%	3.8%	9.4%	8.2%
Performance in continuous assessment is moderate.	19.3%	48.0%	67.3%	6.2%	11.0%	3.5%	14.5%	4.6%
Performance in continuous assessment is fair.	13.9%	33.0%	46.9%	6.4%	26.0%	6.4%	32.4%	1.4%
Performance in continuous assessment is poor.	16.6%	25.2%	41.8%	4.8%	20.6%	22.0%	42.6%	1.0%
Average	26.9%	40.1%	67.0%	4.8%	11.2%	6.2%	17.4%	3.9%
Exercises								
Teachers give exercises after lessons.	44.5%	40.8%	85.3%	2.7%	3.2%	2.9%	6.2%	13.8%
Students answer all questions in exercises.	30.8%	43.7%	74.5%	5.9%	8.6%	2.9%	11.5%	6.5%
The exercise are evaluated	27.9%	47.7%	75.6%	7.5%	5.9%	2.1%	8.0%	9.5%
Feedbacks on exercise are prompt.	29.8%	46.4%	76.1%	4.6%	8.0%	1.9%	9.9%	7.7%
Performance in the exercises is excellent	32.4%	41.3%	73.7%	4.3%	8.3%	4.6%	12.9%	5.7%
Performance in the exercises is good	26.8%	50.4%	77.2%	4.6%	7.0%	2.1%	9.1%	8.5%
Performance in the exercises is moderate	22.0%	42.9%	64.9%	6.4%	13.4%	3.5%	16.9%	3.8%
Performance in the exercises is fair	16.6%	31.9%	48.5%	7.5%	22.0%	10.2%	32.2%	1.5%
Performance in the exercises is poor	18.2%	19.6%	37.8%	6.4%	20.9%	24.9%	45.8%	0.8%
Average	27.7%	40.5%	68.2%	5.5%	10.8%	6.1%	16.9%	4.0%
Academic performance Average	25.9%	39.5%	65.4%	5.3%	12.0%	6.9%	19.0%	

On average, approximately 25.9% of respondents strongly agree with the statements, around 39.5% of respondents agree with the statements. Therefore, on average, about 65.4% of respondents either strongly agree or agree with the statements. However, on average,19.0% of respondents either disagree or strongly disagree with the statements, of which around 12% of

respondents disagree and, about 6.9% of respondents strongly disagree with the statements. Approximately 5.3% of respondents neither agree nor disagree with the statements.

Under Grade at UCE, the result showed that 25.5% of the respondents strongly agree, 41.0% agree, 3.8% were neutral, 12.3% of the respondents disagree, and 7.2% strongly disagree that our students' grades are generally excellent. The finding revealed that a total 66.5% agreed that our students' grades are generally excellent. The ratio value of 3.4% indicates a strong level of agreement or support for students' grades are generally excellent.

Similarly, 28.7% strongly agree, 45.0% agree, 4.6% were neutral, 9.1% of the respondents disagree, and 3.2% strongly disagree. The ratio value of 6.0% indicates a strong level of agreement or support for students' grades are generally good.

Also, 20.4% strongly agree, 46.1% agree, 7.5% were neutral, 12.6% of the respondents disagree, and 3.5% strongly disagree. The ratio value of 4.1% indicates a strong level of agreement or support for students' grades are generally moderate. 18.0% strongly agree, 30.8% agree, 6.4% were neutral, 24.9% of the respondents disagree, and 6.7% strongly disagree. Overall, 48.8% agreed that our students' grades are fair. The ratio value of 1.5% indicates a low level of agreement or support for students' grades are generally fair.

The result also showed that 13.4% strongly agree, 21.2% agree, 6.2% were neutral, 19.6% of the respondents disagree, and 27.1% strongly disagree. The ratio value of 0.7% indicates no agreement or support for students' grades are generally poor.

Continuous assessment result showed that 30.8% of the respondents strongly agree, 37.5% agree, 5.4% were neutral, 11.5% of the respondents disagree, and 5.4% strongly disagree that performance in continuous assessment is excellent. Therefore, a total 68.4% agreed that performance in continuous assessment is excellent. 32.2% of the respondents strongly agree, 47.7% agree, 2.9% were neutral, 3.8% of the respondents disagree, and 4.0% strongly disagree that there is continuous assessment in this school.

The result also indicated that 31.4% of the respondents strongly agree, 45.8% agree, 4.6% were neutral, 5.6% of the respondents disagree, and 3.8% strongly disagree that performance in continuous assessment is good. 19.3% of the respondents strongly agree, 48.0% agree, 6.2% were neutral, 11.0% of the respondents disagree, and 3.5% strongly disagree that performance in continuous assessment is moderate, and a total 67.3% agreed that performance in continuous assessment is moderate.

Performance in continuous assessment was fair as the result showed that 13.9% of the respondents strongly agree, 33.0% agree, 6.4% were neutral, 26.0% of the respondents

disagree, and 6.4% strongly disagree that Performance in continuous assessment is fair. 16.6% of the respondents strongly agree, 25.2% agree, 4.8% were neutral, 20.6% of the respondents disagree, and 22.0% strongly disagree that performance in continuous assessment is poor, implying that a total 41.8% agreed that Performance in continuous assessment is poor.

On the exercises, the result showed that 44.5% of the respondents strongly agree, 40.8% agree, 2.7% were neutral, 3.2% of the respondents disagree, and 2.9% strongly disagree that teachers give exercises after lessons. 30.8% of the respondents strongly agree, 43.7% agree, 5.9% were neutral, 8.6% of the respondents disagree, and 2.9% strongly disagree that students answer all questions in exercises, revealing that 74.5% agreed that students answer all questions in exercises. 27.9% of the respondents strongly agree, 47.7% agree, 7.5% were neutral, 5.9% of the respondents disagree, and 2.1% strongly disagree that the exercises are evaluated, a total majority of 75.6% agreed.

The result revealed that 29.8% of the respondents strongly agree, 46.4% agree, 4.6% were neutral, 8.0% of the respondents disagree, and 1.9% strongly disagree that feedbacks on exercise are prompt. This implies that 76.1% agreed that feedbacks on exercise are prompt.

