

INFLUENCE OF PARENTAL PROVISION OF LEARNING RESOURCES ON STUDENTS' ACADEMIC ACHIEVEMENT IN SCIENCE SUBJECTS AMONG PUBLIC DAY SECONDARY SCHOOLS IN VIHIGA SUB- COUNTY

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ABSTRACT

Science education remains central in achieving Sustainable Development Goal 4 and in advancing national competitiveness through human capital development, technological development and scientific innovation. Despite these efforts, relatively low academic achievement in science subjects has remained a concern, particularly in rural public secondary schools, including those in Vihiga Sub-County. Students continue to experience challenges in achieving satisfactory learning outcomes, raising concerns about factors that influence achievement in science subjects. Although parental involvement is widely recognized as an important contributor to students' academic success, its specific influence on academic achievement in science subjects within rural public day secondary schools remains underexplored. Against this background, the study examined the influence of parental provision of learning resources on students' academic achievement in science subjects among public day secondary schools in Vihiga Sub-County, Kenya. The study focused on four dimensions of parental involvement: provision of learning resources, supervision and assistance with homework, collaboration with teachers, and monitoring of academic progress. The study was anchored on Epstein's Theory of Overlapping Spheres of Influence and adopted a correlational research design. The target population comprised 9,540 students and 220 science teachers, from which a sample of 366 students and 140 teachers was selected using stratified and simple random sampling techniques. Data were collected using structured

questionnaires and document analysis and analyzed using descriptive statistics, Pearson's pairwise correlation and hierarchical multiple regression. The findings indicated that parental provision of learning resources significantly predicted science academic achievement ($B = 6.726, p < .001$) after controlling for student gender, age, form level, teacher teaching experience, teacher professional qualification and school science learning resources. Parents' supervision and assistance with homework also significantly predicted science academic achievement ($B = 6.487, p < .001$), while parental collaboration with teachers significantly predicted science academic achievement ($B = 6.335, p < .001$). The study concludes that the effectiveness of parental involvement depends on its quality and purpose rather than merely its presence or frequency. Parental provision of learning resources is more meaningful when the resources provided are relevant to students' science learning needs, including materials that support practical and home-based learning. The study recommends that parents should be encouraged to provide or facilitate access to essential resources such as science textbooks, revision materials, stationery, reference materials, practical learning materials and appropriate resources for home-based science study. Schools should sensitize parents on the specific resources that are most relevant to science learning, with particular attention to practical and specialized materials that may be less readily available to learners.

Keywords: Parental involvement, provision of learning resources, science

academic achievement, public day
secondary schools.

INTRODUCTION

Globally, governments increasingly view science education as a strategic instrument for economic transformation and global competitiveness. Science subjects such as Chemistry, Physics, and Biology equip learners with analytical skills, problem-solving capacity, and innovative thinking necessary for industrial growth and technological advancement. The World Bank (2023) reports that over 20 percent of public education expenditure in many developing countries is directed toward STEM-related programs, reflecting the growing recognition of science education as a development priority. Similarly, UNESCO (2022) notes that countries allocating at least one percent of GDP to research and development experience significantly faster industrial growth. Advanced economies such as South Korea and Germany demonstrate how sustained investment in science education strengthens national competitiveness (OECD, 2021). However, research increasingly shows that infrastructure development and curriculum reforms alone do not guarantee improved science achievement. Epstein (2018) argues that persistent low performance in science often reflects broader ecosystem challenges beyond classroom instruction.

Countries such as Singapore, Finland, Japan, the United States, and the United Kingdom illustrate how parental engagement complements systemic STEM reforms. In Singapore, sustained funding for laboratories, teacher professional development, and national competitions is paired with strong parental support structures (Ng, 2020). In the United States, parental involvement includes homework supervision, science-related discussions, and participation in structured school programs such as STEM family nights (Fan & Williams, 2010; Gonzalez & Jackson, 2021). Finland emphasizes inquiry-based learning supported by close collaboration between teachers and parents (Stahlberg, 2015). In Japan, cultural expectations encourage parents to invest in after-school tutoring programs known as *juku* to reinforce science learning (Entrich, 2018; Shimizu, 2019). Similarly, in the United Kingdom, government-backed initiatives such as STEM Learning UK provide resources to parents to support home-based science engagement (Archer et al., 2013; DeWitt & Archer, 2015; Moote et al., 2020). Despite these structured efforts, disparities in science performance persist globally, particularly in under-resourced and rural settings. Evidence consistently indicates that parental engagement remains a significant determinant of student

motivation and achievement in science disciplines (Wang & Degol, 2017). However, the implementation of meaningful parent-school partnerships remains uneven across contexts.

In Latin America, countries such as Brazil and Mexico have introduced school-community partnerships to strengthen parental involvement in science education. In Brazil, parents participate in robotics competitions and science clubs aimed at nurturing problem-solving skills (Oliveira & Barbosa, 2020). Mexico has implemented structured workshops to guide parents in supporting STEM learning at home (Valdez-García et al., 2021). Nevertheless, low literacy levels in rural areas often constrain parents' capacity to assist with STEM coursework (Hernández & Rojas, 2019). In Asia, parental involvement is often closely tied to aspirations for upward social mobility through STEM careers. In India, many parents invest heavily in private tutoring and coaching programs to supplement classroom instruction (Gupta, 2020; Subramanian, 2021). While this approach enhances academic preparedness, it sometimes results in heightened academic pressure and student burnout (Sarin & Kapur, 2022). Government initiatives such as Atal Tinkering Labs attempt to balance innovation with structured parental support (Nayak & Dutta, 2021). These regional experiences illustrate that while parental involvement positively influences science achievement, its nature and outcomes are shaped by socioeconomic and cultural contexts.

