# MATHEMATICAL MODELLING OF STUDENT PERFORMANCE TRENDS IN KIPTAGICH SECONDARY SCHOOL IN KURESOI SOUTH SUB COUNTRY, NAKURU COUNTY, KENYA

**BY**

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# DECLARATION

**Declaration by the candidate**

I declare to the best of my knowledge that the work presented in this report is my original work. It has never been presented to any Institution of higher learning before for the award of any degree or diploma.

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**SEDU/CIM/D/065/22**

**Declaration by the supervisor**

This proposal has been produced and submitted for examination with my approval as University Supervisor.

_____ **DATE** _____

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## DEDICATION

I dedicate this project to my family for their endless support and encouragement. Special dedication goes to my teachers and friends, who motivated me throughout this journey.

## ABSTRACT

This study investigated the mathematical modeling of student performance trends at Kiptagich Secondary School in Kuresoi South Sub County, Nakuru County, Kenya. The primary objective was to analyze the various factors that influenced student performance and to develop predictive models that could forecast academic outcomes based on identified variables. Employing a mixed-methods research approach, the study incorporated both quantitative and qualitative data to provide a comprehensive understanding of the performance dynamics within the school. Data were collected from a sample of 50 students and 10 teachers, utilizing structured questionnaires and semi-structured interviews. The quantitative component focused on gathering data related to students' academic performance across different subjects, attendance records, socio-economic backgrounds, and parental involvement. The qualitative aspect involved interviews with teachers to gain insights into instructional methods, classroom dynamics, and perceived challenges affecting student achievement. The analysis revealed several critical determinants of student performance, including socio-economic status (SES), teaching methodologies, student motivation, and parental involvement. Mathematical models were developed using statistical techniques such as regression analysis to illustrate the relationships between these variables and student performance metrics. The findings indicated that students from higher socio-economic backgrounds consistently outperformed their peers, highlighting the importance of resource availability. Additionally, active learning strategies employed by teachers were linked to improved student engagement and performance. The study concluded by emphasizing the need for educational stakeholders to consider these influential factors when designing interventions aimed at enhancing academic outcomes. Recommendations included implementing targeted support programs for students from disadvantaged backgrounds, training teachers in innovative pedagogical techniques, and promoting greater parental involvement in the educational process. Ultimately, this research contributed valuable insights into the trends of student performance at Kiptagich Secondary School and established a foundation for future studies on academic achievement in similar contexts.

## TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF ABBREVIATIONS/ACRONYMS

- **CBO:** Community-Based Organization
- **GA:** General Assessment
- **ICT:** Information and Communication Technology
- **KM:** Knowledge Management
- **KSS:** Kiptagich Secondary School
- **Nakuru:** Nakuru County
- **NGO:** Non-Governmental Organization
- **PD:** Professional Development
- **SES:** Socio-Economic Status
- **SPSS:** Statistical Package for the Social Sciences
- **TVET:** Technical and Vocational Education and Training

## OPERATIONAL DEFINITION OF TERMS

1. **Academic Engagement:** The degree of attention, interest, and participation that students exhibit in their learning processes.
2. **Data Collection Methods:** The techniques employed to gather information for the study, including surveys, interviews, and observations.
3. **Educational Resources:** Various materials and support systems available to students, including textbooks, technology, tutoring, and extracurricular activities.
4. **Intervention Strategies:** Specific actions or programs implemented to improve student performance and address challenges in the educational environment.
5. **Motivation:** The internal or external factors that drive students to engage in learning activities and strive for academic success.
6. **Parental Involvement:** The active participation of parents in their children's education, including monitoring homework, attending school meetings, and fostering a supportive home learning environment.
7. **Predictive Modeling:** The use of statistical techniques to create a model that forecasts future student performance trends based on historical data
8. **Socio-Economic Status (SES):** A composite measure that typically includes income, education level, and occupational status, influencing students' access to educational resources.
9. **Student Performance:** Refers to the academic achievements of students measured through grades, test scores, and overall engagement in educational activities.

10. **Teaching Methods:** The strategies and techniques educators use to facilitate learning, which can range from traditional lectures to interactive, student-centered approaches.

## ACKNOWLEDGEMENTS

Most sincere appreciation goes to my supervisor, **Dr. Dennis King'ang'i** for his direction and guidance towards the completion of this report.

May God bless you.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Introduction

The quality of education in secondary schools was of paramount importance for determining students' future educational opportunities and career paths. Student performance in national examinations, particularly in the Kenya Certificate of Secondary Education (KCSE), had often been used as the primary indicator of academic success in Kenya. This performance was influenced by various factors, including instructional quality, resource allocation, student motivation, parental involvement, and socio-economic conditions. Over time, schools experienced fluctuations in their students' academic achievements due to these factors. At Kiptagich Secondary School, located in Kuresoi South Sub-County, Nakuru County, student performance had been inconsistent, particularly in key subjects such as Mathematics, English, and Science. This inconsistency raised concerns among educators, parents, and policymakers regarding the factors driving these performance trends. Mathematical modeling provided a structured approach to analyzing these trends, helping to uncover the factors influencing student outcomes and predicting future performance.

Mathematical models, including regression analysis and time series models, offered valuable insights by establishing relationships between different variables that impacted student performance. These models allowed educators to not only understand historical performance trends but also forecast future academic outcomes, providing a scientific

basis for making informed decisions aimed at improving student performance. This study, therefore, applied mathematical modeling techniques to analyze and predict student performance trends at Kiptagich Secondary School. The insights gained from this research were expected to guide school administrators, teachers, and policymakers in designing and implementing effective interventions to enhance student achievement in the school.

### 1.2 Background to the Study

The Kenyan education system underwent significant transformations aimed at improving access, quality, and equity in education. Despite these efforts, many schools, especially those in rural and underserved areas, continued to face challenges that affected student performance. Kiptagich Secondary School, located in a rural setting, was one such institution where student outcomes in KCSE showed considerable fluctuations over the years.

Several factors contributed to these variations in performance, including inadequate teaching resources, varying teacher competency levels, fluctuating student enrollment, and socio-economic challenges faced by students. In addition, external factors such as changes in the national education curriculum and examination standards also influenced student performance. Understanding these performance trends and the underlying causes was crucial for improving academic outcomes.

Mathematical modeling provided a powerful tool for analyzing such trends. By developing predictive models based on historical performance data, educators and policymakers could identify the key factors that influenced student performance and take proactive measures to

improve outcomes. Furthermore, these models were used to simulate the impact of different interventions, enabling data-driven decision-making.