Also, 32.4% of the respondents strongly agree, 41.3% agree, 4.3% were neutral, 8.3% of the respondents disagree, and 4.6% strongly disagree that performance in the exercises is excellent. A total of 73.7% agreed that performance in the exercises is excellent. 26.8% of the respondents strongly agree, 50.4% agree, 4.6% were neutral, 7.0% of the respondents disagree, and 2.1% strongly disagree that performance in the exercises is good. Overall, 77.2% agreed that performance in the exercises are good.

22.0% of the respondents strongly agree, 42.9% agree, 6.4% were neutral, 13.4% of the respondents disagree, and 3.5% strongly disagree that performance in the exercises is moderate. Implying 64.9% agreed that performance in the exercises is moderate. 16.6% of the respondents strongly agree, 31.9% agree, 7.5% were neutral, 22.0% of the respondents disagree, and 10.2% strongly disagree that performance in the exercises is fair. 18.2% of the respondents strongly agree, 19.6% agree, 6.4% were neutral, 20.9% of the respondents disagree, and 25.9% strongly disagree that performance in the exercises is poor. Total of 45.8% disagreed that performance in the exercises is poor.

Also, in the interview Headteachers;

> *"Applauded the student performance during UCE, and continuous assessment. That The combination of positive perceptions and areas of concern presents an opportunity for educators and administrators to reflect on their practices, identify*

areas for improvement, and implement targeted strategies to ensure a well-rounded and impactful learning environment for all students".

Table 10: ANOVA analysis for students' performance

Level of Students Performance							
				95% Confidence Interval			
Schools	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
School 1	3.4887	0.5708	0.0807	3.3265	3.6509	2.00	5.00
School 2	4.2051	0.4413	0.0579	4.0891	4.3212	3.00	4.78
School 3	3.5954	0.5077	0.0561	3.4838	3.7069	1.62	5.00
School 4	3.5267	0.8308	0.1039	3.3192	3.7342	1.00	5.00
Teachers' qualification							
Master degree	4.1970	0.2922	0.1687	3.4710	4.9229	3.86	4.41
Bachelor degree	4.2249	0.3171	0.0647	4.0910	4.3588	3.14	4.68
Diploma	3.9109	0.5790	0.1263	3.6474	4.1745	3.00	5.00
Teachers' experiences							
less than 2 years	4.2754	0.23307	0.06464	4.1346	4.4162	3.86	4.68
2-5 years	4.0083	0.55752	0.11886	3.7611	4.2555	3	4.77
6-10 years	4.0274	0.45711	0.12678	3.7512	4.3037	3.41	5

The provided table presents descriptive statistics for "Students' Performances" across different schools. The one-way ANOVA analysis examining the relationship between students' performances and the schools they attend. Starting with school 1, the mean performance score is 3.4887. The standard deviation of 0.57075 indicates some variability in students' performances within this school. The standard error of 0.08072 reflects the variability of the sample mean. School 2, the mean performance score is 4.2051. With a standard deviation of 0.44126, there's a moderate amount of variability in students' performances within this institution. The standard error of 0.05794 characterizes the variability of the sample mean.

Among students from school 3, the mean performance score is 3.5954. The standard deviation of 0.50767 indicates variability in student performances within this school. The standard error of 0.05606 reflects the variability of the sample mean.

School 4, the mean performance score is 3.5267. The relatively high standard deviation of 0.83080 indicates a wide variability in student performances within this institution. The standard error of 0.10385 reflects the variability of the sample mean.

In summary, the ANOVA statistics showed that School 2 had the highest level of students' performance 4.21, followed by School 3, 3.60, followed by school 4 3.53, and School 1 3.49

with the lowest level of students' performance among the sampled schools.

Students' Performance based on teachers' qualifications. The one-way ANOVA analysis, investigating the potential relationship between students' performance and the qualifications of their teachers. Among students taught by teachers with a "Master degree", the mean performance score is 4.1970. The standard deviation of 0.29223 indicates some variability in students' performances within this group. The standard error of 0.16872 reflects the variability of the sample mean. For students taught by teachers with a "Bachelor degree", the mean performance score is 4.2249. With a standard deviation of 0.31705, there's a moderate amount of variability in students' performances within this group. The standard error of 0.06472 characterizes the variability of the sample mean.

Among students taught by teachers with a "Diploma", the mean performance score is 3.9109. The relatively high standard deviation of 0.57896 indicates a wide variability in students' performances within this group. The standard error of 0.12634 reflects the variability of the sample mean.

In summary, the ANOVA statistics showed that teachers with bachelor degree had the highest level of students' performance 4.22, followed by teachers with master degree 4.20, and teachers with diploma 3.91 with the lowest level of students' performance among the level of teachers qualification.

The one-way ANOVA analysis, exploring the potential relationship between students' performance and their teachers' years of experience. Among students taught by teachers with "less than 2 years" of experience, the mean performance score is 4.2754. The standard deviation of 0.23307 indicates relatively low variability in students' performances within this group. The standard error of 0.06464 reflects the variability of the sample mean. For students taught by teachers with "2-5 years" of experience, the mean performance score is 4.0083. The standard deviation of 0.55752 indicates moderate variability in students' performances within this group. The standard error of 0.11886 characterizes the variability of the sample mean.

Among students taught by teachers with "6-10 years" of experience, the mean performance score is 4.0274. The standard deviation of 0.45711 indicates variability in students' performances within this group. The standard error of 0.12678 reflects the variability of the sample mean.

In summary, the ANOVA statistics showed that teachers with 6-10 years experience had the highest level of students' performance 4.28, followed by teachers with less-than 2 years experience 4.03, and teachers with 2-5 years experience 4.01 with the lowest level of students' performance among the level of teachers experience.

4.5 The relationship between implementation of SESEMAT teaching approaches of ALEI-PIEI and students' performance in Sciences and Mathematics

The objectives three of this study was to establish the relationship between implementation of SESEMAT teaching approaches of ALEI- PIEI and students' performance in Sciences and Mathematics in Lamogi Sub-county, Amuru District. The findings of this study are presented using descriptive statistics and inferential statistics.

