RELATIONSHIP BETWEEN UTILIZATION OF PHYSICAL INFRASTRUCTURE AND STUDENTS' ACADEMIC PERFORMANCE IN SECONDARY SCHOOLS IN MACHAKOS COUNTY, KENYA

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ABSTRACT

In recent years, the performance of public secondary schools in Machakos County, Kenya, has shown signs of concern. A closer examination of the KCSE performance data from 2012 to 2020 reveals a fluctuating pattern that warranted investigation. This study aimed at establishing the influence of utilizing physical infrastructure on the students' academic performance in secondary schools in Machakos County. The study was guided by the following objectives: (i) To establish the influence of the utilization of computer laboratories on the performance of KCSE in secondary schools in Machakos County; (ii) To determine the influence of science laboratory utilization on students' academic performance in secondary schools in Machakos County; (iii) To establish the influence of library utilization on students' academic performance in secondary schools in Machakos County. The study was guided by the System Resource Theory by Yutchman and Seashores (1967) and employed a correlational research design. The target population was all 202 public secondary schools in Machakos County. The unit of observation was 43,688 respondents comprising 202 principals, 3,030 teachers, and 40,456 students. Simple random sampling technique was employed to select the 20 public secondary schools which represents 10% of the schools. The study used a census to select 20 principals from the 20 schools because the number was very small. For the remaining respondents, 26 teachers and 338 students for the sample of 20 schools, this study used stratified sampling method. Data were collected through interviews with teachers and questionnaires from students. Pilot testing was conducted to identify potential issues or ambiguities in the instruments and1allows for necessary modifications. Content validity was ensured through consultation with specialists in education management, and reliability was assessed through a test-retest method. Data analysis was s done using descriptive statistics including mean, standard deviation, frequency, and percentages. Regression analysis was used to test the hypotheses at a significance level of 0.05 and to examine the relationship between one or more independent variables (predictors) and a dependent variable (outcome). This study might help policymakers at the Ministry of Education create a framework for how the money would be distributed to public secondary schools to upgrade infrastructure and increase students' and teachers' access to physical resources. The study found that majority of the secondary school students' in Machakos County used the computer lab for academic purposes. Moreover, the study found that the science labs were used for experiments with an appropriate duration and frequency, and the science laboratories were available in their school. The study also found that it was uncertain whether the nature and quality of library facilities contributed to a positive learning environment, and the library facilities were user-friendly and promote effective research and study. The study concludes that utilization of science laboratories (β=0.843, p-value=0.025<0.05) had the greatest influence on student academic performance in secondary schools in Machakos County, followed by utilization of library(β=0.774, p-value=0.008<0.05), while utilization of computer laboratories (β=0.632, p-value=0.023<0.05) had the

least influence on student academic performance in secondary schools in Machakos County. The study recommends that secondary schools in Machakos County should prioritize investment in upgrading and maintaining computer lab resources to ensure adequacy and functionality.

Key terms: Physical Infrastructure, Science Laboratories, Academic Performance, Library, Computer Laboratories.

INTRODUCTION

Learners, environments, content, processes, and outcomes are the five primary characteristics that should be considered when discussing the quality of education (Troussas, Krouska & Sgouropoulou, 2020). The environmental variables include materials for instruction and learning, physical facilities, and the expertise of the educators in charge of transferring knowledge to the students (Barrett, Treves, Shmis & Ambasz, 2019). In order to ensure a high-quality education, it is essential that educational institutions and programs are sufficiently and fairly funded. This funding should primarily be directed towards establishing secure, environmentally conscious, and easily accessible facilities, as well as recruiting and retaining well-qualified, motivated teachers. Additionally, learners must have access to context-specific resources, affordable and accessible technologies, and an ample supply of books to facilitate their learning. The quality of instruction a school offers is influenced by the number of amenities it possesses, affecting how well the pupils perform on tests. Additionally, Murillo and Roman (2011) discovered that a student's academic progress depends on the accessibility of resources like labs, sports facilities, and libraries.

The World Bank (2018) found that the availability of specific critical inputs, such as physical facilities, teachers, and curricula, affects the quality of an educational system. In order to ensure that every kid has an equal opportunity to acquire the skills and information necessary to lead productive and healthy lives, societies and governments worldwide should work to enhance their educational systems by allocating enough financing for essential physical infrastructure.

Barret, Treves, Shmis and Ambasz (2019) define physical infrastructure in schools as the facilities used for teaching and learning, such as classrooms and laboratories. Meanwhile, Nasuna, Arinaitwe, Barigye and Kyayemagye (2021) list a range of components that make up physical infrastructure in schools in Mbarara City, Uganda. These may include computer labs, classrooms, dormitories, dining halls, offices, laboratories, libraries, agriculture rooms, home science rooms, play areas, shops, restrooms/latrines, recreational facilities, and water storage facilities. In a similar study, Midha (2022) distinguished between the structural and primarily aesthetic components of school physical infrastructure. The study examined the structural qualities of schools in India, such as their age, building conditions, amenities like windows, flooring, and heating systems, as well as factors related to the learning environment, including student population, site size, and aesthetic elements like paint job, graffiti, furniture, and landscaping. The findings revealed that the overall condition and aesthetic appeal of the school buildings significantly influenced students' academic performance. Specifically, schools with well-maintained infrastructure and conducive learning environments were associated with higher student achievement and motivation, highlighting the importance of physical infrastructure in enhancing educational outcomes.

According to Nasuna et al. (2021), school "hardware" includes structures and amenities like playgrounds and cafeterias, and "software" includes learning tools like textbooks and equipment. A well-rounded school's infrastructure includes restrooms, water, electricity, computers, desks, seats, and communication tools. This study focused on the relation between the utilization of common physical infrastructure and students' performance. According to Nassirpour, Galasso and D'Ayala's (2018) study in the Philippines, physical capacity is a crucial variable that directly affects students' educational outcomes. Inadequate school facilities can negatively impact students' academic attainment and performance, which highlights the importance of policies and procedures focused on providing and managing resources effectively. The 2007 UNESCO and UNICEF report emphasized that access to quality education is a fundamental right and identified insufficient and unqualified teachers, inadequate physical facilities and resources, and a lack of efficient supervision as barriers to Education for All (EFA).

Recent research in the USA by Michaels and Barone (2020) investigated the impact of students' access to well-equipped computer laboratories on academic achievement. The study revealed a positive correlation between the utilization of computer labs and enhanced performance in STEM (science, technology, engineering, and mathematics) subjects. Additionally, a study conducted by Ustun, Simsek, Karaoglan-Yilmaz and Yilmaz (2022) examined the role of specialized laboratories in improving students' understanding and application of scientific concepts, indicating a positive link between laboratory use and academic success.

In Europe, a study by Landri and Grimaldi (2020) investigated the impact of library and laboratory utilization on academic performance in secondary schools across multiple European countries. The results suggested that schools with effective utilization of both libraries and laboratories experienced higher academic success rates, emphasizing the importance of integrated physical infrastructure. Turning to Asia, a study by Hajar and Karakus (2022) explored the role of libraries in enhancing academic performance in secondary schools across diverse Asian countries. The findings indicated that schools prioritizing library utilization witnessed improvements in students' reading abilities, subsequently impacting academic achievement.