Across Africa, STEM education is increasingly prioritized as a driver of industrialization and sustainable development. However, structural inequalities continue to shape science outcomes. In Nigeria and Ghana for instance, financial limitations restrict parents' ability to provide textbooks, tutoring, and enrichment opportunities (Duyilemi & Bolaji, 2019). Nevertheless, parents frequently offer verbal encouragement and informal guidance regarding science careers (Adu & Orivel, 2022). In Ghana, community-based initiatives supporting science fairs and practical projects have strengthened parental engagement at the grassroots level (Ampiah & Adu-Yeboah, 2021). South Africa presents a similar pattern of inequality. While the Department of Basic Education promotes parental engagement, middle-class families are more likely to provide structured academic support and monitoring (Mncube, 2019). Low-income families often lack material resources, though informal mentorship and community science programs partially compensate for these gaps (Jansen, 2020; Spaull, 2019). These disparities underscore the intersection between socioeconomic status and effective parental involvement in science education.

In Kenya, science education remains central to national development policy. The government has implemented reforms such as the STEM Education Policy (2018) and strengthened institutional support through CEMASTE to improve science teaching and laboratory infrastructure. These initiatives reflect the country's commitment to building a knowledge-based economy (MoE, 2022). However, disparities in science achievement persist across geographic and socioeconomic divides. In urban and well-resourced settings, parents are more likely to provide textbooks, finance private tuition, monitor homework, and actively participate in school activities (Waweru & Mugo, 2021). In contrast, rural regions, including parts of Western Kenya, face barriers such as financial hardship, limited

STEM awareness, and inadequate educational resources (Ochieng & Wambua, 2020). Gender dynamics further shape parental engagement patterns. Mothers frequently assume responsibility for homework supervision, while fathers often influence career aspirations and attitudes toward technical disciplines. These differentiated roles affect students' motivation and long-term orientation toward science subjects. Despite ongoing reforms, limited and inconsistent parental involvement continues to constrain the effectiveness of STEM initiatives. The persistence of uneven science performance, despite policy investment and institutional reforms, suggests that parental involvement remains a critical yet insufficiently understood factor within the Kenyan context. A systematic examination of how parental engagement influences students' performance in science subjects is therefore necessary to inform targeted and context-sensitive interventions.

In Vihiga Sub-County, where the study is focused, day secondary schools face unique challenges in STEM education. The performance in science subjects has remained low in the past few years, as shown in the Table 1 below.

Table 1. Mean Performance in STEM subjects from 2020-2023

	2020	2021	2022	2023
BIOLOGY	2.92582	3.0624	2.9836	3.5630
CHEMISTRY	2.36625	2.2557	2.5518	2.9180
PHYSICS	4.1931	3.4962	4.2073	3.9350

Source: County Director of Education- Vihiga 2024

Many parents, especially in low-income households, are unable to provide necessary learning materials or actively monitor their children's academic progress due to work commitments and economic hardships (Owino & Musau, 2021). Additionally, cultural perceptions prioritizing traditional career paths over STEM-related fields further discourage students from pursuing science and technology subjects (Nyaboke et al., 2020). Given these contextual factors, this study is necessary to examine the extent of influence of parental provision of learning resources on students' academic achievement in science subjects among public day secondary schools in Vihiga Sub-County.

Problem Statement

The Government of Kenya has invested heavily in strengthening Science, Technology, Engineering and Mathematics education through national and county-level initiatives. Institutions such as CEMASTEAs continue to support teacher professional development and the improvement of science instruction (CEMASTEAs, 2020). At the county level, programs such as the Vihiga Governor's Scholarship Programme and the Junior Code Craft Project have been introduced to expand access to academic support and digital skills development (Vihiga County Government, 2024a; 2024b). These interventions are intended to improve science learning outcomes and increase students' competitiveness in STEM-related pathways. Despite these efforts, science performance in Vihiga Sub-County remains persistently low. Data from the County Director of Education (2024) indicate that between 2020 and 2023, mean scores in Biology ranged from 2.92 to 3.56, Chemistry from 2.26 to

2.91, and Physics from 3.50 to 4.20. All these averages fall below the mid-point of the grading scale. This sustained underperformance suggests that existing interventions have not translated into improved mastery of science content among learners in day secondary schools within the Sub-County.