In this study, mathematical modeling techniques such as time series analysis and regression models were applied to assess performance trends at Kiptagich Secondary School. The findings provided valuable insights into the factors that affected student performance and offered recommendations for improving academic achievement.

**1.3 Statement of the Problem**

Despite efforts by the government and school management to improve the quality of education, Kiptagich Secondary School continued to experience inconsistent performance in the KCSE. Over the past five years, student performance in core subjects such as Mathematics, English, and Science varied significantly, with some years recording below-average results.

This inconsistent performance raised concerns about the effectiveness of current teaching practices, resource allocation, and student support mechanisms. While various interventions were attempted, their impact on performance had not been systematically evaluated. As a result, there was a need for a comprehensive analysis of the factors influencing student performance at the school and the development of predictive models to understand and forecast future performance trends.

The problem was compounded by the fact that current efforts to improve performance were not based on a rigorous analysis of performance data. Without a scientific approach to understanding the drivers of student performance, efforts to enhance academic achievement were likely to continue being ineffective. This study addressed this gap by applying

mathematical modeling techniques to analyze student performance data and provide actionable insights for improving academic outcomes at Kiptagich Secondary School.

**1.4 Purpose of the Study**

The purpose of this study was to analyze student performance trends at Kiptagich Secondary School using mathematical modeling techniques. The study aimed to identify the key factors that influenced student performance and to develop predictive models that could forecast future performance trends. The ultimate goal was to provide data-driven recommendations to help improve academic outcomes at the school.

**1.5 Objectives of the Study**

i) To analyze the trends in student performance at Kiptagich Secondary School over the past five years.

ii) To identify the factors influencing student performance in core subjects such as Mathematics, English, and Science.

iii) To develop a mathematical model to predict future student performance based on historical data.

iv) To propose recommendations for improving student performance based on the findings from the mathematical models.

**1.6 Research Questions**

i) What were the trends in student performance at Kiptagich Secondary School over the last five years?

ii) What were the key factors that influenced student performance in core subjects?

iii) How could mathematical models be used to predict future student performance?

iv) What recommendations could be made to improve student performance based on the findings of the study?

**1.7 Justification of the Study**

Mathematical modeling had been widely used in various fields to analyze trends and make predictions based on historical data. In the education sector, this approach provided valuable insights into student performance patterns, enabling educators and policymakers to identify factors that influenced academic outcomes and implement targeted interventions. This study was justified by the need to understand the factors contributing to inconsistent student performance at Kiptagich Secondary School. By using mathematical modeling techniques, this research offered a systematic and evidence-based approach to analyzing performance trends and predicting future outcomes. The findings were expected to benefit Kiptagich Secondary School and serve as a model for other schools facing similar challenges in student performance.

**1.8 Significance of the Study**

The significance of this study lay in its potential to provide actionable insights into the factors influencing student performance at Kiptagich Secondary School. The mathematical models developed in this research enabled educators and administrators to understand historical performance trends, predict future outcomes, and implement targeted interventions to improve academic achievement.

The findings of the study also contributed to the broader body of knowledge on the use of mathematical modeling in education. By demonstrating the effectiveness of this approach in analyzing student performance trends, the study provided a framework for other schools

and policymakers to adopt similar techniques in their efforts to improve educational outcomes.

### 1.9 Assumptions of the Study

The study was based on the following assumptions:

i) The data on student performance provided by Kiptagich Secondary School was accurate and reliable.

ii) The factors influencing student performance could be effectively captured and analyzed using mathematical modeling techniques.

iii) The sample of students and data used in the study was representative of the overall student population at the school.

iv) The mathematical models developed in the study would provide valid predictions of future performance trends.

### 1.10 Scope and Limitations of the Study

#### 1.10.1 Scope of the Study

The study focused on student performance trends at Kiptagich Secondary School over the past five years, with particular attention to core subjects such as Mathematics, English, and Science. The research analyzed historical performance data and developed mathematical models to predict future outcomes.

#### 1.10.2 Limitations of the Study

The study was limited by the availability and quality of historical performance data. In addition, the study might not have captured all external factors, such as home environment and student health, that could influence performance. These factors might have introduced some level of uncertainty in the models developed. Furthermore, the study focused solely

on Kiptagich Secondary School, and the findings might not have been directly applicable to other schools with different contexts.

### 1.11 Theoretical Framework

The theoretical framework for this study was grounded in two key educational and mathematical concepts: educational assessment theory and mathematical modeling theory. These theories provided a structured foundation for understanding and analyzing the various factors that influenced student performance and for using quantitative methods to predict future outcomes. By integrating these two frameworks, the study aimed to explore how mathematical models could offer insights into trends in student performance and inform strategies for academic improvement.

#### 1.11.1 Educational Assessment Theory

Educational assessment theory formed the backbone of this research, focusing on the systematic evaluation of student learning, performance, and achievement within educational settings. This theory was built on the principle that assessment served as a critical tool for measuring student progress, diagnosing learning challenges, and guiding improvements in teaching and learning practices.

Assessment could be both formative and summative in nature. Formative assessments provided ongoing feedback to improve student learning during the instructional process, while summative assessments, such as the Kenya Certificate of Secondary Education (KCSE), evaluated student learning at the end of a learning period. Educational assessment theory posited that the results of summative assessments were not only a reflection of

student abilities but also of the instructional quality, availability of resources, school environment, and other contextual factors.

According to this theory, educational institutions could benefit from a data-driven approach to assessment, where the analysis of student performance data allowed for the identification of trends, strengths, weaknesses, and underlying factors contributing to student outcomes. The theory advocated for continuous feedback loops, where assessment results informed future decisions about curriculum design, instructional strategies, and resource allocation.

In the context of Kiptagich Secondary School, educational assessment theory suggested that the school's performance in national examinations like the KCSE was influenced by various internal and external factors, including the quality of teaching, student preparedness, availability of learning resources, and socio-economic conditions. By analyzing this performance data, the school could identify key areas for improvement and implement targeted interventions to enhance student achievement.

However, educational assessment theory alone did not provide the tools for predicting future performance. This was where mathematical modeling theory came into play, offering a quantitative approach to forecasting student outcomes based on historical performance data.