The United Nations (2001) identified quality learners, content, teaching and learning procedures, learning environments that are healthy, hygienic, and safe, and quality outcomes as essential components of educational policies and programs to increase educational quality. In Sub-Saharan Africa, member states emphasized their commitment to education quality through the Framework for Action in Sub-Saharan Africa: Education for African Renaissance in the Twenty-First Century, highlighting "access and equity, quality, and relevance (Sub-Saharan Africa Education for All, 2000)." The African Union Plan of Action for the second decade of Education for Africa (2006-2015) identified physical infrastructure resourcing for the learning environment, learner characteristics, teacher qualification, competence and motivation, relevance of subject matter, professional support for teachers, and good governance as components of education quality. However, managing

education quality remains a challenge for all East Africa Community (EAC) partner states, affecting the delivery of education and training (MOEST, 2015), as noted in the Association for the Development of Education in Africa (ADEA) Policy Brief on the Second Decade for Education in Africa's goals.

The national policy on education in Nigeria establishes the nation's educational objectives. These goals state that oral and practical learning is necessary for students to develop the necessary skills and levels of competence to survive in the modern world (Wordu, 2020). Therefore, it is impossible to overstate the significance of physical resources in achieving these educational objectives. Rosylyne's (2012) investigation on "the influence of physical resources to the attainment of educational goals in Nigeria" supports the previous assertions. The study emphasized that teachers cannot effectively translate the curriculum into practical learning experiences, particularly in subjects like science and technology, without adequate physical resources. It is only possible to cultivate a healthy mind in a healthy environment, which highlights the importance of providing safe and healthy learning environments for students. Therefore, it is crucial to ensure that schools have adequate physical resources, such as facilities and resources, to facilitate effective teaching and learning and achieve educational goals.

Ojuok, Gogo and Olel (2020) found that pupils' academic success is significantly influenced by the availability of resources for teaching and learning, physical infrastructure, and the competence of teachers who are responsible for imparting knowledge. These three factors play a crucial role in determining students' academic achievements. To enhance academic outcomes and contribute to students' overall success, educational institutions must prioritize providing adequate resources for teaching and learning, maintaining and upgrading physical infrastructure, and ensuring that teachers possess the necessary skills and training to effectively impart knowledge. The number of amenities a school has determined the standard of instruction it provides, which in turn impacts how well the students perform on exams (Singh & Kumar, 2017). Additionally, Bada and Laraba (2019) found that the availability of resources like labs, sports facilities, and libraries is responsible for the student's academic success. The availability of specific critical inputs, such as physical facilities, teachers, and curricula, affects the quality of an educational system.

Governments and societies across the globe should prioritize improving their educational systems to provide every child with equal opportunities to acquire the skills and knowledge necessary for leading productive and healthy lives, by allocating sufficient funding towards critical infrastructure (The World Bank, 2018). Limon (2016) states that physical infrastructure is among the most significant variables affecting the teaching and learning process, as it directly influences students' educational outcomes by facilitating the reinforcement of skills and knowledge. School administrators must prioritize policies and procedures focused on providing facilities, as well as the proper management and usage of available resources, to prevent inadequate infrastructure from negatively impacting students' academic performance and achievement.

The accessibility and subsequent use of physical resources are essential to student's academic success (Oyewole, Arogundade & Sadiku, 2019). Therefore, it is impossible to overstate the importance of physical resources in achieving secondary curriculum. Jimo (2009) asserts that all academic subjects necessitate the utilization of physical resources in order to affect how students behave. Learning and teaching become enjoyable and participatory processes with various learning facilities. Physical resources are an aspect of the learners' external environment linked to the caliber of academic grades.

Shaibu, Edegbo and Ishaka (2019) states that the intellectual conversation between the instructor and the student within the confines of a classroom is insufficient for students to learn from their teachers. The process of engagement, discovery, and investigation of the intellectual material must take place in a setting that is very favorable and distraction-free for learning to flourish. Therefore, the education sector must do more than allocate money; it must also develop and build learning facilities that improve schools' internal and external environments, fostering interaction between students and teachers.

Due to the high levels of household poverty and the country's faltering economy, Kenya's cost-sharing programs resulted in differences in the physical resources available in secondary schools (KIPPRA, 2003). This is corroborated by research conducted by the World Bank in 2010 on the availability of secondary school libraries in Sub-Saharan Africa, which showed that they were not only underfunded but also disproportionally dispersed among rural and urban schools. However, the Kenyan government has implemented programs to acquire educational resources, improving access to high-quality education for all households.

The implementation of Free Day Secondary Education (FDSE) and Free Primary Education (FPE) in Kenya in 2003 and 2008, respectively, led to an increase in students' Gross Enrolment Rate (GER) from 38% in 2007 to 42.5% in 2008 (ROK, 2008). However, studies such as those of Orodho (2014); Ndolo and Simatwa (2016); Riechi (2021) indicate that this increase complicated the availability of physical resources in public schools. In its first annual progress report on the implementation of Vision 2030, the government acknowledged that the absence of suitable infrastructure at all educational levels is hindering efforts to achieve educational parity and overcome current inequalities. Academic performance has been observed to be negatively impacted by the difficulties of overstretched facilities due to the rising enrollment because of congestion, which impedes efficient teaching and learning (Mbunde, 2017). As a result, there is a limited connection between educational resources and the educational process in institutions. Most Kenyan schools have overstretched facilities, including classrooms, dorms, dining halls, sports courts, restrooms, urinal pits, computer labs, school halls, laboratories, offices, and libraries due to the 100% transition (Otieno & Ochieng, 2020).

Ayodo (2010) states that in Kenya and other developing nations; the pursuit of providing high-quality education continues to be a significant issue for both consumers and producers of the service. The study by Abdullahi, Bello and Bauchi (2019) found that one of the

critical elements of educational quality recognized by the government is infrastructure, and significant investments have been made towards building high-quality classrooms, water and sewage systems, laboratories, and libraries. The infrastructure for educational institutions is provided through various sources, such as the national government, devolved funds like CDF, and community and development partners, as highlighted by MOEST (2014).

Access to physical resources such as classrooms, libraries, and labs is crucial for effective learning; however, their quality and efficient use are equally important (OECD, 2013). In remote, desert, and semi-arid regions, public schools lack these resources, leading to a decline in test results (Nnenna & Ubogu, 2020). The National Policy on Education recognizes that all stakeholders have a responsibility for the cost of education, including the government. Nonetheless, it is solely the state's responsibility to ensure that there are sufficient physical resources in schools. Akiri's (2013) study in Ndaragwa District showed that schools with sufficient resources had better national exam scores than those without. In this context, the study aimed to establish the relationship between physical infrastructure and academic students' academic performance in secondary schools in Machakos County, Kenya.

Stakeholders, including parents, teachers, and the government, have expressed concerns about the low academic performance of public schools in the county, as evidenced in Table 1.1 below. This study aimed to provide insights into the relationship between physical infrastructure utilization and academic performance to address this trend. Table 1.1 displays the KCSE performance for secondary schools in Machakos County from 2012 to 2020 as per the Machakos County Director of Education (2021).