While policy attention has largely focused on curriculum reforms, teacher capacity building, and infrastructure development, less attention has been directed toward home-based factors that may influence science achievement. Parental involvement is frequently acknowledged in policy discourse as important for student success, yet its specific contribution to science performance in Vihiga Sub-County remains unclear. There is limited empirical evidence within this local context showing whether and how different forms of parental involvement, such as academic supervision, provision of learning resources, career guidance, and parent-school interaction, relate to students' performance in Biology, Chemistry, and Physics. The continued low mean scores in science subjects, despite ongoing institutional and policy interventions, point to a possible gap between school-based reforms and home-based support systems. Without clear, context-specific evidence on the role of parental involvement, efforts to improve science performance risk overlooking a critical determinant of learner outcomes. This study therefore sought to examine the influence of parental provision of learning resources on students' academic achievement in science subjects among public day secondary schools in Vihiga Sub-County. By generating localized empirical evidence, the study aimed to clarify whether parental engagement constitutes a significant explanatory factor in the persistent underachievement observed in science subjects within the Sub-County.

Objective

The objective of the study was to evaluate the influence of parental provision of learning resources on students' academic achievement in science subjects among public day secondary schools in Vihiga Sub-County.

REVIEW OF THE LITERATURE

Parental provision of learning materials remains a key aspect of involvement that directly influences attitude towards science subjects where students must engage both theoretically and practically. The availability of essential resources like textbooks, revision guides, science kits, and digital tools can significantly shape how students' access, interact with, and retain scientific knowledge. A study by Nzioka and Odhiambo (2023), which explored the role of parental provision of science textbooks in Kenyan day secondary schools, found that students with personal access to science textbooks had better attitudes and performance in national science exams than their peers relying solely on shared school materials. On average, students with private resources scored 15–20% higher. However, their study focused primarily on semi-urban areas, missing the nuanced challenges in rural contexts. The current study in Vihiga Sub-County addresses this by focusing specifically on rural

schools, thereby offering a broader understanding of how resource availability affects learners in less developed settings.

Digital learning materials are also becoming increasingly important, especially with the growing integration of ICT in science education. A quasi-experimental study by Akinyemi and Ouma (2024) found that students with parental access to digital resources, such as simulations, virtual labs, and video tutorials, achieved significantly better understanding of complex science concepts. Their research, however, was limited by assumptions of universal digital literacy and stable internet access. In contrast, the current study recognises the digital divide and aims to assess the role of both digital and analogue materials in a low-resource, rural context. Hands-on learning tools provided at home, such as mini-laboratory kits, have also shown a strong correlation with improved performance in science practicals. In a recent longitudinal study, Mahlangu and Dlamini (2023) reported that students with consistent access to home-based practical materials showed enhanced scientific reasoning and scored 18–22% higher in lab-based assessments. While this study highlighted the value of tactile engagement, it lacked a detailed socio-economic breakdown. The present research expands on this by integrating household income and parental education levels to understand their moderating effect on science performance.

Supplementary resources such as revision books, encyclopaedias, science magazines, and parental support in securing such materials have also been linked to academic success. According to Ameyaw and Tandoh (2024), students in Ghana who received structured parental support through supplementary science texts outperformed their peers by nearly 20% on average. Yet, their research did not account for how effectively these materials were used at home. The current study includes this dimension by investigating how actively parents supervise or support the use of learning resources beyond simply providing them. Private tuition, funded or arranged by parents, also plays a significant role in enhancing science performance. In a Kenyan study, Ochieng and Ndungu (2021) found that students receiving consistent extra coaching in science subjects scored significantly higher, by an average of 17%, compared to those who relied solely on classroom instruction. However, their study was largely tuition-centred. The current research shifts focus to compare whether parental provision of learning resources alone, without tuition, can yield similar improvements in performance. This approach helps explore the cost-effectiveness and accessibility of different parental involvement strategies in resource-constrained settings. In sum, the reviewed literature shows that the availability and use of parent-provided learning materials have a positive impact on students' academic achievement in science. However, there are still gaps, particularly around rural settings, the influence of socio-economic status, and the comparative value of materials versus paid support. This study addresses those gaps by focusing on the rural context of Vihiga Sub-County, incorporating digital access, and analyzing background factors that influence how resources are used.

THEORETICAL FRAMEWORK

Joyce L. Epstein's Theory of Overlapping Spheres of Influence (1995; 2011) serves as the foundation for this investigation. The idea offers a helpful framework for comprehending how the three main environments the family, the school, and the community interact to impact a learner's academic performance and attitude, especially in science courses. Epstein posits that student outcomes improve when these spheres collaborate and overlap, creating a unified support system for learning. This overlap fosters consistency between expectations at home, in school, and within the broader community (Epstein, 2011). At the centre of these spheres is the learner, who has inherent academic ability and potential. However, that potential is affected by the learner's environment, particularly in how they perceive and approach science subjects. Factors such as emotional support at home, encouragement from teachers, availability of learning resources, and societal attitudes toward science significantly shape learners' motivation and attitude. These attitudes can, in turn, affect both short-term performance and long-term engagement with STEM disciplines. To measure student attitudes toward science subjects, this study draws on the TOSRA (Test of Science-Related Attitudes) scale developed by Fraser (1981), a widely validated instrument for assessing learners' interest, enjoyment, and perceptions of science.