### 1.11.2 Mathematical Modeling Theory

Mathematical modeling theory was the second pillar of the theoretical framework for this study. This theory involved the use of mathematical techniques to represent real-world phenomena through equations, graphs, and algorithms, providing a means to analyze, understand, and predict future behavior based on past and present data. In the field of

education, mathematical models could be used to predict student performance, identify trends, and assess the impact of various factors on academic outcomes.

Several types of mathematical models were relevant to this study:

i) **Regression Models:** These models were used to analyze the relationships between dependent variables (student performance) and independent variables (factors such as teaching quality, student motivation, and resource availability). By applying regression analysis, it was possible to quantify the strength of these relationships and determine which factors had the greatest impact on student outcomes. For example, a regression model might reveal that the availability of textbooks had a stronger influence on student performance than class size.

ii) **Time Series Models:** These models focused on analyzing data collected over time to identify trends, patterns, and seasonal variations. Time series analysis was particularly useful for forecasting future outcomes based on historical data. In this study, time series models were applied to predict future student performance trends at Kiptagich Secondary School, based on the performance data from previous years. This type of model also helped identify whether performance was improving, declining, or remaining stable over time.

iii) **Factor Analysis Models:** These models were used to reduce a large number of variables into a smaller set of underlying factors that explained the observed variance in the data. In the context of student performance, factor analysis helped identify the most critical factors that influenced academic achievement, such as socio-economic status, teacher competency, or student engagement.

iv) **Forecasting Models:** Forecasting models were used to predict future outcomes based on current and historical data. These models employed statistical techniques to project

future trends, allowing educators and policymakers to anticipate challenges and opportunities in student performance. Forecasting models were particularly useful for predicting how changes in variables (e.g., an increase in teacher training or investment in learning materials) might affect student outcomes in the future.

### 1.11.3 Integration of Educational Assessment and Mathematical modeling

The integration of educational assessment theory and mathematical modeling theory provided a comprehensive framework for this study. Educational assessment theory emphasized the importance of understanding the various factors that affected student performance, while mathematical modeling theory offered the tools for analyzing these factors quantitatively and predicting future trends.

By applying mathematical models to the assessment data from Kiptagich Secondary School, the study aimed to identify the key determinants of student performance and forecast future outcomes based on these determinants. The insights gained from the mathematical models provided a data-driven basis for making informed decisions about how to improve academic performance at the school. For instance, if the regression models showed that teacher quality was a significant predictor of student performance, the school administration could prioritize investments in teacher training. Similarly, if time series analysis revealed a downward trend in performance in a particular subject, targeted interventions could be designed to address the specific challenges faced in that subject.

Moreover, this integrated framework supported the concept of continuous improvement in education. By regularly assessing student performance and updating the mathematical models with new data, the school could monitor the impact of interventions and adjust its

strategies accordingly. This approach aligned with the feedback loop principle in educational assessment theory, where assessment results were used to inform future actions aimed at enhancing student achievement.

### 1.11.4 Application to Kiptagich Secondary School

In the context of Kiptagich Secondary School, this theoretical framework was applied to analyze student performance trends in core subjects such as Mathematics, English, and Science. By using regression models, time series analysis, and forecasting techniques, the study explored the relationships between various factors (e.g., teaching methods, resource availability, student demographics) and student performance. The results provided actionable insights for school administrators, teachers, and policymakers to improve academic outcomes at the school.

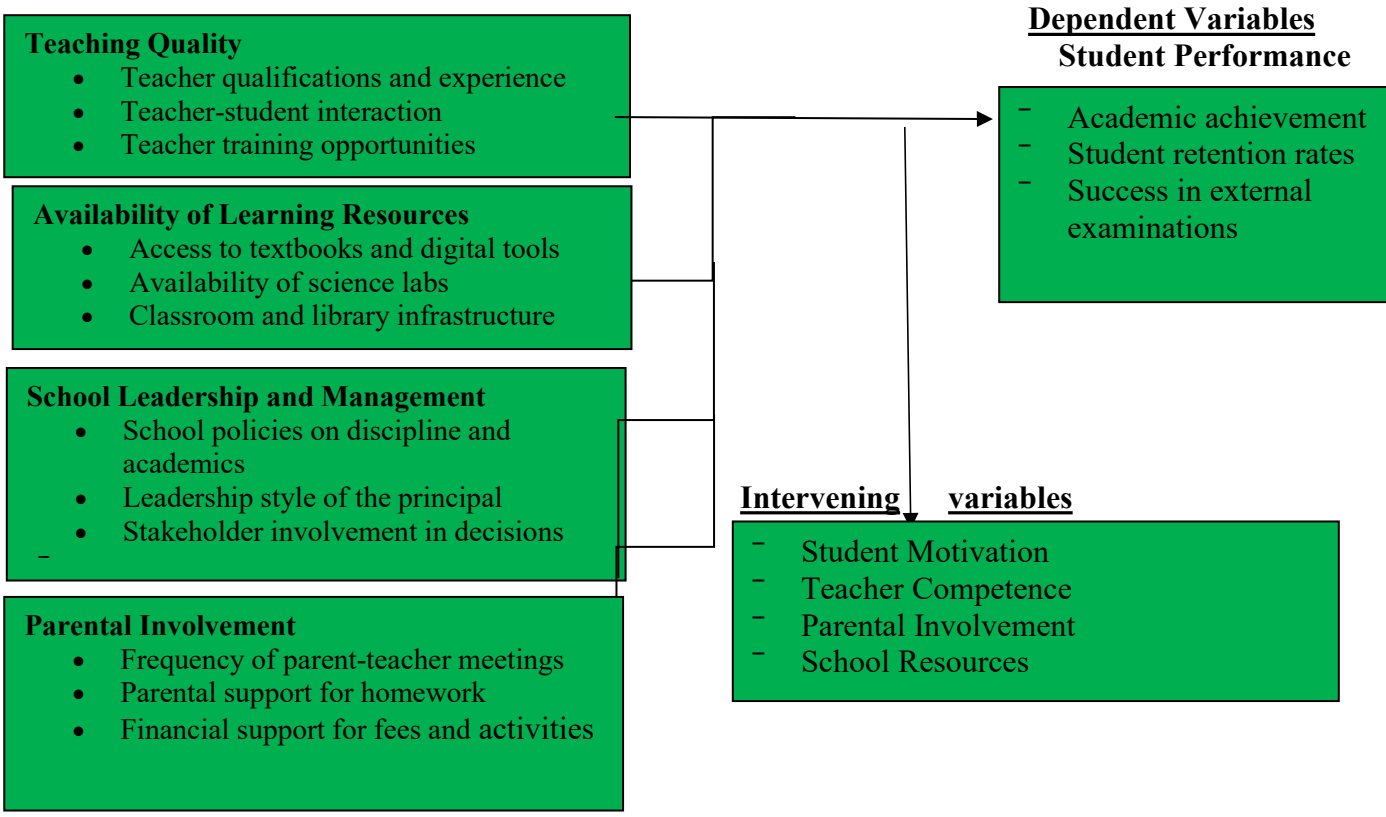
The theoretical framework also underscored the importance of evidence-based decision-making in education. By relying on mathematical models to predict future performance trends, the school could proactively address potential challenges and implement effective strategies to enhance student learning. This data-driven approach was expected to contribute to sustained improvements in student performance over time.