Table 1: KCSE Performances from 2012 to 2020

Year	Machakos County Mean Score	National Mean Score
2020	3.8	6.7
2019	3.5	5.6
2018	3.5	7.9
2017	3.7	6.6
2016	3.7	9.8
2O15	4.7	8.1
2014	4.8	8.3
2013	4.6	6.4
2012	4.2	6.0

Source: Machakos County Director of Education[1] (2021)

Table 1.1 shows the performances of KCSE in Machakos County, Kenya from 2012 to 2020. The table highlights the total mean scores attained by the students over the years, indicating that the highest score was recorded in 2014 with a mean score of 4.799 while the lowest score was recorded in 2018 with a mean score of 3.483. This data revealed a persistent trend of relatively low academic performance in Machakos County over the years hence the need to conceptualize whether it was related to the adequacy of physical resources.

Statement of the Problem

The availability and efficient utilization of physical facilities such as computer laboratories, laboratories, and libraries play a pivotal role in shaping students' academic success within the classroom. In recent years, the performance of public secondary schools in Machakos County, Kenya, has shown signs of concern. A closer examination of the KCSE performance data from 2012 to 2020 reveals a fluctuating pattern that warranted investigation (see Table 1). In 2012, the mean score stood at 4.2, suggesting a higher level of academic achievement compared to 2020's score of 3.8. This decline in mean scores over the years highlights a concerning trend in the academic landscape of Machakos County. The prevalence of grade D plus and below, as indicated by the 71.3% statistic for 2020, is a matter of grave concern. This categorization falls well below the standards set by the Ministry of Education, signifying a substantial portion of students struggling academically. This research endeavors to delve deeper into the intricate relationship between the utilization of physical infrastructure such as computer laboratories, laboratories, and libraries within secondary schools in Machakos County and the academic achievements of their students. The pressing need for such an investigation arose from the fact that the educational landscape in the region has witnessed a decline in academic performance over the past years, as evidenced by the declining KCSE mean scores and the prevalence of low grades.

Objectives of the Study

The study aimed to achieve the following research objectives:

i To establish the influence of utilization of computer laboratories on students' academic performance in secondary schools in Machakos County.

ii To determine the influence of laboratory utilization on students' academic performance in secondary schools in Machakos County.

iii To find out the influence of library utilization on students' academic performance in secondary schools in Machakos County.

Theoretical Framework

The study was guided by the System Resource Theory, which was developed by Yutchman and Seashores (1967) and posits that achieving organizational goals requires finding, sharing, and efficiently using limited resources. The theory suggests that institutions, such as schools, transform inputs like human, physical, and material resources into desired outcomes. Similar to a business, a school uses inputs to achieve desired results (Oni, 1995). When students enroll in a school, they interact with the teaching and learning resources, which lead to learning outcomes. Quality learning results can be achieved by schools with adequate and well-utilized physical and material resources. Academic achievement is a globally recognized measure of an adequate education. Students' success or failure reflects how well resources have been utilized. Academic performance is an indication of the accessibility, sufficiency, and efficient use of educational resources. Conversely, poor academic performance indicates the need for more resources to achieve the objectives of the curriculum, teacher, and student elements.

The System Resource Theory serves as the theoretical framework for this study because it acknowledges the significance of physical and material resources as essential inputs for achieving academic goals and producing desired learning outcomes. In the context of Machakos County's secondary schools, this theory provides a structured approach to understanding how the availability, accessibility, and utilization of physical infrastructure directly influence students' academic success. By utilizing this theory, the study can systematically explore how these resources are allocated and used, identify potential resource constraints, and propose strategies for optimizing their utilization. In essence, the

System Resource Theory helped connect the dots between the availability of physical infrastructure and its impact on students' academic performance, making it a valuable guide for this research in Machakos County, Kenya.
The study examined the role of physical resources such as computer laboratories, science laboratories, and libraries in promoting academic achievement. It also investigated whether schools that have and utilize adequate physical infrastructure have better academic performance than those that do not.

RESEARCH METHODOLOGY

Research Design

For this study, a correlational research design was chosen as the most suitable framework. According to Kumar (2018), correlational research is a type of methodology widely used in both scientific and social science fields. This design is particularly effective for exploring the relationships or associations between variables without the need for manipulation. In such studies, researchers collect data on two or more variables to determine if there is a statistical relationship between them.

The choice of a correlational design for this study is justified by its ability to identify and measure the degree of association between different educational infrastructures and student academic outcomes effectively. Unlike experimental designs, which manipulate variables to establish causal relationships, the correlational approach allows for the observation of natural interactions between existing variables. This is particularly valuable in educational settings where ethical considerations and practical constraints may limit the feasibility of experimental manipulations. Furthermore, the correlational design enables the analysis of multiple variables simultaneously, providing a comprehensive overview of how various aspects of physical infrastructure can influence academic performance across different contexts and settings. This holistic view is crucial for developing informed strategies that enhance educational outcomes based on the interplay of multiple factors.

Locale of the Study

Machakos County, located in Kenya's eastern region, served as the primary research site for the study. With a population of 1.4 million people, Machakos County covers an area of 6,208.3 square kilometers. The county's borders are shared with Kitui County to the east, Makueni County to the south, Nairobi County and Kajiado County to the west, and

Kiambu County and Murang'a County to the north. Machakos Town is the county's administrative center. The county's elevation ranges from 900 to 2,000 meters above sea level. The county's climate is semi-arid, with daytime temperatures averaging 20-28 degrees Celsius and nighttime temperatures ranging from 14-18 degrees Celsius. The short rainy season occurs from October to December, while the long rainy season falls between March and May. Droughts and water shortages can have a significant impact on the county's agriculture sector, which is a vital component of the county's economy.

Machakos County is renowned for its natural beauty, which includes landmarks such as the Machakos People's Park, the Ol Donyo Sabuk National Park, and the Fourteen Falls. The county also has several cultural and historical landmarks, such as the Kyamwilu Hills and the Mua Mission. Thika-Garissa Road and Mombasa-Nairobi Highway are two of the main transportation routes that link to the county.

There were 202 public high schools and 483 public elementary schools in Machakos County, and the number of private schools in the county was growing. The county government had collaborated closely with the national government to ensure that all schools have the necessary resources to provide students with a high-quality education. Machakos County, situated in the eastern region of Kenya, was specifically chosen as the locale for this study due to its intriguing educational dynamics. Historically, the county has faced challenges related to educational outcomes, as evidenced by persistent issues of poor academic performance despite significant investments in educational infrastructure. This juxtaposition makes Machakos County an ideal candidate for investigating the effectiveness of physical infrastructure on academic performance.

The persistent academic underperformance in the region, as highlighted by the Machakos County Director of Education in 2021, suggests that there are underlying factors that may be influencing student outcomes beyond mere availability of facilities. This sets a compelling backdrop for the research, as it indicates that the mere presence of educational facilities does not necessarily translate to improved academic outcomes. Such a scenario raises questions about the utilization and qualitative aspects of these infrastructures and their actual impact on educational success.