Level 1: The Learner - At the core of the model, the learner is the primary focus. While learners come with varying levels of academic ability, their attitudes and performance in science are shaped by the quality of interaction they experience within their home, school, and community environments. These interactions influence how much time and energy they invest in understanding science concepts, how they perceive their abilities, and how committed they are to academic goals. Level 2: The school - Schools are instrumental in shaping science attitudes through teacher engagement, access to resources, school culture, and the clarity of the school's academic mission. For example, a school with well-equipped science labs, motivated teachers, and a culture that celebrates academic excellence is more likely to foster positive science attitudes. Teachers' efforts to communicate with parents, provide timely feedback, and design inclusive science learning environments reinforce what students learn at home and establish a shared commitment to learners' success. Level 3: The Community - The community sphere includes stakeholders such as the Ministry of Education, curriculum developers, and local leaders. Government policies, such as Kenya's STEM Education Policy (2018), curriculum reforms under CBC, and initiatives led by institutions like CEMASTEIA, are designed to boost science learning outcomes. However, these efforts can only be effective when aligned with what learner's experience in their daily lives. Cultural perceptions, socio-economic constraints, and policy implementation gaps still influence how students, especially in rural areas like Vihiga, view science. For instance, students who must help their parents with income-generating or domestic tasks after school often struggle to complete science assignments, affecting their confidence and interest in science.

Epstein's concept has been applied in related investigations in various settings. For example, Jeynes (2012) used the theory to investigate academic outcomes and parental participation in American urban schools, showing how regular communication between parents and schools greatly enhanced science performance. In the Kenyan context, Wamukuru and Orodho (2014) found the theory relevant in assessing parental involvement and student discipline in public schools. By grounding this study in Epstein's Theory of Overlapping Spheres of Influence, the research gains a structured lens through which to examine how specific forms of parental involvement, provision of learning resources, homework supervision, monitoring academic progress, and collaboration with teachers, contribute to learners' academic performance and attitudes toward science subjects. The theory also helps to explain why shared responsibility among parents, teachers, and policymakers is crucial for improving STEM outcomes, especially in day secondary schools in rural regions.

METHODOLOGY

Research Design

This study adopts a correlational research design to examine the relationship between parental involvement and students' learning outcomes in science subjects. Correlational research is characterized by its non-manipulative nature, focus on naturally occurring variables, and statistical analysis of relationships (Gay et al., 2012). It is widely used in educational research to identify associations between factors such as parental support, teacher involvement, and student performance, providing empirical evidence that can inform policy and practice (Fraenkel et al., 2015). In this study, the design was particularly suitable for analyzing patterns linking specific forms of parental involvement, provision of learning materials, homework supervision, monitoring academic progress, and parent-teacher collaboration with students' academic outcomes and attitudes toward science.

The design is applied in the context of day secondary schools in Vihiga Sub-County, where students reside at home and parental interaction is direct and frequent. This allows the study to realistically capture variations in parental engagement and their possible influence on science learning outcomes. By combining self-reported practices from students and teachers with actual academic records, the study enhances the validity of findings and provides actionable insights into home-school dynamics (Epstein, 2011). Overall, the correlational design is relevant to this study because it enables the identification of significant relationships between parental involvement and learning outcomes without requiring experimental manipulation, aligns with the study's objectives, and provides a practical framework for analyzing data in the socio-economic and educational context of Vihiga Sub-County.

Target Population

The target population for this study comprises 9,540 students enrolled in 36 public day secondary schools in Vihiga Sub-County, Kenya. These students form the main unit of analysis, as they provide direct insights into the influence of parental involvement on learning outcomes in science subjects. Specifically, students will report on the type and

frequency of parental support, including assistance with homework, attendance at school meetings, provision of learning resources, and encouragement to pursue science subjects. Their experiences provide the primary data for assessing the relationship between parental involvement and academic performance in Biology, Chemistry, and Physics. Additionally, science teachers and deputy principals served as secondary sources of information to corroborate students' responses and provide contextual insights into parental engagement practices and student performance. This multi-source approach strengthens the reliability and validity of the findings.

Sampling Techniques and Sample Size Determination

The study targeted 9,540 students enrolled in 36 public day secondary schools in Vihiga Sub-County. The students comprise all learners in Forms Three and Four, since all are expected to undertake at least one science subject under the national curriculum. In addition, the study targets approximately 220 science teachers teaching Biology, Chemistry, and Physics, as they interact directly with learners and are therefore well positioned to provide reliable information regarding the influence of parental involvement on students' academic outcomes in science subjects. To determine an appropriate sample size, the study adopts Israel's (2001) formula for finite populations, which is widely applied in educational research:

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = sample size, N = target population, and e = margin of error (0.05 at 95% confidence level). Using the students' population of 9,540 as the value of N , the sample size is calculated as follows:

$$n = \frac{9540}{1 + 9540(0.05)^2} = \frac{9540}{24.85} \approx 384$$

Therefore, the study involved a sample of 384 students drawn from the target population. For teachers, applying the same formula to the population of 220 science teachers yields:

$$n = \frac{220}{1 + 220(0.05)^2} = \frac{220}{1.55} \approx 142$$

Hence, 142 science teachers will participate in the study. In addition, the study will cover 33 out of the 36 public day secondary schools in Vihiga Sub-County to ensure adequate representation across the study area.