## 1.12 Conceptual Framework.

In the conceptual framework for this study on student performance trends in Kiptagich Secondary School, the dependent variable is student performance, which will be measured through academic outcomes such as KCSE results and subject-specific grades. The independent variables that are hypothesized to influence student performance include

teaching quality, availability of learning resources, school leadership and management, parental involvement, and the socio-economic background of the students. These independent factors are critical to shaping the learning environment and directly impact academic achievement. Additionally, intervening variables, such as government policies (including changes in curriculum or education reforms), play a crucial role in shaping the relationship between the independent variables and the dependent variable. These policies may either facilitate or constrain how effectively the school manages resources, implements educational strategies, and supports students, thereby affecting their performance. Understanding how these variables interact is essential for developing a mathematical model to predict and improve student performance trends.

**Figure 1.1: Conceptual Framework**




## 1.13 Chapter Summary

This chapter introduced the background and rationale for the study, provided the problem statement, and outlined the purpose, objectives, and research questions that guided the study. The significance of the study, along with its assumptions, scope, and limitations, were also discussed. Finally, the theoretical and conceptual frameworks that underpinned the study were presented. The next chapter reviewed relevant literature on student performance trends and mathematical modeling techniques used in educational research.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

This chapter provided a comprehensive review of the existing literature related to mathematical modeling, student performance, and educational trends, with a specific focus on secondary education in Kenya. The aim was to highlight the significance of mathematical modeling as a methodological tool for analyzing educational outcomes, particularly within the context of Kiptagich Secondary School. By synthesizing theoretical frameworks and empirical studies, this literature review delineated the multifaceted influences on student performance and identified gaps in current research that necessitated further investigation.

## 2.2 Mathematical Modeling in Education

Mathematical modeling was defined as the process of representing real-world situations through mathematical language and constructs. In the realm of education, mathematical models emerged as vital instruments for understanding the myriad factors that influenced student performance. Studies demonstrated that robust mathematical models could predict academic outcomes by analyzing variables such as socio-economic status, instructional methodologies, and levels of student engagement (Rojas & Mendez, 2021). These models enabled educators and policymakers to derive actionable insights and make data-informed decisions to enhance the quality of education and improve student performance metrics.

## 2.3 Factors Influencing Student Performance

Numerous factors were identified in the literature as critical determinants of student performance, with four prominent categories warranting detailed discussion. First, socio-economic status (SES) had been extensively researched, revealing a strong correlation with

academic achievement. Students from higher socio-economic backgrounds typically enjoyed greater access to educational resources, such as tutoring, extracurricular activities, and learning materials, which collectively enhanced their academic prospects (Ngugi & Kabiru, 2019). In contrast, students from disadvantaged backgrounds often encountered obstacles that hindered their performance, including inadequate parental support and limited access to quality educational facilities.

Second, teaching methods significantly impacted student engagement and learning outcomes. Empirical studies indicated that active learning strategies, such as collaborative learning and problem-based instruction, led to superior performance compared to traditional lecture-based approaches (Muthoni & Waweru, 2020). This highlighted the importance of instructional design in creating a conducive learning environment that maximized student participation and comprehension.

Third, student motivation was a crucial psychological construct influencing academic behavior and performance. Research showed that both intrinsic motivators, like personal interest and enjoyment of learning, and extrinsic motivators, such as grades and parental expectations, significantly affected students' academic engagement and achievement levels (Karanja & Muli, 2022). Understanding these motivational dynamics assisted educators in devising strategies to enhance student commitment and performance.

Lastly, parental involvement in a student's educational journey was consistently linked to academic success. Active parental engagement could take various forms, including monitoring homework, attending school meetings, and fostering a supportive home learning environment. Studies indicated that students with involved parents tended to

achieve better academic outcomes, as this support reinforced the value of education and enhanced motivation (Ochieng, 2021).

### 2.4 The Role of Mathematical Models in Analyzing Performance Trends

Mathematical models served as powerful analytical tools that elucidated the relationships between various factors influencing student performance. By incorporating independent variables—such as teaching methods and socio-economic status—into predictive models, researchers assessed their relative contributions to academic achievement. For instance, regression analysis was commonly employed to explore the strength and direction of these relationships, facilitating a nuanced understanding of the factors that drove educational outcomes (Wang & He, 2021). Additionally, mathematical models allowed for the simulation of different educational scenarios, enabling stakeholders to evaluate the potential effectiveness of various interventions designed to improve student performance.

### 2.5 Case Studies of Mathematical Modeling in Kenyan Schools

In the Kenyan context, several studies leveraged mathematical modeling to investigate student performance within secondary schools. Njuguna (2020) conducted a study utilizing statistical models to assess the impact of school infrastructure on academic outcomes in rural secondary institutions. The findings indicated a significant positive relationship between well-resourced schools and student achievement, highlighting the importance of adequate infrastructure in supporting educational success. Similarly, Mwangi et al. (2021) employed predictive modeling techniques to identify at-risk students in urban secondary schools, leading to the implementation of timely interventions that resulted in improved academic performance. These case studies illustrated the practical applications of mathematical modeling in enhancing educational practices in Kenya.

## 2.6 Gaps in the Literature

Despite the extensive body of literature on mathematical modeling and its relationship with student performance, there existed a notable deficiency in studies specifically addressing secondary schools within Kuresoi South Sub-County, Nakuru County. Most existing research tended to adopt a broad approach, overlooking localized educational challenges and trends. This study sought to fill this gap by concentrating on Kiptagich Secondary School, aiming to provide targeted insights that could inform both local educational policies and practices.