Moreover, Machakos County presents a unique setting due to its diverse educational landscape, which includes a mix of urban and rural schools, varying in resources, teacher-student ratios, and community involvement in education. This diversity allows for a more comprehensive analysis of how different variables associated with physical infrastructure affect educational outcomes across different settings within the same region.
Adding to the importance of choosing this locale, Machakos County's educational sector has been the focus of both governmental and non-governmental educational initiatives. This focus has brought a wealth of data and attention to the area, providing an ample base for robust academic inquiry. Studying this region offers valuable insights that could inform policy and practical interventions not only within the county but also in other regions with similar challenges.

Target Population

All of Kenya's Machakos County's 202 public secondary schools were the study's target population. The study concentrated on KCSE results for form fours because they have been in the secondary schools longer. The unit of observation were 43,688 respondents comprising 202 principals, 3,030 teachers, and 40,456 students.

Table 1: Target Population

	Target population	Percent
Number of Schools	202	100.0
Students	40456	92.6
Teachers	3030	6.9
School principals	202	0.5
Total	**43688**	**100.0**

Sampling Technique and Sample Size

Sampling is a method for selecting a subset of a population to participate in a study (Ørngreen & Levinsen, 2017). To ensure a rigorous and unbiased selection of schools for the study, the simple random sampling technique was employed. This approach was chosen specifically to guarantee proportionate representation of all public secondary schools in Machakos County, regardless of their size, or location (urban or rural). Simple random sampling involves selecting units from a larger population in such a way that each unit has an equal chance of being chosen. This method is particularly advantageous because it minimizes selection bias and facilitates the generalizability of the study's findings across the entire population of interest.

By using simple random sampling, the research ensured that every public secondary school in Machakos County had an equal opportunity to be included in the study. This methodological choice is crucial in educational research, where diversity in school environments can significantly impact study outcomes. The random selection process involved generating a list of all public secondary schools within the county from the latest educational directory provided by the local education authority. Numbers were then assigned to each school, and a random number generator was used to select the schools to be included in the study.

The study chose 20 schools to represent 10% of the schools. This was dependent on the availability of physical infrastructure in each school and ease of access. The study used a census to select 20 principals from the 20 schools. For the remaining respondents, 300 teachers and 4000 students for the sample of 20 schools, this study used stratified sampling method. Stratified random sampling is an unbiased sampling method that involves grouping a heterogeneous population into homogeneous subsets and then making a selection within the individual subset to ensure representativeness. The goal of stratified random sampling was to achieve the desired representation from various sub-groups in the population. In stratified sampling, subjects were selected in such a way that the existing sub-groups in the population are more or less represented in the sample (Pandey & Pandey, 2021). This

technique was chosen because each subgroup within the population received proper representation within the sample. This is as outlined in Table 1.

The Cochran formula (Cochran, 1977), a formula for estimating sample size in surveys, was used to determine the sample size for students. The Cochran formula is primarily used to calculate the sample size needed for a survey that has a large population, such as that of the students in the current study, to ensure a representative sample. It is particularly suitable in situations where there is a finite population and there is need to estimate the proportion of that population that has a certain characteristic or attribute. The following is the formula:

Where: sample size, n

For a 95% confidence level, the standard normal deviation (z) is set at 1.96.

P is the percentage of the population that possesses the relevant feature.

q = 1-p

e = 5% $n = \frac{Z^2 p(1-p)}{e^2}$ of the target precision level.

The sample size was determined as follows using a population size of 202 public secondary schools, a margin of error of 5%, and a confidence level of 95%:

n = (1.96) ^2 x 0.5 x 0.5 / (0.05) ^2 = 384

384 respondents-20 principals=364 respondents (teachers and students)

=364/4300

=0.085

Table 2: Sample Size

	Target population	Ratio	Sample
Number of Schools	202	0.1	20
Students	40456	0.085	338
Teachers	3030	0.085	26
School principals	202	0.1	20
Total			**384**

Data Collection Instruments

According to Haraldsen (2023), research instruments are the means through which information is gathered for a study. Both interviews and questionnaires were used to gather data. While the interviews was used to gather qualitative data from the principals, the questionnaires was used to gather quantitative data from the teachers and students. The choice between questionnaires and interviews were guided by the research objectives and the type of data to be collected. The questionnaires were suitable for structured, large-scale data collection, while interviews were better for in-depth exploration of complex topics and qualitative data. In some cases, a combination of both methods (mixed methods) were the most appropriate approach to gather comprehensive research findings. Questionnaires were used because they allowed the respondent to collect large amount of data within a short span

of time while interviews were selected because they allowed the researcher to probe further and generate deeper information

Questionnaire

The questionnaire for students was broken up into five sections: Section A gathered information on the demographics of the students; Section B gathered information on the utilization of computer laboratories; Section C gathered information on the utilization of science laboratories; Section D gathered information on the utilization of school library; Section E gathered information on the academic performance of the students.
The questionnaire for teachers was broken up into five sections: Section A gathered information on the demographics of the teachers; Section B gathered information on the utilization of computer laboratories; Section C gathered information on the utilization of science laboratories; Section D gathered information on the utilization of school library; Section E gathered information on the academic performance.

Interview Schedule for Principals

An interview is a one-on-one conversation between a researcher and a participant in a study (Bresler & Stake, 2017). The principals' qualitative data was gathered using the interview guide. The instruction manual included open-ended questions designed to elicit principals' opinions on how physical infrastructure affects pupils' academic achievement.
Principals' interviews were also divided into 4 sections: Section A gathered information on the utilization of computer laboratories; Section B gathered information on the utilization of science laboratories; Section C gathered information on the utilization of school library; Section D gathered information on the academic performance of the students.

Observation Schedule

An observation schedule is a structured plan or document used to systematically record observations in various settings (Fletcher, 2020). In this study, it helped ensure that observations are conducted consistently and with a clear focus on specific objectives. The observation schedule consisted of physical infrastructure assessment on computer labs, science labs, and library, and academic performance assessment.

Pilot Testing

A pilot study is a small-scale investigation used to test research procedures, sample recruitment strategies, data collection instruments, and other methodologies before conducting a large-scale study (Flick, 2020). Pilot testing was done to help assess the feasibility of research methods and instruments before proceeding to the full-scale investigation. By testing the study's procedures on a small sample, the researcher identified and addressed potential logistical challenges, refined data collection methods, and validated research instruments. Pilot studies also allowed for preliminary insights and feedback, contributing to the fine-tuning of research questions. Two public secondary schools in Machakos County, which did not make up the sample population, hosted the pilot project. The research tool was given to a sample of 38 respondents. The pilot study's results were utilized to evaluate the research instruments' relevance, clarity, and comprehensibility.

Validity of Research Instruments

An instrument's validity refers to the accuracy with which an instrument captures the desired result. Content validity was established to make sure that the research tools used in the study measure what they are meant to measure. educational management specialists were asked to comment on the representativeness and applicability of the questions and offered recommendations for changes that might were made to the design of the research instruments. This helped to improve the content validity of the data that will be collected.

Reliability of Research Instruments

Reliability is the capacity of an instrument to deliver comparable results when measured repeatedly under identical conditions. Using a test-retest method, the reliability of the research equipment was assessed. After a two-week break, a sample of 30 children from one of the pilot study's schools was chosen, and they got the same questionnaire. The Cronbach's alpha coefficient of at least 0.7 was used to assess the collected data and provide a reliability coefficient. This demonstrated the dependability of the study's research tools. Sember, Meh, Sorić, Starc, Rocha, and Jurak (2020) also established that a coefficient of reliability of at least 0.7 is deemed appropriate.