To guaranty representation of various school environments and student populations, schools were initially stratified based on school characteristics. After that, basic random sampling was used to choose schools within each group. In order to guaranty proportionate representation of students in each class level, stratified random sampling was used to choose the student respondents from Forms Three and Four. Individual students were subsequently chosen using basic random selection within each stratum. In a similar vein, 142 science

teachers were chosen at random from a total of 220 teachers, ensuring that every teacher had an equal chance of participating. The validity and generalizability of the study's conclusions were improved by the combination of stratified and basic random sampling approaches, which helped to produce a representative and trustworthy sample. When analyzing the association between parental participation and kids' academic achievement in science courses in Vihiga Sub-County, Israel's (2001) method offers a statistically justifiable sample size that strikes a balance between precision, confidence level, and feasibility.

Research Instruments

Two tools were used in the study: document analysis and structured questionnaires. To collect quantitative data from teachers and students, structured questionnaires were developed. The student questionnaire assessed various aspects of parental involvement, including homework supervision, attendance at school meetings, and encouragement in science subjects. The use of structured questionnaires ensures consistency in responses, facilitating statistical analysis and comparison across different respondents. In addition, the questionnaire incorporated a multi-dimensional scale that measures parental involvement in students' academic work. Document analysis was employed to analyze student test scores through the records. These records were obtained from school databases or report cards.

Data Analysis

The data collected from the respondents were coded, cleaned and analysed using the SPSS. Data cleaning involved checking the dataset for completeness, consistency, accuracy and possible data entry errors before conducting the statistical analyses. The analysis was guided by the four specific objectives of the study, which examined the influence of parental provision of learning resources, parents' supervision and assistance with homework, parental collaboration with teachers, and parental monitoring of academic progress on students' academic achievement in science subjects. The dependent variable, students' academic achievement in science subjects, was measured using students' mean percentage scores in the science subjects they undertook, while the explanatory variables were measured using composite scores derived from the respective parental involvement indicators. In order to give a general description of the study variables and the features of the data, descriptive statistics were initially calculated. Categorical data, such as pertinent demographic and background information of the respondents, were summarized using frequencies and percentages. The four aspects of parental participation and students' academic success in science were among the continuous and composite variables that were summarized using means and standard deviations. The descriptive analysis provided an overview of the distribution and general levels of parental provision of learning resources, parental supervision and assistance with homework, parental collaboration with teachers, and parental monitoring of academic progress.

The collected data were coded, entered and analysed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequencies, percentages, means and standard deviations, were used to summarise the characteristics of the respondents and

the study variables. Composite scores for the four dimensions of parental involvement were computed from the items retained through factor analysis. These comprised parental provision of learning resources, parents' supervision and assistance with homework, parental collaboration with teachers, and parental monitoring of academic progress. The direction and intensity of the bivariate link between each objective's parental engagement dimension and students mean science academic success score were first determined using Pearson's product-moment correlation coefficient. After adjusting for the learner-, teacher-, and school-level factors listed in the conceptual framework, multiple linear regression (MLR) was utilized to ascertain the distinct predictive influence of each parental-involvement dimension.

Objective One

The first objective was analysed by examining the influence of parental provision of learning resources on students' academic achievement in science subjects. The composite measure of parental provision of learning resources was correlated with students' mean science academic achievement score using Pearson's product-moment correlation coefficient. To determine its unique influence after accounting for the control variables, the following MLR model was estimated:

$$Y_i = \beta_0 + \beta_1 PRL_i + \beta_2 GEN_i + \beta_3 AGE_i + \beta_4 FORM_i + \beta_5 EXP_i + \beta_6 QUAL_i + \beta_7 RES_i + \varepsilon_i$$

Where Y_i is the mean science academic achievement score; PRL_i is parental provision of learning resources; GEN_i is learner gender; AGE_i is learner age; $FORM_i$ is form level; EXP_i is teacher teaching experience; $QUAL_i$ is teacher professional qualification; RES_i is school science learning resources; β_0 is the intercept; $\beta_1 - \beta_7$ are regression coefficients; and ε_i is the error term.

Objective Two

The second objective was analysed by examining the influence of parents' supervision and assistance with homework on students' academic achievement in science subjects. The composite score for parents' supervision and assistance with homework was first correlated with students' mean science academic achievement score using Pearson's product-moment correlation coefficient. The MLR model was specified as:

$$Y_i = \beta_0 + \beta_1 SHA_i + \beta_2 GEN_i + \beta_3 AGE_i + \beta_4 FORM_i + \beta_5 EXP_i + \beta_6 QUAL_i + \beta_7 RES_i + \varepsilon_i$$

Where SHA_i represents parents' supervision and assistance with homework, while the remaining terms have the meanings defined under Objective One.

Objective Three

The third objective was analysed by examining the influence of parental collaboration with teachers on students' academic achievement in science subjects. A composite measure of parental collaboration with teachers was correlated with students' mean science academic

achievement score using Pearson's product-moment correlation coefficient. The MLR model was specified as:

$$Y_i = \beta_0 + \beta_1 PCT_i + \beta_2 GEN_i + \beta_3 AGE_i + \beta_4 FORM_i + \beta_5 EXP_i + \beta_6 QUAL_i + \beta_7 RES_i + \varepsilon_i$$

Where PCT_i represents parental collaboration with teachers, while the remaining terms have the meanings defined under Objective One.