Table 11: Pearson correlation analysis for the relationship between SESMAT and students' academic performance.

		SESMAT approaches	Academic Performance
SESMAT approaches	Pearson Correlation	1	.649**
	Sig. (2-tailed)		.000
	N	80	80
Academic performance	Pearson Correlation	.649**	1
	Sig. (2-tailed)	.000	
	N	80	80

The Pearson correlation analysis presented in the table 11 shows the relationships between SESMAT approaches, and academic performance.

There is a strong positive significant relationship between SESMAT approaches and academic performance, with a Pearson correlation coefficient, r of 0.649 ($p < 0.01$). The Pearson correlation analysis suggests that there are positive associations between SESMAT and academic performance. The findings indicate that the effective utilization of SESMAT teaching approaches contributes to improved academic performance.

Table 12: Bivariate regression analysis between SESEMAT teaching approaches and performance in Sciences and Mathematics

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.960	.211		4.552	.000
	Teaching approaches	.679	.051	.568	13.266	.000

a. Dependent Variable: Academic performance

The table 12 shows the coefficients for a regression model with Academic performance as the dependent variable and Teaching approaches as the independent variable. The constant coefficient is .960, meaning that if the Teaching approaches variable is zero, the predicted value for Academic performance would be .960. The coefficient for Teaching approaches is .679,

indicating that for every one-unit increase in Teaching approaches, the predicted value for Academic performance increases by .679. The standardized coefficient for Teaching approaches is .568, indicating that Teaching approaches has a moderate positive effect on Academic performance. The t-value for Teaching approaches is 13.266, which is statistically significant ($p < .05$).

Table 13: Multivariate regression analysis for each categorical teaching approaches and Academic performance

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.955	.217		4.396	.000
	Activity-based teaching	.133	.064	.134	2.080	.038
	Learner-centered teaching	.090	.070	.081	1.273	.204
	Encouragement	.009	.067	.009	.127	.899
	Improvision	.100	.054	.106	1.845	.066
	Planning	-.090	.061	-.094	-1.466	.144
	Evaluation	.307	.061	.349	5.069	.000
	Improvement	.134	.052	.148	2.603	.010
2	(Constant)	1.127	.308		3.665	.000
	Activity-based teaching	.092	.067	.099	1.375	.170
	Lerner-centered	.084	.077	.081	1.088	.278
	Encouragement	.017	.073	.018	.229	.819
	Improvision	.074	.057	.084	1.286	.200
	Planning	-.010	.071	-.011	-.141	.888
	Evaluation	.283	.067	.345	4.198	.000
	Improvement	.131	.055	.158	2.382	.018
	Intervening variables	-.046	.065	-.037	-.707	.480

a. Dependent Variable: Academic performance

The table shows the coefficients for a multiple linear regression model with academic performance as the dependent variable and six independent variables: activity-based teaching, learner-centered teaching, encouragement, improvisation, planning, and evaluation. The coefficients represent the change in the dependent variable (academic performance) for a one-unit change in the independent variable, holding all other independent variables constant.

The constant term in the model is 0.955, which represents the expected academic performance score when all independent variables are set to zero.

The standardized coefficients, represented by Beta, indicate the relative importance of each independent variable in predicting academic performance. The standardized coefficient for

teaching approaches is 0.568, indicating that this variable has the strongest relationship with academic performance.

The p-values associated with each coefficient indicate whether the coefficient is statistically significant or not. In this model, only the coefficients for activity-based teaching, evaluation, and improvisation have p-values less than 0.05, indicating that they are statistically significant predictors of academic performance. The coefficients for learner-centered teaching, encouragement, and planning are not statistically significant.

Model 2 attempts to explore the combined effects of various teaching practices and intervening variable on students' academic performance. The interveningg variable's coefficients are shown in the output as "-.046" with a standard error of ".065," a t-value of "-.707," and a p-value of ".480." In this case, the intervening variable affects how the teaching practices impact students' academic performance. The negative coefficient suggests that the intervening variable weaken the relationship between the teaching practices and academic performance. However, the p-value of ".480" indicates that this effect is not statistically significant at the conventional levels (typically, $p < 0.05$). This means that the intervening variable may not significantly alter the relationship between the teaching practices and students' academic performance.

Table 14: Multiple regression model summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.622[a]	.387	.375	.53054

a. Predictors: (Constant), Improvision, Improvision, Learner centred teaching, Planning, Activity based teaching, Encouragement, Evaluation

This is a summary of a regression model with one dependent variable (academic performance) and seven independent variables (teaching approaches such as activity-based teaching, learner-centered teaching, encouragement, improvisation, planning, and evaluation).

The model summary shows that the model has a multiple R (correlation coefficient) of 0.622, indicating a moderate positive relationship between the independent variables and academic performance. The R-squared value (coefficient of determination) is 0.387, which means that the independent variables explain 38.7% of the variance in academic performance.

The adjusted R-squared value, which takes into account the number of independent variables in the model, is 0.375. The standard error of the estimate is 0.53054, which represents the average difference between the observed values of the dependent variable and the predicted values by the model.

Table 15: ANOVA for teaching approaches and Academic performance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	62.304	7	8.901	31.621	.000[b]
	Residual	98.799	351	.281		
	Total	161.103	358			

a. Dependent Variable: Academic performance

b. Predictors: (Constant), Improvision, Improvision, Learner centred teaching, Planning, Activity based teaching, Encouragement, Evaluation

The ANOVA table shows the results of the analysis of variance for the regression model. The "Sum of Squares" column indicates the total variance in the dependent variable that is accounted for by the model (Regression) and the residual variance that is not explained by the model (Residual). The "df" column shows the degrees of freedom associated with each source of variance, and the "Mean Square" column shows the average amount of variance per degree of freedom.

The "F" statistic in the last column represents the ratio of the explained variance to the unexplained variance, and is used to test the null hypothesis that all of the regression coefficients are equal to zero (i.e., the model has no predictive power). The "Sig." column shows the p-value associated with the F-statistic.