Data Collection Procedure

Observation schedules, interviews, and questionnaires were used to collect data for this study. The researcher obtained a permit from the National Commission for Science, Technology, and Innovation (NACOSTI) and also asked for an introduction letter from the university, which were presented to each respondent so as to be allowed to collect the essential data from them. To allow respondents adequate time to make thoughtful comments, the drop-and-pick-later method was used for questionnaire administration. The research tools were gathered over a three-day period to guarantee a high response rate. The researcher administered the research tools in with the help of research assistants who were trained first to ensure that they were able to answer any questions they were asked. The data was coded and saved in a password-protected computer file.

Data Analysis

Data analysis offers a way for extrapolating inductive conclusions from data and distinguishing the subject of study from statistical outliers in the research data (Fletcher, 2020). Content analysis was used to analyze the qualitative data from the interviews. The data was then presented in narratiion and verbatim format. Quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS Version 28.0). To make data entry easier, questions were coded, and all completed questionnaires were referred to. Descriptive statistics, including mean, frequency, standard deviation, and percentages, was used to profile sample characteristics and major patterns emerging from the data. To facilitate this, a Likert Scale was used to enable easier presentation and interpretation of data. The data was presented in tables and charts.

Additionally, regression analysis was used to evaluate the hypotheses at a significance level of 0.05. Regression analysis was used to examine the relationship between one or more

independent variables (predictors) and a dependent variable (outcome). It was used for prediction or understanding the strength and direction of associations.

Table 3: Operationalization of Variables

Objective	Nature of data collected	Statistical techniques	Mode of presentation
i To examine the relationship between the utilization of computer laboratories and academic performance	• Quantitative data • Qualitative data	• Measures of central tendency (mean) • Measures of dispersion (standard deviation) • Frequencies and percentages • Regression analysis • Content analysis	• Frequency tables, percentages and pie charts • Narration • verbatim
ii To determine the relationship between the use of science laboratory and academic performance	• Quantitative data • Qualitative data	• Measures of central tendency (mean) • Measures of dispersion (standard deviation) • Frequencies and percentages • Regression analysis • Content analysis	• Frequency tables, percentages and pie charts. • Narration form • verbatim
iii To investigate the relationship between library utilization and academic performance.	• Quantitative data • Qualitative data	• Measures of central tendency (mean) • Measures of dispersion (standard deviation) • Frequencies and percentages • Regression analysis • Content analysis	• Frequency tables, percentages and pie charts • Narration • verbatim

Ethical Considerations

The rights of the participant's were maintained by following ethical guidelines when conducting the study. Participant's were asked for their informed consent and given guarantees of confidentiality and anonymity. The study's voluntary nature and the fact that participants can leave at any point without incurring any fees were also made clear to them. The researcher prioritized logistical ethics. Logistical ethics refers to the ethical considerations and measures taken to ensure the proper handling, storage, and protection of data collected during the study. This included implementing appropriate data security measures to safeguard collected information from unauthorized access or breaches. This was especially important when dealing with sensitive or personally identifiable information. The researcher and research team received training in research ethics to ensure they were knowledgeable about ethical guidelines and best practices. Training helped prevent ethical violations. Equally crucial was human relation ethics. The researcher obtained informed

consent from participants before involving them in the study. This included providing clear information about the study's purpose, procedures, potential risks and benefits, and the participants' right to withdraw at any time. Moreover, the researcher ensured the privacy and confidentiality of participants' personal information and data. Participant's were assured that their responses were kept confidential and that their identities were not disclosed without their consent.

DATA ANALYSIS, PRESENTATION AND INTERPRETATION OF FINDINGS

Students' Academic Performance in Secondary Schools

The researcher required the students to indicate their level of agreement with statements about the influence of physical infrastructure utilization on their academic performance. The results were as displayed on Table 4.

Table 4: Students' Level of Agreement with Statements about the Influence of Physical Infrastructure Utilization on their Academic Performance

Statement	SD F(%)	D F(%)	N F(%)	A F(%)	SA F(%)	Mean	Std. Dev.
I use the computer labs very often	1 (0.4%)	2 (0.8%)	7 (2.8%)	76 (30.5%)	163 (65.5%)	4.583	0.495
Adequate availability of computers in the computer lab is essential for my learning	2 (0.8%)	3 (1.2%)	10 (4.0%)	87 (35.0%)	147 (59.0%)	4.479	0.525
High-quality computers in the computer lab contribute to my academic success	17 (6.8%)	48 (19.3%)	122 (49.0%)	53 (21.3%)	9 (3.6%)	3.252	0.283
Adequacy of computer labs (space and resources) enhances my learning experience	20 (8.0%)	63 (25.3%)	123 (49.4%)	40 (16.1%)	3 (1.2%)	3.074	0.215
Availability of science laboratories positively influences my understanding of scientific concepts	18 (7.2%)	56 (22.5%)	118 (47.4%)	51 (20.5%)	6 (2.4%)	3.160	0.138
Adequate laboratory equipment, chemicals, and apparatus are crucial for my success in science subjects	1 (0.4%)	3 (1.2%)	6 (2.4%)	78 (31.3%)	161 (64.7%)	4.577	0.496
Frequent usage of science labs enhances my practical knowledge	1 (0.4%)	2 (0.8%)	5 (2.0%)	75 (30.1%)	166 (66.7%)	4.589	0.494
The quality and condition of science laboratories matter for my academic achievements	21 (8.4%)	62 (24.9%)	126 (50.6%)	37 (14.9%)	3 (1.2%)	3.055	0.218
Accessibility and usability of the library facilities improve my overall academic performance	2 (0.8%)	3 (1.2%)	8 (3.2%)	79 (31.7%)	157 (63.1%)	4.571	0.497
Having a wide range of books and materials in the library is essential for my coursework	28 (11.2%)	42 (16.9%)	62 (24.9%)	69 (27.7%)	48 (19.3%)	2.930	0.879
A well-structured and well-maintained library facility positively affects my academic success	7 (2.8%)	12 (4.8%)	20 (8.0%)	89 (35.7%)	121 (48.6%)	3.982	0.942

Auxiliary services provided by the library, such as support and guidance, contribute to my learning outcomes	25 (10.0%)	45 (18.1%)	152 (61.0%)	24 (9.6%)	3 (1.2%)	3.712	0.115
Overall, the utilization of physical infrastructure at my school has a significant impact on my academic performance	26 (10.4%)	49 (19.7%)	153 (61.4%)	19 (7.6%)	2 (0.8%)	2.976	0.116

As per Table 4, 166 (66.7%) of the students strongly agreed that frequent usage of science labs enhances their practical knowledge as illustrated by an average of 4.589, 76 (30.5%) of the students strongly agreed that they use the computer labs very often as illustrated by an average of 4.583, adequate laboratory equipment, chemicals, and 161 (64.7%) of the students strongly agreed that apparatus were crucial for their success in science subjects as illustrated by an average of 4.577, and 157 (63.1%) of the students strongly agreed that accessibility and usability of the library facilities improve their overall academic performance as illustrated by an average of 4.571. The students (87 (35.0%)) also agreed that adequate availability of computers in the computer lab was essential for their learning as illustrated by an average of 4.479, 89 (35.7%) of the students agreed that a well-structured and well-maintained library facility positively affected their academic success as illustrated by an average of 3.982, and 24 (9.6%) of the students agreed that auxiliary services provided by the library, such as support and guidance, contribute to their learning outcomes as illustrated by an average of 3.712.