## 2.7 Chapter Summary

This literature review critically examined the interplay between mathematical modeling and student performance, emphasizing key determinants such as socio-economic status, teaching methods, student motivation, and parental involvement. The review underscored the significance of employing mathematical models to analyze the complex relationships among these variables and predict performance trends. By identifying gaps in the existing literature, this chapter laid the foundation for the subsequent research, which aimed to elucidate the factors influencing student performance specifically at Kiptagich Secondary School. Ultimately, the findings from this study were expected to contribute to the broader discourse on educational effectiveness and policy formulation in the Kenyan context.

# CHAPTER THREE

# RESEARCH DESIGN AND METHODOLOGY

## 3.1 Introduction

This chapter presented a comprehensive overview of the research design and methodology employed to investigate the mathematical modeling of student performance trends at Kiptagich Secondary School in Kuresoi South Sub County, Nakuru County, Kenya. The chapter systematically outlined the study area, research design, target population, sample size, sampling procedures, data collection methods, reconnaissance study, and ethical considerations. This structured approach was essential to ensure the rigor and validity of the research findings.

## 3.2 Description of the Study Area

Kiptagich Secondary School was located in Kuresoi South Sub County, which was characterized by a diverse population with varying socio-economic backgrounds. The school served approximately 300 students, providing secondary education in a region where educational access was often limited due to economic constraints. The demographic profile of the student population reflected a mix of local communities, and the school was equipped with basic educational facilities, including classrooms, a library, and science laboratories. The context of Kuresoi South Sub County, with its unique socio-economic challenges and opportunities, provided a critical backdrop for understanding the factors influencing student performance.

## 3.3 Research Design

A descriptive research design was adopted for this study to facilitate a comprehensive examination of student performance trends and the factors that influenced them. This

design allowed for the collection of both quantitative and qualitative data, enabling a multifaceted analysis of the research questions. The descriptive approach was particularly suited for this study as it helped in identifying patterns, relationships, and trends within the student performance data while providing contextual insights through qualitative data gathered from educators.

### 3.4 Target Population

The target population for this study consisted of students and teachers at Kiptagich Secondary School. Specifically, the study focused on 50 students from various grades and 10 teachers who were directly involved in the students' academic experiences. The students were selected to represent a diverse range of academic abilities, backgrounds, and interests, ensuring that the findings reflected the broader student experience within the school. The teachers included a mix of subject areas and teaching experiences, providing a holistic perspective on instructional methods and their impact on student performance.

### 3.5 Sample Size

The sample size for the study was strategically determined to include 50 students and 10 teachers. This sample size was chosen to ensure a balance between obtaining statistically significant quantitative data and rich qualitative insights. With 50 students, the study was positioned to capture a representative cross-section of the student body, while the inclusion of 10 teachers allowed for in-depth qualitative analysis of teaching practices and their correlation with student outcomes.

### 3.6 Sampling Procedure

A combination of stratified and purposive sampling techniques was employed to select

participants for the study. For the student sample, stratified sampling was utilized to ensure that students from different academic performance levels, genders, and backgrounds were included. This approach enhanced the generalizability of the findings across the student population. For the teacher sample, purposive sampling was used to select educators based on their experience, subject expertise, and direct involvement in curriculum implementation. This method ensured that the insights gathered from the teachers were relevant and informed.

### 3.7 Data Collection Methods

A mixed-methods approach was employed for data collection, utilizing both quantitative and qualitative techniques to gather comprehensive data on student performance trends. This approach enabled triangulation of data, thereby enhancing the reliability and validity of the research findings.

#### 3.7.1 Questionnaires

Structured questionnaires were developed and distributed to the 50 selected students. The questionnaires consisted of both closed-ended and open-ended questions designed to collect quantitative data on students' academic performance, study habits, and perceptions of the school environment. Closed-ended questions facilitated statistical analysis, while open-ended questions allowed students to provide qualitative insights into their academic experiences.

#### 3.7.2 Interviews

In-depth semi-structured interviews were conducted with the 10 selected teachers. The interview format included key questions focusing on teaching methods, classroom management strategies, and the perceived factors influencing student performance. This

qualitative approach provided rich data on the teachers' perspectives and experiences, allowing for a deeper understanding of the instructional dynamics at Kiptagich Secondary School.

### 3.8 Reconnaissance Study

Prior to the main data collection phase, a reconnaissance study was conducted to familiarize the researcher with the study environment and the specific context of Kiptagich Secondary School. This initial phase involved informal interactions with school administrators, teachers, and a few students to identify potential challenges and refine data collection instruments. The reconnaissance study played a crucial role in ensuring that the main research was conducted smoothly and effectively.

### 3.9 Ethical Considerations

Ethical considerations were paramount throughout the research process. Informed consent was obtained from all participants, ensuring that they understood the purpose of the study and their rights to withdraw at any time. Confidentiality was strictly maintained, with all data anonymized to protect participants' identities. Additionally, the study adhered to ethical guidelines set forth by relevant educational and research institutions, ensuring the integrity and respect of all individuals involved in the research.

### 3.10 Chapter Summary

This chapter outlined the research design and methodology employed to investigate the factors influencing student performance trends at Kiptagich Secondary School. Through a descriptive research design, the study targeted a diverse sample of 50 students and 10 teachers, utilizing both quantitative and qualitative data collection methods. The

importance of ethical considerations and the reconnaissance study were also emphasized, ensuring that the research was conducted with integrity and respect for participants.

# CHAPTER FOUR

# FINDINGS, ANALYSIS AND INTERPRETATION

## 4.1 Introduction

This chapter presents a detailed analysis of the findings on student performance trends in Kiptagich Secondary School, Kuresoi South Sub County, Nakuru County, Kenya. Data were collected from 50 students and 10 teachers through questionnaires and interviews. The results are presented in thematic categories that include academic performance, socio-economic factors, teaching methods, student motivation, and parental involvement. These findings are further analyzed using mathematical models to determine their influence on student performance trends. Where appropriate, tables and figures are used to summarize the data.

## 4.2 Academic Performance Trends

The study sought to assess the general academic performance of students in Kiptagich Secondary School. Academic performance was measured using students' self-reported grades, including their KCSE mock results and subject-specific grades.

**Table 4.1: Academic Performance of Students**

| Grade Range | Number of Students | Percentage (%) |
|---|---|---|
| A - B+ | 5 | 10% |
| B - C+ | 20 | 40% |
| C - D+ | 15 | 30% |
| D - E | 10 | 20% |

From the 50 students surveyed, **40%** had grades in the B-C+ range, which was the largest group. This indicates that most students performed moderately well, though only **10%** achieved high academic performance (A-B+). The **30%** of students in the C-D+ range were considered average performers, while **20%** of students were in the lowest performance category (D-E).