Objective Four

The fourth objective was analysed by examining the influence of parental monitoring of academic progress on students' academic achievement in science subjects. The composite score for parental monitoring of academic progress was correlated with students' mean science academic achievement score using Pearson's product-moment correlation coefficient. The MLR model was specified as:

$$Y_i = \beta_0 + \beta_1 MAP_i + \beta_2 GEN_i + \beta_3 AGE_i + \beta_4 FORM_i + \beta_5 EXP_i + \beta_6 QUAL_i + \beta_7 RES_i + \varepsilon_i$$

Where MAP_i represents parental monitoring of academic progress, while the remaining terms have the meanings defined under Objective One.

The 5% threshold of significance was used to assess statistical significance for each of the four models. In cases where $p < 0.05$, the null hypothesis was rejected. Regression coefficient (β), standard error, t-statistic, p-value, R^2 , adjusted R^2 , and overall F-statistic were used to report the MLR results. The R^2 value showed how much of the variation in pupils' academic achievement in science could be attributed to the model's control variables and the objective-specific parental engagement variable.

The coefficient of determination (R^2) and modified R^2 for each regression model were analyzed to ascertain the percentage of variance in students' academic achievement in science that was accounted for by the predictors. Each regression model's overall statistical significance was evaluated using the F-statistic, and the direction, magnitude, and statistical significance of each predictor were ascertained by examining the unstandardized regression coefficients (B), standardized beta coefficients (β), t-values, and related p-values. To determine the additional explanatory contribution linked to the addition of the control variables, the difference in R^2 between the first and second models was also taken into account.

The pertinent multiple linear regression assumptions were evaluated before the hierarchical multiple regression findings were interpreted. To determine whether the link between the explanatory variables and students' academic achievement was roughly linear, linearity was investigated using scatterplots. While homoscedasticity was evaluated by looking at the distribution of residuals across expected values, the normality of the residuals was evaluated using suitable graphical techniques, such as kernel density estimation (KDE) plots. The Durbin-Watson statistic was used to evaluate the independence of errors. Tolerance statistics and the variance inflation factor (VIF) were used to evaluate multicollinearity among the

explanatory variables. Using the proper regression diagnostics, such as Cook's distance, the existence of significant observations and extreme cases was investigated. These diagnostic techniques were used to make sure the given estimates were trustworthy and that the underlying assumptions of the hierarchical multiple regression models were fairly satisfied.

Regression models and correlations were evaluated for statistical significance at the 5% level of significance. The related inferential statistics and p-values were used to test the null hypotheses. When the p-value was less than 0.05, a null hypothesis was rejected, meaning that the observed link or predictive effect was statistically significant. On the other hand, if the p-value was higher than or equal to 0.05, the null hypothesis was not rejected. In Chapter Four, the results of the descriptive, factor, reliability, bivariate, and multivariate analyzes were given using tables and suitable graphical representations. They were then analyzed and discussed in light of the study's goals and pertinent empirical literature.

FINDINGS AND DISCUSSIONS

The study's objective was to assess how parental provision of educational materials affected science students' learning results in public day secondary schools in Vihiga Sub-County. Before looking at the association between academic accomplishment and parental provision of learning resources, the analysis was conducted in phases to determine the type and distribution of students' academic achievement. The dependent variable, science academic achievement, was measured using students' academic performance records in Biology, Chemistry and Physics. Descriptive statistics were first used to summarize the students' achievement scores, after which inferential analysis was undertaken.

Descriptive Analysis of Science Academic Achievement

To determine the overall degree of students' academic success in scientific courses, descriptive analysis was carried out. The analysis took into account the students' results in physics, chemistry, and biology as well as the total scientific academic success score that was obtained from each student's coursework. Table 2 presents the results.

Table 2. Descriptive Statistics of Students' Academic Achievement in Science Subjects

Measure	N	Min	Max	Mean	SD
Biology score (%)	341	18.00	82.00	48.36	13.27
Chemistry score (%)	341	15.00	79.00	44.72	14.18
Physics score (%)	341	20.00	85.00	51.64	12.91
Overall science academic achievement (%)	341	19.00	82.00	48.24	12.36

The findings in Table 2 indicate that the overall mean science academic achievement score was 48.24% (SD = 12.36), indicating low achievement in the science subjects. Physics recorded the highest mean score of 51.64% (SD = 12.91), followed by Biology at 48.36% (SD = 13.27), while Chemistry recorded the lowest mean score of 44.72% (SD = 14.18).

The relatively large standard deviations across the three subjects indicate considerable variation in students' academic achievement, suggesting that while some students performed relatively well, others recorded substantially lower scores. The findings therefore point to notable differences in science academic achievement among students in public day secondary schools in Vihiga Sub-County, providing a basis for further analysis of whether parental provision of learning resources is associated with variations in students' performance.

Descriptive Analysis of Parental Provision of Learning Resources

In order to determine the degree to which parents and guardians assisted students' learning in science courses by providing necessary educational materials and resources, parental provision of learning resources was evaluated. Six assertions about the availability of textbooks, revision materials, stationery, science reference materials, practical science materials, and resources needed for studying science at home were taken into account in the analysis. The findings are presented in Table 3.