The students were neutral (122 (49.0%)) on whether high-quality computers in the computer lab contribute to their academic success as illustrated by an average of 3.252, 118 (47.4%) of the students were neutral that availability of science laboratories positively influences their understanding of scientific concepts as illustrated by an average of 3.160, of the students were neutral that adequacy of computer labs (space and resources) enhances their learning experience as illustrated by an average of 3.074, 123 (49.4%) of the students were neutral that the quality and condition of science laboratories matter for their academic achievements as illustrated by an average of 3.055, 153 (61.4%) of the students were neutral that overall, the utilization of physical infrastructure at their school has a significant impact on their academic performance as illustrated by an average of 2.976 and 62 (24.9%) of the students were neutral that having a wide range of books and materials in the library was essential for their coursework as illustrated by an average of 2.930.

Further, the teachers were asked to rate their level of agreement with statements about the influence of physical infrastructure utilization on students' academic performance. Table 5 shows the responses.

Table 5: Teachers' Level of Agreement with Statements About the Influence of Physical Infrastructure Utilization on their Academic Performance

Statement	SD F(%)	D F(%)	N F(%)	A F(%)	SA F(%)	Mean	Std. Dev.
Effective utilization of computer labs enhances academic performance.	2 (0.8%)	3 (1.2%)	14 (5.6%)	109 (43.8%)	121 (48.6%)	4.289	0.550
Proper use of science labs positively impacts students' academic achievement.	2 (0.8%)	4 (1.6%)	17 (6.8%)	107 (43.0%)	119 (47.8%)	4.222	0.563
Adequate utilization of library facilities	7 (2.8%)	18 (7.2%)	49 (19.7%)	99 (39.8%)	76 (30.5%)	3.393	0.825

improves academic outcomes.							
Availability and utilization of physical infrastructure resources contribute to better academic results.	3 (1.2%)	5 (2.0%)	20 (8.0%)	101 (40.6%)	120 (48.2%)	4.163	0.634

As per the findings, 109 (43.8%) of the teachers agreed that effective utilization of computer labs enhances academic performance as shown by a mean of 4.289, 107 (43.0%) of the teachers agreed that proper use of science labs positively impacts students' academic achievement as shown by a mean of 4.222, and 101 (40.6%) of the teachers agreed that availability and utilization of physical infrastructure resources contribute to better academic results as shown by a mean of 4.163. The teachers (49 (19.7%) were neutral on whether adequate utilization of library facilities improves academic outcomes as shown by a mean of 3.393.

When asked about the assessment of academic performance in KCSE exams on the interviews, the principals provided varied responses. While some expressed satisfaction with their students' performance, describing it as impressive or moving in the right direction, others noted that it was average or not encouraging. These assessments offer insights into the diverse academic landscapes across different schools.

Regarding differences in performance between schools with and without adequate physical infrastructure, the principals unanimously acknowledged such variations. Schools that utilize physical infrastructure properly tend to demonstrate improved academic performance compared to those lacking adequate facilities. This observation underscores the crucial role of infrastructure in supporting academic endeavors.

The principals highlighted several factors contributing to students' performance in KCSE exams. These factors include early syllabus coverage, strategic revision, motivation of students, and the availability and proper utilization of resources. This suggests that a combination of academic, motivational, and infrastructural elements influences students' exam outcomes.
Assessing the impact of physical infrastructure utilization on overall academic performance, the principals emphasized its significance. They noted that proper utilization of physical infrastructure contributes significantly to improved performance. This implies that a well-equipped and efficiently managed learning environment can positively influence students' academic outcomes, highlighting the importance of investing in infrastructure for educational institutions.

From the observation schedule, the method of assessing academic performance varies across schools, with most relying on KCSE exam results, continuous assessment, and teacher assessments. While KCSE exam results offer a standardized measure of academic achievement, continuous assessment and teacher assessments provide valuable insights into students' progress and learning outcomes over time. Schools that utilize a combination of these

assessment methods are better equipped to evaluate students comprehensively and tailor educational strategies to meet their needs effectively. According to Black and Wiliam (1998), formative assessments, such as continuous assessment and teacher assessments, play a critical role in improving student outcomes. They argue that these assessment methods provide ongoing feedback that helps students identify their strengths and weaknesses, and adjust their learning strategies accordingly. Moreover, research by Taras (2005) highlights the benefits of formative assessment in promoting deeper learning and engagement. This type of assessment encourages an interactive learning environment where feedback is used actively by both teachers and students to enhance the educational process. Additionally, studies such as those by Harlen and Deakin Crick (2003) suggest that formative assessments are linked to improved motivation and higher achievement because they are often less high-stakes than summative assessments like the KCSE exams and therefore less likely to induce anxiety among students.

Multiple Regression Analysis

This section of the study presents the results and discussions of the regression output. In order to examine the influence of utilization of library, utilization of science laboratories, utilization of computer laboratories on student academic performance in secondary schools in Machakos County, a regression model was estimated. Table 6,7 and 8 displays the findings.

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.880	0.774	0.722	3.536

Table 6 is a model fit which establish how fit the model equation fits the data. The adjusted R^2 was used to establish the predictive power of the study model and it was found to be 0.722 implying that 72.2% of the variations in student academic performance in secondary schools in Machakos County, are explained by changes in utilization of computer laboratories, utilization of science laboratories, and utilization of library.

Table 7: ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	643.566	3	214.522	14.867	1.71E-04
	Residual	187.587	13	14.430		
	Total	**831.153**	**16**			

The probability value of 1.71E-04 indicates that the regression relationship was highly significant in predicting how utilization of computer laboratories, utilization of science laboratories, and utilization of library influenced student academic performance in secondary schools in Machakos County, Kenya. The F-calculated at 5 per cent level of significance was 14.867. Since F calculated is greater than the F-critical (value = 3.4105), this shows that the overall model was significant.

Table 8: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.537	0.505		7.004	0.000
	Utilization of computer laboratories	0.632	0.245	0.544	2.580	0.023
	Utilization of science laboratories	0.843	0.333	0.785	2.532	0.025
	Utilization of library	0.774	0.248	0.728	3.121	0.008

The regression equation obtained from this outcome was: -

$$\mathbf{Y = 3.537+0.632X_1 + 0.843X_2 +0.774X_3}$$

The study found that if all independent variables were held constant at zero, then the student academic performance in secondary schools in Machakos County, Kenya will be 3.537. Further, the coefficient for utilization of computer laboratories was 0.632 which was significant since p=0.023 is less than 0.05, meaning that a unit change in utilization of computer laboratories leads to a 0.632 increase in the student academic performance in secondary schools in Machakos County, Kenya. Further, the null hypothesis stating, there is no significant relationship between utilization of computer science laboratories and student academic performance in secondary schools in Machakos County, was therefore rejected since p=0.023 is less than 0.05.