In this case, the ANOVA table indicates that the regression model as a whole is statistically significant, with an F-statistic of 31.621 and a p-value of .000, indicating that at least one of the predictors is significantly related to academic performance.

Chapter Five: Discussion, Conclusion, and Recommendations

5.0 Introduction

This chapter presents the summary, discussion, conclusion, and recommendations arising out of the study findings according to the stipulated objectives.

5.1 Discussion

5.1.1 The level of implementation of SESEMAT Teaching approaches of ALEI- PIEI in Secondary schools in Lamogi Sub-county.

A survey on the level of implementation of SESMAT teaching approaches using ANOVA statistics revealed distinct disparities in SESMAT Teaching Approaches implementation across the schools. School 2 emerged as a leader with the highest implementation level of 4.27, followed by School 3 at 4.12, School 1 at 3.92, and finally, School 4 at 3.62, reflecting the lowest implementation level. These findings illuminate the varying degrees of integration of SESMAT Teaching Approaches among the schools. This concurs with a study by Akol et al. (2016) who found that there was significant variation in the implementation of a science and mathematics education program across schools. The studies also found that the availability of resources, the training of teachers, and the support from school leaders were all factors that influenced the level of implementation. The findings of these studies suggest that there is no one-size-fits-all approach to implementing science and mathematics education programs. Instead, it is important to consider the specific context of each school when planning and implementing such program.

The analysis based on ANOVA statistics highlights a clear hierarchy among teachers' qualifications in terms of SESMAT Teaching Approaches implementation. Teachers with a master's degree exhibit the highest level of implementation at 4.27, followed closely by teachers with a bachelor's degree at 4.24. Teachers with a diploma have the lowest implementation level at 4.23. The study brought insights into the varying degrees of integration of SESMAT Teaching Approaches among teachers with different qualifications. A study by Muindi et al. (2020) investigated the relationship between teachers' qualifications and the implementation of active learning strategies in secondary schools in Kenya. The study found that there was a positive correlation between teachers' qualifications and their level of implementation of effective teaching practices. This suggests that teachers with higher qualifications are more likely to implement active learning strategies in their classrooms.

The study revealed a clear picture of the relationship between teachers' years of experience and the implementation of SESMAT Teaching Approaches. Teachers with 6-10 years of experience exhibit the highest implementation level at 4.33, followed by those with less than 2 years at

4.23, and teachers with 2-5 years at 4.17, representing the lowest implementation level. This provided the impact of experience levels on teaching approach implementation contributes valuable information to the field of education.

The study highlights distinct differences in the implementation of SESMAT Teaching Approaches across different classes. Implementation in Senior three exhibit the highest implementation level at 4.07, followed by senior two at 4.04, and senior one at 3.65, reflecting the lowest implementation level. This analysis provides meaningful insights into how class distinctions impact the integration of SESMAT Teaching Approaches. Huda et al. (2019), found that the traditional model of teaching, which involves the teacher as the sole source of knowledge, has shifted towards a student-centered approach that emphasizes activities and engagement. The study argues that this shift is necessary to promote student participation and active learning, which leads to better academic outcomes.

5.1.2 The level of students' performances in Sciences and Mathematics in Lamogi Sub-county.

The results obtained from the ANOVA analysis reveal noteworthy disparities in students' performance levels across the sampled schools. School 2 demonstrated the highest level of students' performance at 4.21, followed by School 3 with 3.60, then School 4 with 3.53, and finally, School 1 with the lowest performance level of 3.49 among the schools analyzed. These findings illustrated the variations in student performance across different educational institutions. However, Mushi et al. (2018), found that students in Uganda generally perform well in their secondary education exams, with a majority of students achieving good grades.

The findings unveil a distinct pattern regarding students' performance in relation to teachers' qualifications. Teachers with a bachelor's degree exhibit the highest level of students' performance at 4.22, followed closely by teachers with a master's degree at 4.20. In contrast, students taught by teachers with a diploma display the lowest performance level of 3.91.

The ANOVA analysis outcomes uncover a discernible pattern regarding students' performance in relation to their teachers' years of experience. Teachers with 6-10 years of experience exhibit the highest level of students' performance at 4.28. Notably, teachers with "less than 2 years" experience follow closely with a performance level of 4.03, while teachers with "2-5 years" experience display the lowest performance level of 4.01. These findings showed the potential influence of teachers' experience on students' academic achievements. Goldhaber et al. (2010) suggest that teacher experience is an important factor that can influence student learning. However, he noted noted that the relationship between teacher experience and student achievement is not always linear. A study by Gerritsen et al, (2017) found that teacher experience positively impacts student test performance, with the most significant effect in early grades and career stages with less labor market mobility.

5.1.3 The relationship between implementation of SESEMAT teaching approaches of ALEI-PIEI and students' performance in Sciences and Mathematics in Lamogi Sub-county.

The Pearson correlation analysis revealed that there is a positive significant association between implementation of SESMAT teaching approaches and students' academic performance. The study showed that the effective implementation of SESMAT teaching approaches contributes to improved students' academic performance ($r = 0.649$; $p = 0.000$).

According to bivariate regression analysis, the study found that if the teaching approaches variable is zero, the predicted value for academic performance would be .960. The coefficient for teaching approaches is .679, indicating that for every one-unit increase in teaching approaches, the predicted value for academic performance increases by .679, implying that SESMAT directly influence academic performance.

This finding is consistent with previous research on the impact of teaching approaches on academic performance. For instance, a study by Wilder, (2015) found that teaching approaches such as problem-based learning, cooperative learning, and inquiry-based learning were positively related to academic achievement. These findings suggest that the use of effective teaching approaches can have a significant impact on students' academic performance.

Hattie (2009), found that teacher-student relationships have a strong positive effect on academic achievement. The study analyzed over 800 meta-analyses on the factors that influence academic achievement and found that positive teacher-student relationships had the highest effect size. This suggests that building strong relationships with students can lead to better academic outcomes.