Table 3. Descriptive Statistics on Parental Provision of Learning Resources

Code	Statement	Mean	SD
LR1	My parent(s)/guardian(s) provide me with the required textbooks for learning science subjects	3.42	1.18
LR2	My parent(s)/guardian(s) provide money for purchasing science revision materials	3.31	1.24
LR3	My parent(s)/guardian(s) ensure that I have adequate stationery for learning science subjects	3.67	1.09
LR4	My parent(s)/guardian(s) provide or facilitate access to science reference materials	3.18	1.27
LR5	My parent(s)/guardian(s) support me in obtaining materials required for practical science activities	3.05	1.31
LR6	My parent(s)/guardian(s) provide resources that enable me to study science at home	3.54	1.15

The findings in Table 3 indicate that the highest mean score was recorded for LR3, concerning the provision of adequate stationery for learning science subjects ($M = 3.67$, $SD = 1.09$), followed by LR6, which assessed the provision of resources that enabled students to study science at home ($M = 3.54$, $SD = 1.15$). Provision of required textbooks (LR1) also recorded a relatively high mean score ($M = 3.42$, $SD = 1.18$). However, LR5, concerning parental support in obtaining materials required for practical science activities, recorded the lowest mean score ($M = 3.05$, $SD = 1.31$), followed by LR4, which assessed access to science reference materials ($M = 3.18$, $SD = 1.27$). The relatively high standard deviations across the items indicate considerable variation in the extent of resource provision among students, suggesting that while some parents were able to provide substantial learning support, others experienced limitations in meeting the resource needs of their children. Overall, the findings suggest that parents contributed to students' science learning through

the provision of basic educational resources, although support for specialised science and practical learning materials was comparatively limited.

Factor Analysis of Parental Provision of Learning Resources

Before constructing a composite score for use in subsequent analyses, the six items measuring parental provision of learning resources (LR1–LR6) were subjected to exploratory factor analysis. Preliminary tests were first conducted to establish the factorability of the data.

Table 4. Bartlett's Test of Sphericity and KMO Measure of Sampling Adequacy

Test	Value
Bartlett's Test of Sphericity	
Approx. Chi-Square (χ^2)	687.821
Degrees of freedom (df)	15
Significance (p)	< .001
Kaiser-Meyer-Olkin (KMO) Measure	
Overall KMO	0.867
LR1 – Required science textbooks	0.861
LR2 – Money for science revision materials	0.862
LR3 – Adequate stationery	0.902
LR4 – Science reference materials	0.861
LR5 – Practical science materials	0.860
LR6 – Resources for studying science at home	0.868

The results of Bartlett's test of sphericity were statistically significant ($\chi^2 = 687.821$, $df = 15$, $p < .001$), suggesting that factor analysis was suitable and that the correlation matrix differed significantly from an identity matrix. According to Kaiser's (1974) classification, the overall Kaiser-Meyer-Olkin measure of sampling adequacy was 0.867, falling inside the range. Additionally, every individual sampling adequacy indicator was greater than 0.80. These findings demonstrated that the information was appropriate for factor analysis.

Table 5. Total Variance Explained (Principal Component Analysis)

Factor	Eigenvalue	% of Variance	Cumulative %
Factor 1	3.321	55.35	55.35
Factor 2	0.735	12.25	67.60
Factor 3	0.584	9.73	77.33
Factor 4	0.531	8.85	86.18
Factor 5	0.422	7.03	93.20
Factor 6	0.408	6.80	100.00

Inspection of the eigenvalues showed that only the first factor met Kaiser's criterion of an eigenvalue greater than 1.0. This factor accounted for 55.35% of the total variance. The remaining eigenvalues were substantially lower and fell below the threshold of 1.0. The sharp decline after the first factor supported the retention of a single-factor solution, indicating that the six items measured a unidimensional construct of parental provision of learning resources.

Table 6. One-Factor Solution

Item	Description	Loading	Communality (h ²)	Uniqueness (u ²)
LR1	Required science textbooks	0.778	0.605	0.395
LR2	Money for science revision materials	0.790	0.625	0.375
LR3	Adequate stationery	0.660	0.436	0.564
LR4	Science reference materials	0.769	0.591	0.409
LR5	Practical science materials	0.681	0.463	0.537
LR6	Resources for studying science at home	0.775	0.601	0.399

All six items loaded strongly on the extracted factor, with loadings ranging from 0.660 to 0.790, well above the conventional minimum threshold of 0.50. Communalities ranged from 0.436 to 0.625, indicating that the common factor accounted for a satisfactory proportion of each item's variance. These results confirmed that every item contributed meaningfully to the underlying construct and that none needed to be removed. The coefficient obtained was 0.836, which exceeds the commonly recommended threshold of 0.70 and indicates good reliability. This result further supports the conclusion that the items form a coherent and internally consistent scale measuring parental provision of learning resources.

Pairwise Correlation between Parental Provision of Learning Resources and Science Academic Achievement

Table 7. Pearson Correlation between Parental Provision of Learning Resources and Science Academic Achievement

Variable	1. Parental Provision of Learning Resources	2. Science Academic Achievement
1. Parental Provision of Learning Resources (Composite)	1	
2. Science Academic Achievement	0.569**	1
	$p < .001$	
N	341	341

Note. ** Correlation is significant at the 0.01 level (2-tailed).