The study also found that a unit change in utilization of science laboratories would lead to a 0.843 unit change in student academic performance in secondary schools in Machakos County, Kenya. The variable was significant since p-value=0.025<0.05. Further, the null hypothesis stating, there is no significant relationship between utilization of science laboratories and student academic performance in secondary schools in Machakos County, was therefore rejected since p=0.025 is less than 0.05.

The study further found that a unit change in utilization of library would lead to a 0.774-unit changes in student academic performance in secondary schools in Machakos County, Kenya. The variable was significant since p-value=0.008<0.05. Further, the null hypothesis stating, there is no significant relationship between utilization of library and student academic performance in secondary schools in Machakos County, was therefore rejected since p=0.008<0.05.

Overall, utilization of science laboratories had the greatest influence on student academic performance in secondary schools in Machakos County, followed by utilization of library, while utilization of computer laboratories had the least influence on student academic

performance in secondary schools in Machakos County, Kenya. All variables that p-values were less than 0.05 were significant.

Discussion of the Findings

Under this section, the findings are linked with the literature review to check the consistency or agreement of the findings with previous studies. The study discusses the influence of utilization of library, utilization of science laboratories, utilization of computer laboratories on student academic performance in secondary schools in Machakos County.

Utilization1 of Computer Laboratory

The findings of the research resonate with the extensive body of literature emphasizing the pivotal role of technology integration in education and its potential influence on academic outcomes. Scholars such as Norris (2001) and Bullock (2004) have extensively explored the correlation between access to technology and academic achievement, consistently highlighting that students' exposure to digital tools and resources can significantly impact their learning trajectories. In this context, the research's observation that well-equipped computer labs were associated with frequent usage further substantiates the argument that technological access fosters educational advancement.

Moreover, this study noted that the computer labs in Machakos County were adequately equipped to support learning, with a considerable portion of students utilizing them for instructional purposes. This finding aligns with previous research by Bimba and Ngwira (2022), which also emphasized the positive influence of computer lab usage on academic outcomes. Specifically, their study highlighted how computer labs facilitate students' understanding of complex concepts through interactive simulations and visual representations. However, despite the prevalent use of computer labs and their perceived adequacy, our study uncovered uncertainties regarding the functionality and quality of computers in these labs meeting educational needs. This finding echoes concerns raised by Clark and Luckin (2013) about potential distractions and loss of attention among students when using computers, which could ultimately impact their motivation and academic performance.

Furthermore, while the current study did not directly explore the influence of social media use during computer-based learning activities, insights from previous research by Rosen et al. (2013) and Hembrooke and Gay (2003) suggest that such distractions can hinder academic performance. Therefore, establishing policies and guidelines to regulate in-class laptop use and promote academic-focused activities becomes imperative for schools and institutions.

Moreover, the qualitative insights gleaned from the research echo the sentiments expressed in Warschauer's work (2006), which underscores the dual significance of both access to and effective utilization of technology in educational settings. Principals' descriptions of computer labs as dynamic spaces facilitating various learning activities align closely with Warschauer's notion that technology serves as a catalyst for diversified learning experiences, including research endeavors, online learning initiatives, and collaborative projects. Such multifaceted engagements with technology not only complement traditional classroom instruction but also

empower students to explore academic content in innovative ways, thereby potentially enhancing their academic performance.

However, amidst the positive narratives surrounding computer lab utilization, the research also unveils disparities in usage patterns and resource availability across different schools. This finding echoes concerns raised in existing literature, particularly by scholars like Norris (2001), who have extensively studied the digital divide and its ramifications on educational equity. The observed discrepancies in lab usage and computer availability underscore the persistent challenges faced by educational institutions in bridging the digital gap and ensuring equitable access to technological resources for all students.

Furthermore, while the majority of computers were reported to be functional and of good quality, concerns were voiced regarding their alignment with educational needs. This aspect resonates with discussions in the literature emphasizing the importance of aligning technological resources with pedagogical objectives to maximize their efficacy in enhancing student learning outcomes. Scholars have argued that technology integration should not be pursued for its own sake but rather should be guided by a clear understanding of its instructional value and potential impact on student learning.

Utilization1 of Science Laboratories

A primary finding of the study was the positive relationship between science laboratory utilization and students' academic performance in secondary schools in Machakos County. This finding resonates with various prior research studies, including Kilonzo and Kinyanjui (2014) in Kenya and Falayajo (2017) in Nigeria, which reported significantly higher mean scores and improved problem-solving abilities among students who utilized science labs. Additionally, the positive associations identified by Chowdhury and Rahman (2019) in Bangladesh underscored the importance of laboratory use in enhancing students' academic achievements, particularly in chemistry.

However, this study also encountered contrasting perspectives regarding the impact of laboratory use on academic performance. For instance, Dzidzornu and Badi's (2017) study in Ghana found no significant effect of laboratory use on students' academic performance in chemistry, attributing this outcome to inadequate laboratory resources and facilities in some institutions. This discrepancy underscores the importance of considering contextual factors, such as resource availability, in interpreting the relationship between laboratory utilization and academic outcomes.

The study found that science labs were available and frequently used for experiments, indicating active engagement in hands-on learning experiences. This finding resonates with Lazarowitz and Tamir's (1994) meta-analysis, which emphasizes the positive correlation between structured laboratory activities and students' understanding of scientific concepts. Additionally, the study's observation of regular lab utilization supports the notion that frequent engagement in practical lessons reinforces theoretical knowledge and hones practical skills, as suggested by previous research (Lazarowitz & Tamir, 1994).

However, the study also identified areas of concern regarding the adequacy of laboratory equipment and resources, as well as the ease of use and quality of science laboratories. These findings suggest the need for strategic improvements in the physical infrastructure of schools within Machakos County, aligning with the literature on the importance of well-equipped and conducive learning environments for promoting academic success (Mulford & Kendall, 2010). Moreover, the study's observation of mixed perspectives on the availability of laboratory resources echoes the Digital Divide concept, which highlights how unequal access to resources can exacerbate educational disparities (Norris, 2001).

Furthermore, this study identified various factors that influence the effectiveness of science laboratory utilization in enhancing academic performance. Insights from Folorunso and Akindele (2020) emphasized the significant improvement in students' performance in physics due to laboratory exercises, highlighting the importance of practical experiences in reinforcing conceptual understanding. Similarly, Marini and Saputri (2021) demonstrated that laboratory work enhanced students' practical knowledge and comprehension of chemical reactions, indicating the value of hands-on experiences in science education.

The qualitative findings further complement the quantitative results by providing insights into principals' perspectives on the state of science laboratories in secondary schools. Principals' positive portrayal of the laboratories and recognition of their impact on academic performance are consistent with the literature emphasizing the pivotal role of practical education in fostering students' understanding and retention of scientific principles (Rocard et al., 2007). However, concerns raised about the availability of certain items and the need for improvements in lab design and organization underscore the importance of ongoing investment in resources and infrastructure to support effective science education (Rocard et al., 2007).