A meta-analysis by Dunlosky et al. (2013) found that practice testing is one of the most effective study strategies for improving academic performance. The study analyzed over 700 research articles on learning strategies and found that practice testing had a moderate to high effect size. This suggests that incorporating practice testing into teaching and learning activities can lead to better academic outcomes.

However, a study by Anderson and Brown (2021) found that standardized tests may not be accurate predictors of academic achievement. The study analyzed data from a diverse sample of over 5,000 students and found that standardized tests were only moderately related to academic achievement. This suggests that relying solely on standardized tests may not provide a comprehensive and accurate picture of students' academic performance.

5.2 Conclusion

In conclusion, the findings show that there are SESMAT teaching approaches, including teaching approaches, lesson planning, use of appropriate teaching aids, continuous assessment,

and prompt feedback are being implemented in school in Lamogi sub-county. Teachers who use appropriate teaching approaches, such as improvisation, simplified explanations, and local examples, have a positive effect on student academic performance. In addition, teachers who use appropriate teaching aids, such as local learning aids, simplify formulae and create new explanations, also contribute to student academic performance. This supports the idea that teachers should use a variety of teaching approaches to cater to the diverse learning needs of their students concur with SESMAT.

The studies also indicate that teachers who follow a well-structured scheme of work and plan every lesson as SEMAT teaching approach have a positive effect on academic performance. Teachers who evaluate all learners, use appropriate evaluation methods, and provide feedback, also contribute to academic performance. Continuous assessment, which involves regular testing and evaluation, has a positive effect on academic performance. Moreover, teachers who recognize students' improvement, give corrections, and follow up on students, encourage improvement.

The study reviewed valuable insights into the factors of SESEMAT that contribute to academic performance. The findings suggest that SESEMAT play a crucial role in promoting academic performance, and that the use of appropriate teaching approaches, teaching aids, continuous assessment, and prompt feedback are critical for improving academic performance. These findings underscore the importance of effective teaching and the need for ongoing efforts to improve teaching practices.

5.3 Recommendations

Strengthen Implementation of Activity-Based Teaching: Since activity-based teaching approaches showed the strongest relationship with academic performance, schools should focus on enhancing and expanding the use of hands-on activities and practical exercises in the classroom. Teachers can design engaging activities that allow students to apply their theoretical knowledge, fostering better understanding and retention of concepts.

Provide Teacher Training and Professional Development: To address the challenges related to limited teacher training and professional development, educational authorities should invest in workshops, seminars, and training programs for teachers. These initiatives can equip educators with the necessary skills and knowledge to effectively implement the SESEMAT teaching approaches, such as learner-centered strategies and using local examples.

Foster Student Participation and Engagement: Given the positive perception of students' grades and the adoption of continuous assessment, educators should continue to encourage active student participation and engagement in the learning process. Teachers can employ a variety

of techniques, such as group discussions, project-based learning, and student presentations, to create a dynamic and inclusive learning environment.

Improve Access to Resources: To overcome the limitations of limited resources in rural areas, educational institutions and authorities should prioritize the allocation of necessary teaching materials, textbooks, and equipment. Additionally, partnerships with NGOs, local communities, and government agencies can help supplement resources and bridge the gap in resource availability.

Promote Community Involvement: To tackle challenges related to teachers' attitudes and the lack of community involvement, schools should actively engage parents, community leaders, and other stakeholders in the education process. This collaboration can create a supportive learning environment and encourage teachers to embrace innovative teaching approaches.

Address Teacher Shortage: The shortage of teachers can significantly impact the effective implementation of SESEMAT approaches. Authorities should devise strategies to attract and retain qualified teachers, provide incentives, and ensure manageable workloads to support their efforts in implementing these teaching methods.

Explore Modern Assessment Techniques: As student-centered learning environments may make traditional assessment methods challenging, schools should explore modern assessment techniques. These could include project-based assessments, portfolios, and formative assessments that align better with the principles of student growth and development.

5.4 Suggestion for further studies

A similar study should be conducted on altitude of teachers/learners towards mathematics and science subject. Focus should also be on teachers’ capacity in implementing SESMAT teaching approaches.

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Appendices

Appendix A: Questioner for Teachers

GULU UNIVERSITY

Faculty of Education and Humanities

Department of Curriculum Studies

Introduction

I am Labongo Henry Mutyaba a student of Masters of Education (Curriculum studies) of Gulu University undertaking a research study entitled "SESEMAT teaching approaches in curriculum implementation and students' performance in sciences and mathematics in Amuru District, Lamogi sub-county."

I kindly request you to participate in this academic research and I assure you of confidentiality and that all findings will be strictly for Academic purposes.

Thank you in advance.

SECTION A: Background Information

A1. Types of school (Please circle)

A. Mixed day government school
B. Mixed boarding government aided
C. Mixed day private school
D. Mixed boarding private school

A2. Gender:

A. Male ☐

B. Female. ☐

A3. Age bracket

20-30years ☐ 31-40years ☐ 41-50years ☐ 51-60years ☐

A4. Your academic qualification is:

A. Master Degree B. Post Graduate Diploma

C. Bachelor's degree D. Diploma in Education

A5. How long have you been in this school?

Less than 2years ☐ 2-5years ☐ 6-10years ☐

SECTION B: SESEMAT Teaching approaches

Tick the most appropriate response

Key: 1= Strongly Disagree (SD), 2 = Disagree (D), 3 = Not sure (NS) , 4 =Agree (A) and 5= Strongly Agree (SA)

		SD	**D**	**NS**	**A**	**SA**
a)	Activity based teaching					
i.	The school uses activities in teaching					
ii.	Learners are given assignments in class					
iii.	Our teaching –learning is dominated with activities					
iv.	Our teachers give many activities to all learners					
v.	The activities are assessed					
vi.	Feedback on the class activities are given					
b)	Learner centred – teaching					
i.	Learners are involved in teaching learning					
ii.	Learners take the lead in learning.					
iii.	Learners participate actively in classes.					
iv.	Teachers engage all learners in class.					
v.	Our curriculum encourages learners to contribute.					
vi.	The teacher's guide learners to learner.					
vii.	The learner is at the centre of learning.					
c)	Encouragement					
i.	Teachers encourage all learners in class.					
ii.	Teachers use friendly language in class.					
iii.	There is use of reward as encouragement.					