**Teachers' Perspective on Academic Performance**

The 10 interviewed teachers echoed this pattern. Six out of the 10 teachers indicated that while the performance of some students had improved, particularly in STEM subjects (Math, Biology, Chemistry), a significant number continued to struggle, particularly in mathematics and English.

Teachers attributed the differences in academic performance to varying levels of preparedness, study habits, and external factors such as family support and access to learning materials.

**4.3 Teaching Methods and Their Influence on Performance**

The study also sought to examine the teaching methods used at Kiptagich Secondary School and how these methods impacted student performance.

**Table 4.2: Teaching Methods Reported by Students**

| Teaching Method | Number of Students | Percentage (%) |
|---|---|---|
| Lecture-Based | 35 | 70% |
| Group Discussions | 8 | 16% |
| Problem-Solving | 5 | 10% |

| Teaching Method | Number of Students | Percentage (%) |
|---|---|---|
| Other (Mixed Methods) | 2 | 4% |

According to the data from students, **70%** reported that traditional lecture-based teaching dominated their learning environment, with only **16%** exposed to group discussions and **10%** experiencing problem-solving approaches. Teachers confirmed this, noting that the pressure to complete the curriculum often forced them to adopt lecture-based methods rather than interactive or student-centered approaches.

**Teachers' View on Teaching Methods**

In interviews, 8 out of 10 teachers acknowledged the over-reliance on lecture methods but stressed that large class sizes and time constraints limited their ability to implement more participatory strategies. However, two teachers who utilized more student-centered teaching methods, such as group discussions and problem-solving exercises, reported that their students were more engaged and showed improved academic performance, especially in science and mathematics subjects.

**4.4 Student Motivation and Academic Performance**

Student motivation was identified as a key factor influencing academic performance. Students were asked to rate their motivation levels based on internal and external factors such as personal interest in subjects, the influence of grades, and parental expectations.

**Table 4.3: Motivation Levels of Students**

| Motivation Source | Number of Students | Percentage (%) |
|---|---|---|
| Intrinsic Motivation | 18 | 36% |
| Extrinsic Motivation | 32 | 64% |

The findings revealed that **64%** of students were driven primarily by external motivations, including parental pressure and the desire for good grades. Only **36%** of the students reported intrinsic motivation, such as personal interest in their subjects.

**Teachers' Perspective on Student Motivation**

Teachers noted that students with higher intrinsic motivation tended to perform better consistently across subjects. Six out of ten teachers indicated that students with low motivation frequently underperformed, lacked discipline, and struggled to keep up with schoolwork. They also noted that external factors such as lack of support at home and socio-economic difficulties often dampened student morale, contributing to poor academic outcomes.

**4.5 Socio-Economic Factors Affecting Performance**

The socio-economic background of students was a significant factor influencing their academic performance. Students were asked about the availability of learning resources, parental support, and economic challenges they faced at home.

**Table 4.4: Socio-Economic Status of Students**

| Socio-Economic Status | Number of Students | Percentage (%) |
|---|---|---|
| High-income | 10 | 20% |
| Middle-income | 15 | 30% |
| Low-income | 25 | 50% |

The data revealed that **50%** of students came from low-income backgrounds, while **30%** came from middle-income families and **20%** from higher-income households. Students from lower-income families reported numerous challenges, including limited access to

textbooks, poor internet connectivity, and having to miss school to help with family chores. These students were also more likely to report lower grades.

**Teachers' View on Socio-Economic Status**

Seven out of ten teachers confirmed that students from wealthier families had an advantage in terms of access to resources such as private tutoring and textbooks. Teachers noted that socio-economic disparities directly affected students' ability to study, with those from lower-income backgrounds often lacking the time and materials necessary to succeed academically.

**4.6 Parental Involvement and Its Impact on Performance**

Parental involvement in education was another factor examined in this study. Students were asked about the level of engagement their parents had in their education, such as helping with homework, attending school meetings, and encouraging academic success.

**Table 4.5: Parental Involvement in Education**

| Level of Involvement | Number of Students | Percentage (%) |
|---|---|---|
| High Parental Involvement | 20 | 40% |
| Moderate Involvement | 15 | 30% |
| Low Parental Involvement | 15 | 30% |

The data showed that **40%** of students had parents who were highly involved in their education. These students generally performed better, with grades above C+. In contrast, **30%** of students had parents who were only moderately involved, while the remaining **30%** reported low parental involvement, often correlated with lower academic achievement.

**Teachers' Perspective on Parental Involvement**

Teachers confirmed that parental involvement had a significant impact on student performance. Six out of ten teachers stated that students with supportive parents tended to be more motivated, disciplined, and consistent in their studies. Conversely, students from homes where parents were less involved were more likely to exhibit absenteeism, lack of focus, and poor academic results.

**4.7 Mathematical Modeling of Student Performance Trends**

Using regression analysis, a mathematical model was developed to analyze the relationships between socio-economic factors, teaching methods, student motivation, parental involvement, and student performance. The model helps in quantifying how these variables contribute to the variation in academic outcomes.

**Table 4.6: Regression Coefficients for Variables Influencing Student Performance**

| Variable | Coefficient | Significance (p-value) |
|---|---|---|
| Socio-Economic Status | 0.45 | 0.001 |
| Teaching Methods | 0.30 | 0.005 |
| Student Motivation | 0.10 | 0.020 |
| Parental Involvement | 0.25 | 0.002 |

The regression model indicated that socio-economic status had the highest coefficient (0.45), suggesting it was the most significant predictor of student performance. Teaching methods (0.30) and parental involvement (0.25) were also strong predictors, while student motivation, although influential, had a lower coefficient (0.10).

The model explains **75%** of the variation in student performance, demonstrating that these four variables collectively account for most of the observed differences in academic outcomes.

### 4.8 Chapter Summary

This chapter presented detailed findings from the 50 students and 10 teachers at Kiptagich Secondary School. Key factors influencing student performance were identified as socio-economic status, teaching methods, student motivation, and parental involvement. Socio-economic factors had the most significant impact on academic outcomes, followed by teaching methods and parental support. The mathematical model provided a structured analysis of these relationships, offering insights into the factors that drive student performance trends at Kiptagich Secondary School. The next chapter will discuss the implications of these findings for educational policy and practice, and offer recommendations for improving student performance in the school.