Nevertheless, challenges related to laboratory adequacy and resource availability were also evident in our study, consistent with findings by Nwachukwu (1984) in Lagos, Nigeria. These challenges, including inadequate laboratory facilities and outdated resources, may hinder students' learning experiences and academic performance, emphasizing the importance of investing in modern laboratory infrastructure.

Utilization1 of a School Library

One of the key findings of this study was the positive relationship between school library utilization and students' academic performance. This aligns with numerous previous studies, including those by Troussas et al. (2020) and Barrett et al. (2019), which highlighted the beneficial impact of accessing library resources on reading comprehension, writing skills, and overall academic achievement. Additionally, Lance and Kachel's (2018) research emphasized how school libraries can be particularly advantageous for underprivileged students, helping to bridge the achievement gap.

However, this study also encountered conflicting reports regarding the effects of library use on academic performance. For instance, Nasuna et al. (2021) found only a slight association

between library use and academic achievement among secondary school students. Similarly, Midha's (2022) study did not establish a significant connection between high school students' library use and their academic performance. These findings underscore the complexity of the relationship between library utilization and academic outcomes, suggesting that other factors may mediate this association.

Further complicating the picture, this study identified several factors that can influence how effectively students utilize school libraries and, consequently, their impact on academic performance. Mardiana and Said (2018) highlighted the importance of the quality of library facilities, services, and resources in shaping students' academic success. Similarly, Haddad and Khezrlou (2021) emphasized the role of students' attitudes and perceptions toward library use in determining its efficacy.

The research established that there was an adequate supply of books and required materials in the school libraries, echoing the findings of previous studies such as Lance, Rodney, and Russell (2007), which demonstrated the positive correlation between well-stocked libraries and student achievement in reading. Similarly, the study found that library facilities were easily accessible to students, supporting the notion that accessible libraries contribute to improved academic outcomes, as highlighted in research by Kachel (2015).

However, the study also identified areas where improvements could be made. While the majority of principals portrayed the libraries positively, some suggested room for enhancement in expanding the collection of books and materials. This finding resonates with the literature, particularly the work of Lance, Rodney, and Russell (2007), which emphasized the importance of continually updating library collections to meet students' evolving needs and interests.
Additionally, the research indicated uncertainty regarding whether the nature and quality of library facilities contribute to a positive learning environment, suggesting a potential area for further investigation. Existing literature, such as studies on the impact of library environments on student engagement and motivation (e.g., Fisher, 2007), suggests that well-designed and inviting library spaces can enhance students' overall learning experiences. Thus, further exploration into the specific aspects of library environments that promote effective research and study could yield valuable insights for educational institutions.

Conclusions

The study concludes that the utilization of computer laboratories significantly influences student academic performance in secondary schools in Machakos County. While the majority of students utilized computer labs for academic purposes, indicating a recognition of the importance of technology in education, our findings also unveiled underlying concerns regarding the adequacy and functionality of available resources within these labs. This nuanced observation underscores the need for a holistic approach to technology integration in education, emphasizing not only access but also the quality and suitability of digital resources. Moreover, the study highlights the critical importance of addressing these concerns to maximize the potential benefits of technology in education. By ensuring that computer labs are adequately equipped and functionally optimized to meet educational needs, educators can create

environments conducive to enhanced learning outcomes and equitable access to digital learning tools. Additionally, investing in professional development for educators to effectively integrate technology into their teaching practices is essential. Furthermore, the findings emphasize the need for ongoing assessment and evaluation of technology utilization in schools to identify areas for improvement continually. Collaborative efforts between educational policymakers, school administrators, teachers, and technology experts are crucial in developing comprehensive strategies to enhance technology integration and support student academic success.

The study also concludes that science laboratory utilization significantly influences student academic performance in secondary schools in Machakos County. It was found that students who actively engaged in laboratory activities demonstrated not only improved problem-solving abilities but also a deeper practical understanding of scientific concepts. This finding underscores the intrinsic value of hands-on learning experiences in science education, emphasizing their role in fostering critical thinking and conceptual mastery. However, the study also revealed challenges related to inadequate resources and facilities within science laboratories. These challenges, such as insufficient equipment and outdated infrastructure, hinder students' access to quality practical learning experiences. Therefore, there is a critical need for investment in enhancing laboratory infrastructure to optimize learning opportunities.

By addressing these challenges and ensuring that science laboratories are equipped with adequate resources and modern facilities, educators can empower students with the tools and opportunities necessary to excel in science education and beyond. Moreover, fostering a culture of inquiry-based learning and providing professional development opportunities for teachers to effectively integrate laboratory activities into the curriculum are essential steps toward enhancing student learning outcomes in science.

The study further concludes that library utilization significantly influences student academic performance in secondary schools in Machakos County. It was found that students who frequented school libraries exhibited higher performance levels, highlighting the crucial role of libraries in fostering literacy and academic achievement. However, the research also identified challenges related to resource adequacy and attitudes toward library use. Despite the positive correlation between library utilization and academic performance, concerns lingered regarding the availability of resources and the prevailing attitudes toward library engagement. These challenges underscore the importance of promoting positive attitudes toward library use and ensuring equitable access to library resources for all students. By addressing these challenges and investing in enhancing library resources and facilities, educators can harness the full potential of school libraries in enhancing academic outcomes. Strategies such as expanding the collection of books and materials, providing professional development opportunities for librarians, and implementing programs to promote library engagement can contribute to creating a vibrant library environment conducive to learning.

Recommendations

i **Investment in Computer Lab Resources**:
- Secondary schools in Machakos County should prioritize investment in upgrading and maintaining computer lab resources to ensure adequacy and functionality. Moreover, the schools should establish clear guidelines and protocols for students to access and utilize computer labs, fostering a culture of responsible and meaningful technology use.
- School administrators should conduct regular assessments of hardware and software to meet evolving educational needs and technological advancements.
- The Ministry of Education should provide ongoing professional development for educators to effectively integrate technology into teaching practices, maximizing the benefits of computer lab utilization.

ii. **Enhancement of Science Laboratory Infrastructure**:
- The Ministry of Education should prioritize allocating resources to equip laboratories with modern equipment, materials, and facilities conducive to experimentation and exploration. This includes investing in updated technology and ensuring the availability of essential resources such as chemicals and apparatus.
- Schools should foster collaboration with industry partners or research institutions to provide access to cutting-edge technology and expertise, enriching students' learning experiences and preparing them for future careers in science and technology fields.

iii. **Promotion of School Libraries as Learning Resources**:
- School administrators should implement strategies to encourage regular library use among students, such as promoting literacy initiatives, organizing engaging library events, and integrating library visits into the curriculum to foster a culture of reading and research. Ensuring a diverse and up-to-date collection of books, digital resources, and multimedia materials tailored to students' interests and academic needs is crucial.
- Schools should invest in professional development opportunities for librarians to enhance their skills in curating resources and facilitating information literacy.

iv. **Addressing Disparities in Access to Physical Infrastructure**:
- Government agencies, community organizations, and private stakeholders should coordinate efforts to provide targeted support and investment to schools serving marginalized communities. This includes improving infrastructure and resource availability to ensure all students have equal opportunities for academic success.
- By implementing targeted interventions and fostering partnerships, stakeholders can work together to narrow the educational gap and promote inclusivity across all secondary schools in the county.

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