iv.	Teachers encourage learners to perform well.					
v.	Our teachers are very encouraging.					
vi.	Teaching is from simple to complex.					
vii.	Teachers encourage all learners to pass.					
d)	Improvision					
i.	Teachers improvise in teaching.					
ii.	Teachers use local learning teaching aids					
iii.	Teachers use local example in class.					
iv.	Teachers simplified explanation of formulae					
v.	Teacher create new explanation					
e)	Planning					
i.	Teaching have scheme of work.					
ii.	Teachers plan every lesson.					
iii.	Teachers use appropriate teaching methods.					
iv.	Teachers what to teach every day.					
v.	Teachers teach us planed					
vi.	Teachers of continue assessment					
f)	Evaluation					
i.	Teachers follow appropriate evaluation					
ii.	Teachers evaluate all learners					
iii.	Teachers assess and give feedback					
iv.	Teachers use evaluation for decision making					

v.	Teachers are guided in evaluation					
vi.	Teachers evaluation is supervised					
g)	Improvement					
i.	Teachers use appropriate improvement schedule					
ii.	Teachers are aware of students improvement					
iii.	Teachers do correction and follow up					
iv.	Teachers recognized students' improvement					
v.	Teacher are happy with students' performance					
vi.	Teachers courage improving students					

SECTION C: Academic Performance

		SD	**D**	**NS**	**A**	**SA**
a)	Grade at UCE					
i.	Our students' grades are generally excellent.					
ii.	Our students' grades are good.					
iii.	Our students' grades are moderate.					
iv.	Our students' grades are fair.					
v.	Our students' grades are poor.					
b)	Continuous assessment					
i.	Performance in continuous assessment is excellent.					
ii.	There is continuous assessment in this school.					
iii.	Performance in continuous assessment is good.					

iv.	Performance in continuous assessment is moderate.					
v.	Performance in continuous assessment is fair.					
vi.	Performance in continuous assessment is poor.					
vii.	Continuous assessment is mandatory in sciences and mathematics.					
viii.	We give feedback and continue assessment.					
c)	Exercises					
i.	Teachers give exercises after lessons.					
ii.	Students answer all questions in exercises.					
iii.	The exercise are evaluated					
iv.	Feedbacks on exercise are prompt.					
v.	Performance in the exercises is excellent					
vi.	Performance in the exercises is good					
vii.	Performance in the exercises is moderate					
viii.	Performance in the exercises is fair					
ix.	Performance in the exercises is poor					

Appendix B: Questionnaire for Leaners

GULU UNIVERSITY

Faculty of Education and Humanities

Department of Curriculum Studies

I am Labongo Henry Mutyaba a student of Masters of Education (Curriculum studies) of Gulu University undertaking a research study entitled "SESEMAT teaching approaches in curriculum implementation and students' performance in sciences and mathematics in Amuru District, Lamogi sub-county."

I kindly request you to participate in this academic research and assure you of confidentiality and that all findings will be strictly for Academic purposes.
Thank you in advance.

SECTION A: BACKGROUND INFORMATION

1. Gender.

Male ☐ Female ☐

2. Age.

Below 14 years ☐ 14-16 years ☐ above 16 years ☐

3. Class……

4. School ……

SECTION B: SESEMAT Teaching approaches

Tick the most appropriate response

Key: 1= Strongly Disagree (SD), 2 = Disagree (D), 3 = Not sure (NS) , 4 =Agree (A) and 5= Strongly Agree (SA)

		SD	**D**	**NS**	**A**	**SA**
h)	Activity based teaching					
vii.	The school uses activities in teaching					
viii.	Learners are given assignments in class					

ix.	Our teaching –learning is dominated with activities					
x.	Our teachers give many activities to all learners					
xi.	The activities are assessed					
xii.	Feedback on the class activities are given					
i)	Learner centred – teaching					
viii.	Learners are involved in teaching learning					
ix.	Learners take the lead in learning.					
x.	Learners participate actively in classes.					
xi.	Teachers engage all learners in class.					
xii.	Our curriculum encourages learners to contribute.					
xiii.	Teachers guide learners to learner.					
xiv.	The learner is at the centre of learning.					
j)	Encouragement					
viii.	Teachers encourage all learners in class.					
ix.	Teachers use friendly language in class.					
x.	There is use of reward as encouragement.					
xi.	Teachers encourage learners to perform well.					
xii.	Our teachers are very encouraging.					
xiii.	Teaching is from simple to complex.					
xiv.	Teachers encourage all learners to pass.					
k)	Improvision					

vi.	Teachers improvise in teaching.					
vii.	Teachers use local learning teaching aids					
viii.	Teachers use local example in class.					
ix.	Teachers simplified explanation of formulae					
x.	Teacher create new explanation					
l)	Planning					
vii.	Teaching have scheme of work.					
viii.	Teachers plan every lesson.					
ix.	Teachers use appropriate teaching methods.					
x.	Teachers what to teach every day.					
xi.	Teachers teach us planed					
xii.	Teachers of continue assessment					
m)	Evaluation					
vii.	Teachers follow appropriate evaluation					
viii.	Teachers evaluate all learners					
ix.	Teachers assess and give feedback					
x.	Teachers use evaluation for decision making					
xi.	Teachers are guided in evaluation					
xii.	Teachers evaluation is supervised					
n)	Improvement					
vii.	Teachers use appropriate improvement schedule					
viii.	Teachers are aware of students improvement					

ix.	Teachers do correction and follow up					
x.	Teachers recognized students' improvement					
xi.	Teachers are happy with students' performance					
xii.	Teachers courage improving students					