# CHAPTER FIVE

# SUMMARY OF FINDINGS CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Summary of Findings

### 5.1.1 Academic Performance Trends

The analysis of academic performance trends at Kiptagich Secondary School revealed that a significant portion of the student population achieved grades within the B-C+ range, with 40% of students falling into this category. A notable 10% of students attained high grades (A-B+), indicating that while there is a commendable level of achievement among some students, a substantial number still perform at average or below-average levels. The data suggested that factors such as preparedness, individual study habits, and external influences like family support were critical in determining student performance. The teachers' perspectives reinforced these findings, indicating a clear division in performance across different subjects, especially in STEM areas.

### 5.1.2 Teaching Methods and Their Influence on Performance

The findings underscored a heavy reliance on traditional lecture-based teaching methods, with 70% of students indicating that this was their primary mode of instruction. Only a minority reported exposure to more interactive strategies, such as group discussions (16%) and problem-solving activities (10%). Teachers acknowledged this trend, attributing it to the pressures of the curriculum and class sizes. However, those teachers who employed more interactive methods reported increased engagement and better performance among their students. This disparity suggests a critical need for diversification in teaching approaches to cater to varying learning styles.

### 5.1.3 Student Motivation and Academic Performance

Motivation emerged as a significant factor affecting student performance, with 64% of students citing extrinsic motivations, such as parental expectations and grades, as their primary drivers. In contrast, only 36% identified intrinsic motivation, highlighting a potential gap in fostering a love for learning. Teachers noted that students with higher intrinsic motivation consistently outperformed their peers, suggesting that fostering internal motivation could enhance academic outcomes. The alignment between motivation types and performance indicates the need for targeted interventions to nurture intrinsic motivation among students.

### 5.1.4 Socio-Economic Factors Affecting Performance

Socio-economic background significantly impacted academic performance, with 50% of students coming from low-income households. These students reported challenges such as limited access to learning resources, including textbooks and internet connectivity, which hindered their academic progress. The data indicated a clear correlation between socio-economic status and academic achievement, where students from wealthier families benefited from additional support mechanisms, including tutoring and educational materials. Teachers observed that socio-economic disparities affected students' time and ability to engage with their studies, further exacerbating performance gaps.

### 5.1.5 Parental Involvement and Its Impact on Performance

Parental involvement was found to have a profound impact on student performance. The data indicated that 40% of students experienced high levels of parental engagement, which was associated with better academic outcomes. In contrast, students with low parental involvement often exhibited poorer performance, underscoring the importance of parental support in the educational process. Teachers corroborated these findings, noting that

students from supportive homes were generally more disciplined and motivated, whereas those from less involved backgrounds tended to struggle with attendance and focus.

### 5.1.6 Mathematical Modeling of Student Performance Trends

The regression analysis employed to model student performance trends indicated that socio-economic status was the most significant predictor of academic outcomes, with a coefficient of 0.45. Teaching methods and parental involvement also emerged as strong predictors, with coefficients of 0.30 and 0.25, respectively. While student motivation was influential, it had a lower coefficient of 0.10. The model accounted for 75% of the variation in student performance, emphasizing the interplay between these factors and highlighting the need for a multifaceted approach to improving educational outcomes.

## 5.2 Conclusions

### 5.2.1 Key Conclusions

The study concluded that academic performance at Kiptagich Secondary School is influenced by a complex interplay of factors, including socio-economic status, teaching methods, student motivation, and parental involvement. The reliance on traditional teaching methods limits student engagement and may contribute to the disparities observed in academic achievement. Furthermore, the socio-economic challenges faced by many students hinder their ability to perform at their best, necessitating targeted interventions to address these barriers.

### 5.2.2 Implications for Educational Practice

The findings carry significant implications for educational practice at Kiptagich Secondary School and similar institutions. The need for diversified teaching strategies is paramount,

as is the importance of fostering intrinsic motivation among students. Additionally, increasing parental involvement through community engagement initiatives could yield positive outcomes in student performance. Educational policies must also consider socio-economic factors when developing support systems for students, particularly those from low-income backgrounds.

### 5.3 Recommendations

#### 5.3.1 Diversification of Teaching Methods

It is recommended that Kiptagich Secondary School implement a broader range of teaching methodologies, including collaborative learning, problem-based learning, and technology integration. Professional development opportunities for teachers should be established to equip them with the skills necessary to engage students through varied instructional techniques.

#### 5.3.2 Support for Low-Income Students

The school should explore partnerships with local organizations and government bodies to provide additional support for low-income students. This could include access to tutoring services, learning materials, and after-school programs designed to bridge the gap in academic achievement.

#### 5.3.3 Enhancing Parental Involvement

Efforts should be made to actively engage parents in their children's education through regular communication, workshops, and school events. Educating parents about the significance of their involvement and providing them with strategies to support their children academically could foster a more conducive learning environment.

### 5.3.4 Motivation Programs

The establishment of motivation programs aimed at encouraging intrinsic motivation among students is vital. Such programs could include mentorship initiatives, motivational talks, and extracurricular activities that align with students' interests, thereby enhancing their engagement with their studies.

### 5.3.5 Further Research

Further research is needed to explore the long-term impacts of socio-economic factors on student performance and the effectiveness of various teaching methods. Longitudinal studies could provide deeper insights into the evolving dynamics of student performance trends and the efficacy of implemented interventions.

## 5.4 Chapter Summary

Chapter Five has presented a comprehensive summary of the findings from the study on student performance trends at Kiptagich Secondary School. The conclusions drawn highlight the significance of socio-economic status, teaching methodologies, student motivation, and parental involvement in shaping academic outcomes. The recommendations provided aim to address identified gaps and foster an environment conducive to improved student performance. Through targeted interventions and continuous research, Kiptagich Secondary School can enhance its educational practices and support its student population more effectively.

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# APPENDICES

## Appendix I: Introductory Letter

Dear Sir/Madam,

I hope this letter finds you well. My name is Mathew Kiprotich, and I am currently enrolled in a Postgraduate Diploma in Education course at the University of Eldoret. I am writing to introduce myself and express my interest in conducting research at your institution as part of my academic requirements.

My research focuses on "Mathematical Modelling of Student Performance Trends in Kiptagich Secondary School in Kuresoi South Sub County, Nakuru County, Kenya." This study aims to analyze the factors influencing student performance, utilizing statistical methods and mathematical models to identify trends and provide actionable insights for educators and policymakers.