SECTION C: Academic Performance

		SD	**D**	**NS**	**A**	**SA**
d)	Grade at UCE					
vi.	Students' grades are generally excellent.					
vii.	Students' grades are good.					
viii.	Students' grades are moderate.					
ix.	Students' grades are fair.					
x.	Students' grades are poor.					
e)	Continuous assessment					
ix.	Performance in continuous assessment is excellent.					
x.	There is continuous assessment in this school.					
xi.	Performance in continuous assessment is good.					
xii.	Performance in continuous assessment is moderate.					
xiii.	Performance in continuous assessment is fair.					
xiv.	Performance in continuous assessment is poor.					
xv.	Continuous assessment is mandatory in sciences and mathematics.					
xvi.	We give feedback and continue assessment.					
f)	Exercises					

x.	Teachers give exercises after lessons.					
xi.	Students answer all questions in exercises.					
xii.	The exercise are evaluated					
xiii.	Feedbacks on exercise are prompt.					
xiv.	Performance in the exercises is excellent					
xv.	Performance in the exercises is good					
xvi.	Performance in the exercises is moderate					
xvii.	Performance in the exercises is fair					
xviii.	Performance in the exercises is poor					

Appendix C: Interview Schedule for Headteachers

GULU UNIVERSITY

Faculty of Education and Humanities

Department of Curriculum Studies

I am Labongo Henry Mutyaba a student of Masters of Education (Curriculum studies) of Gulu University undertaking a research study entitled "SESEMAT teaching approaches in curriculum implementation and students' performance in sciences and mathematics in Amuru District, Lamogi sub-county."

I kindly request you to participate in this academic research and assure you of confidentiality and that all findings will be strictly for Academic purposes.

Thank you in advance.

1. Does ALEI- PIEI approach enhances the teaching and learning of science in your school?

2. Do you think ALEI- PIEI approach has been well utilized by science teachers in teaching of science in your school?

3. Are science teachers competent enough in the use ALEI- PIEI approach in your school?

4. Does ALEI- PIEI approaches bring about desired change among science teachers in your school?

5. How do you find the learner's attitude towards ALEI- PIEI approach in your school?

6. What are the challenges teachers faces while using ALEI- PIEI approach in your school?

Appendix D: Interview guide for Regional SESMAT trainers and cordinators.

GULU UNIVERSITY

Faculty of Education and Humanities

Department of Curriculum Studies

I am Labongo Henry Mutyaba a student of Masters of Education (Curriculum studies) of Gulu University undertaking a research study entitled "SESEMAT teaching approaches in curriculum implementation and students' performance in sciences and mathematics in Amuru District, Lamogi sub-county."

I kindly request you to participate in this academic research and assure you of confidentiality and that all findings will be strictly for Academic purposes.

Thanks you in advance

1. How many SESEMAT workshops do science teachers participate in per term?
2. How is the implementation of SESEMAT Activity Regional Based (SARB) perceived in your school based on your experience?
3. As the administrator, how do you verify that teachers are adhering to SESEMAT requirements in their teaching?
4. How do science teachers generally perceive the impact of SESEMAT on enhancing the teaching and learning of science subjects, based on your experience?
5. In your perspective, do you consider SESEMAT as a valuable and effective approach to teaching and learning science?
6. How frequently is the submission of the SARB school summary made to the Regional Monitoring Coordinator (RMC)?
7. What measures do you take to support teachers in ensuring that science teaching aligns with SESEMAT principles?
8. Do you have any suggestions for enhancing the effectiveness of SESEMAT?
9. Briefly describe the monitoring mechanisms employed at the regional level for overseeing SESEMAT implementation.
10. From your experience, what challenges do you face in monitoring SARB activities within your region?
11. In your view, what is the current status of SESEMAT implementation at the regional level?
12. In your opinion, what are the teachers accurately perceiving regarding SESEMAT teaching approaches? For example, do they find SESEMAT principles realistic, achievable, or inapplicable?

Appendix E: Table for Determining Sample Size from a given Population. Krejicie and Morgan (1970)

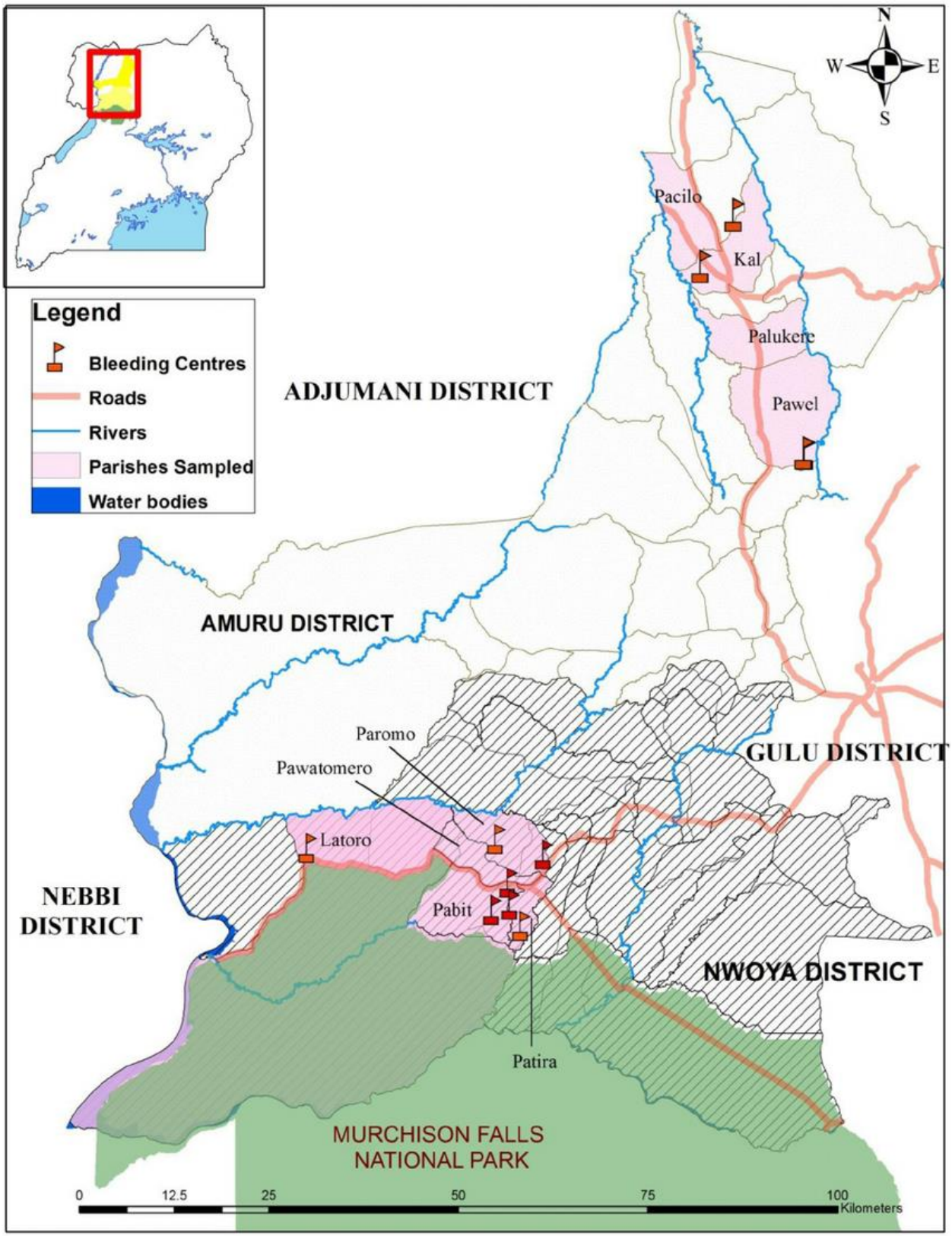
N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	334
15	14	110	86	290	165	850	256	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

Note: “N” is Population Size

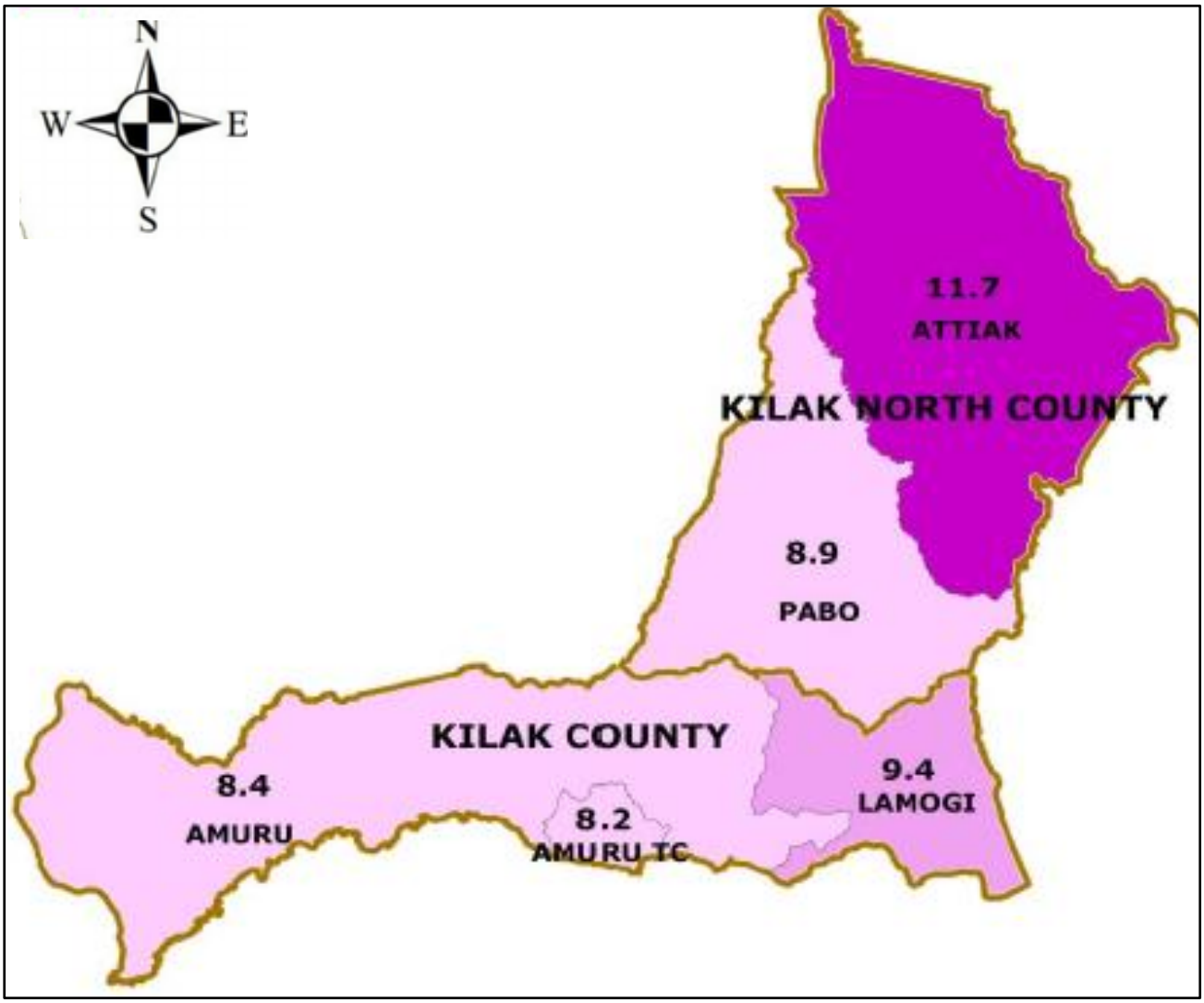
“S” is Sample Size

Krejicie, Robert V, Morgan, Daryle W, “Determining sample size for Research Activities”, *Educational and Psychological measurement, 1970*

Appendix F: Map of Uganda showing location of Amuru District



Appendix G: Map of Amuru District showing Lamogy sub-county



GULU UNIVERSITY

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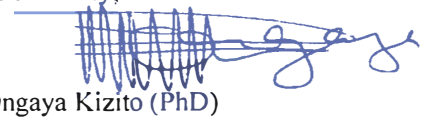
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