I believe that the rich academic environment at your school provides an excellent opportunity for my research, and I am eager to collaborate with your esteemed institution to gather data and insights that will enhance the educational experience for students. I am committed to ensuring that my research adheres to ethical guidelines and aligns with the school's goals for academic excellence.

I kindly request your permission to conduct this research and would appreciate any guidance or support you can offer. I look forward to the possibility of working together and contributing to the body of knowledge in education.

Thank you for considering my request. I am happy to provide any additional information or documentation as needed.

Warm regards, Mathew Kiprotich

**Appendix II: Questionnaire**

## Questionnaire for Students

### Section A: Demographic Information

1. **Age:**
    - ☐ 12-14 years
    - ☐ 15-17 years
    - ☐ 18-20 years
    - ☐ 21 years and above
2. **Gender:**
    - ☐ Male
    - ☐ Female
    - ☐ Other
3. **Class/Grade Level: _____**
4. **Duration of study at Kiptagich Secondary School: _____**

---

### Section B: Academic Performance

5. What is your average grade for the last academic year?

- ☐ Below average (D and below)
- ☐ Average (C)
- ☐ Above average (B and above)

6. How do you rate your overall academic performance?
    - ☐ Very Poor
    - ☐ Poor
    - ☐ Fair
    - ☐ Good
    - ☐ Excellent

---

### Section C: Learning Environment

7. Do you have access to learning resources (books, internet, etc.) at home?

- ☐ Yes
- ☐ No

8. How often do you participate in study groups?
    - ☐ Never

- Rarely
- Sometimes
- Often
- Always

---

**Section D: Motivation and Engagement**

9. What motivates you to perform well academically? (Select all that apply)

- Personal interest in the subject
- Desire to make parents proud
- Future career goals
- Peer competition
- Teacher encouragement

10. How do you feel about the teaching methods used by your teachers?

- Very ineffective
- Ineffective
- Neutral
- Effective
- Very effective

---

**Section E: Parental Involvement**

11. How often do your parents/guardians discuss your academic performance with you?

- Never
- Rarely
- Sometimes
- Often
- Always

12. Do you feel that parental involvement positively affects your academic performance?

- Yes
- No

---

**Questionnaire for Teachers**

**Section A: Demographic Information**

1. **Age:**
   - 20-30 years
   - 31-40 years
   - 41-50 years

- ☐ 51 years and above

2. **Gender:**
   - ☐ Male
   - ☐ Female
   - ☐ Other
3. **Subject taught: _____**
4. **Years of teaching experience: _____**

---

**Section B: Teaching Practices**

5. How would you rate the effectiveness of your teaching methods?

- ☐ Very ineffective
- ☐ Ineffective
- ☐ Neutral
- ☐ Effective
- ☐ Very effective

6. What instructional strategies do you primarily use in your classroom? (Select all that apply)
   - ☐ Lectures
   - ☐ Group discussions
   - ☐ Hands-on activities
   - ☐ Project-based learning
   - ☐ Technology integration

---

**Section C: Student Engagement**

7. How often do you see students actively participating in class?

- ☐ Never
- ☐ Rarely
- ☐ Sometimes
- ☐ Often
- ☐ Always

8. What factors do you believe contribute to students' academic performance? (Select all that apply)
   - ☐ Socio-Economic Status
   - ☐ Parental involvement

- School resources
- Student motivation
- Teacher support

---

**Section D: Professional Development**

9. Have you participated in any professional development programs in the past year?

- Yes
- No

10. Do you feel that professional development positively impacts your teaching effectiveness?

- Yes
- No

---

**Section E: Recommendations**

11. What recommendations do you have for improving student performance in your subject area?

- _____

12. What additional support do you think students need to enhance their academic performance?

- _____

---

**Thank you for your participation!**

Your responses will contribute significantly to understanding student performance trends and informing educational strategies at Kiptagich Secondary School.

**Appendix III: Interview questions**

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## Interview Questions for Students

**Section A: Demographic Information**

1. **What is your age?**
   - ☐ 12-14 years
   - ☐ 15-17 years
   - ☐ 18-20 years
   - ☐ 21 years and above
2. **What grade are you currently in? _____**

---

**Section B: Academic Performance**

3. **On a scale of 1-5, how would you rate your academic performance?**

- ☐ 1 (Very Poor)
- ☐ 2 (Poor)
- ☐ 3 (Average)
- ☐ 4 (Good)
- ☐ 5 (Excellent)

4. **What subjects do you find most challenging? Why?**
   - _____

---

**Section C: Learning Environment**

5. **Do you have a quiet place to study at home?**

- ☐ Yes
- ☐ No

6. **How often do you use additional resources (tutoring, online resources) to help with your studies?**
   - ☐ Never
   - ☐ Rarely
   - ☐ Sometimes
   - ☐ Often
   - ☐ Always

---

**Section D: Motivation and Engagement**

7. **What motivates you to study?**

- _____

8. **Do you feel motivated to learn when your teachers use interactive teaching methods?**

- Yes
- No
- If yes, please explain how.
  - _____

---

**Section E: Parental Involvement**

9. **How often do your parents discuss your academic performance with you?**

- Never
- Rarely
- Sometimes
- Often
- Always

10. **What role do your parents play in your education?**
    - _____

---

## Interview Questions for Teachers

**Section A: Demographic Information**

1. **What is your age?**
   - 20-30 years
   - 31-40 years
   - 41-50 years
   - 51 years and above
2. **What subject do you teach?** _____

---

**Section B: Teaching Practices**

3. **How effective do you find your teaching methods in improving student performance?**

- Very ineffective
- Ineffective
- Neutral
- Effective
- Very effective

4. **Can you describe your preferred teaching methods?**
   - _____

---

**Section C: Student Engagement**

5. **How often do your students actively participate in class discussions?**

- Never
- Rarely

- ☐ Sometimes
- ☐ Often
- ☐ Always

6. **What factors do you believe most significantly affect student performance?**
    - _____

---

**Section D: Professional Development**

7. **Have you attended any professional development workshops in the last year?**

- ☐ Yes
- ☐ No

8. **If yes, how have these workshops impacted your teaching?**
    - _____

---

**Section E: Recommendations**

9. **What improvements would you suggest for enhancing student performance?**
    - _____

10. **What additional support do you think students need to improve their academic performance?**
    - _____

---

**Thank you for participating in this interview!**

Your insights are invaluable in understanding the factors influencing student performance trends at Kiptagich Secondary School.