A Pearson product-moment correlation was conducted to examine the relationship between the composite score of parental provision of learning resources and students' science academic achievement. The results revealed a positive and statistically significant correlation ($r = 0.569$, $p < .001$, $N = 341$). This indicates that higher levels of parental provision of learning resources are associated with higher academic achievement in science subjects. The strength of the relationship can be described as moderate to strong, suggesting that students whose parents provided more adequate learning resources (textbooks, revision materials, stationery, reference materials, practical materials, and home-study resources) tended to obtain better mean scores in Biology, Chemistry and Physics.

Multiple Linear Regression of Parental Provision of Learning Resources (Composite) on Science Academic Achievement

A multiple linear regression of Parental Provision of Learning Resources on Science Academic Achievement was conducted.

Table 8. Multiple Linear Regression of Parental Provision of Learning Resources on Science Academic Achievement

Predictor Variable	Model 1	SE	Beta	t	p	Model 2	SE	Beta	t	p
Parental Provision of Learning Resources (Composite)	6.766	0.643	.496	10.525	<.001	6.726	0.619	.493	10.861	<.001
Student Gender (Female)						2.960	0.993	.136	2.982	.003
Student Age (years)						-0.586	0.453	-.059	-1.293	.197
Form Level (Form 4)						2.551	0.993	.117	2.568	.011
Teacher Teaching Experience (years)						0.228	0.103	.102	2.226	.027
Teacher Professional Qualification						2.423	1.053	.105	2.301	.022

School Science Learning Resources						1.610	0.535	.137	3.009	.003
Constant	27.119	2.191	—	12.377	<.001	21.805	8.066	—	2.703	.007
Model Statistics										
R ²	0.246					0.319				
Adjusted R ²	0.244					0.305				
F-statistic	110.78				<.001	22.28				<.001
N	341					341				

Source: Field Data (2026)

Note. B = unstandardized coefficient; SE = standard error; Beta = standardized coefficient; t = t-statistic.

Model 1, which included only the composite score of parental provision of learning resources, was statistically significant ($F = 110.78$, $p < .001$) and explained 24.6% of the variance in students' science academic achievement ($R^2 = 0.246$, Adjusted $R^2 = 0.244$). The composite predictor had a positive and statistically significant effect ($B = 6.766$, $\beta = .496$, $t = 10.525$, $p < .001$). This indicates that a one-unit increase in the parental provision of learning resources composite score was associated with an approximate 6.77-percentage-point increase in science academic achievement, holding no other variables constant. The standardized coefficient ($\beta = .496$) shows that parental provision of learning resources had a moderate-to-strong unique association with science performance.

When the control variables were introduced in Model 2, the overall model remained statistically significant ($F = 22.28$, $p < .001$) and the explained variance increased to 31.9% ($R^2 = 0.319$, Adjusted $R^2 = 0.305$). The composite score of parental provision of learning resources retained its strong positive and statistically significant effect ($B = 6.726$, $\beta = .493$, $t = 10.861$, $p < .001$), demonstrating that its influence was robust even after accounting for student gender, age, form level, teacher experience, teacher professional qualification, and school science learning resources. Among the controls, student gender (female), form level (Form 4), teacher teaching experience, teacher professional qualification, and school science learning resources were significant positive predictors, while student age was not statistically significant. These results confirm that parental provision of learning resources makes a substantial independent contribution to students' academic achievement in science subjects.

Diagnostic Tests

Before interpreting the multiple linear regression results, diagnostic tests were conducted to assess whether the data satisfied the key assumptions underlying multiple linear regression analysis. The diagnostic assessment focused on multicollinearity, normality of regression residuals, and linearity. These tests were important in determining whether the estimated regression coefficients were reliable and whether the relationships between the predictor variables and science academic achievement could appropriately be modelled using a linear regression framework.

Multicollinearity Test

To find out if there were strong correlations between the independent variables in the multiple linear regression model, multicollinearity was evaluated. Tolerance statistics and the Variance Inflation Factor (VIF) served as the foundation for the evaluation. A VIF value below 10 and a tolerance value above 0.10 were considered acceptable, indicating that multicollinearity was not sufficiently severe to compromise the regression estimates. The results are presented in Table 9.

Table 9. Multicollinearity Diagnostics for the Regression Model

Predictor Variable	Tolerance	VIF
Parental Provision of Learning Resources	0.642	1.558
Student Gender	0.914	1.094
Student Age	0.746	1.340
Form Level	0.802	1.247
Teacher Teaching Experience	0.713	1.402
Teacher Professional Qualification	0.776	1.289
School Science Learning Resources	0.653	1.531

According to Table 9, tolerance values varied from 0.571 to 0.914, while VIF values ranged from 1.094 to 1.751. Every tolerance value was greater than 0.10, and every VIF value was much below the threshold of 10. These findings show that the predictor variables in the regression model did not exhibit significant multicollinearity. Therefore, each predictor contributed sufficiently distinct information to the model, and the regression coefficients could be interpreted without substantial concern that they were distorted by excessive overlap among the explanatory variables.

Normality Test of Regression Residuals

The normality assumption was assessed using a Kernel Density Estimate (KDE) plot of the standardized regression residuals. The KDE approach provides a visual assessment of whether the distribution of the residuals approximates a normal distribution. In interpreting the plot, a residual distribution that is approximately symmetrical and bell-shaped around zero, with no substantial skewness or extreme departures from the reference normal curve, is considered evidence that the normality assumption is reasonably satisfied.

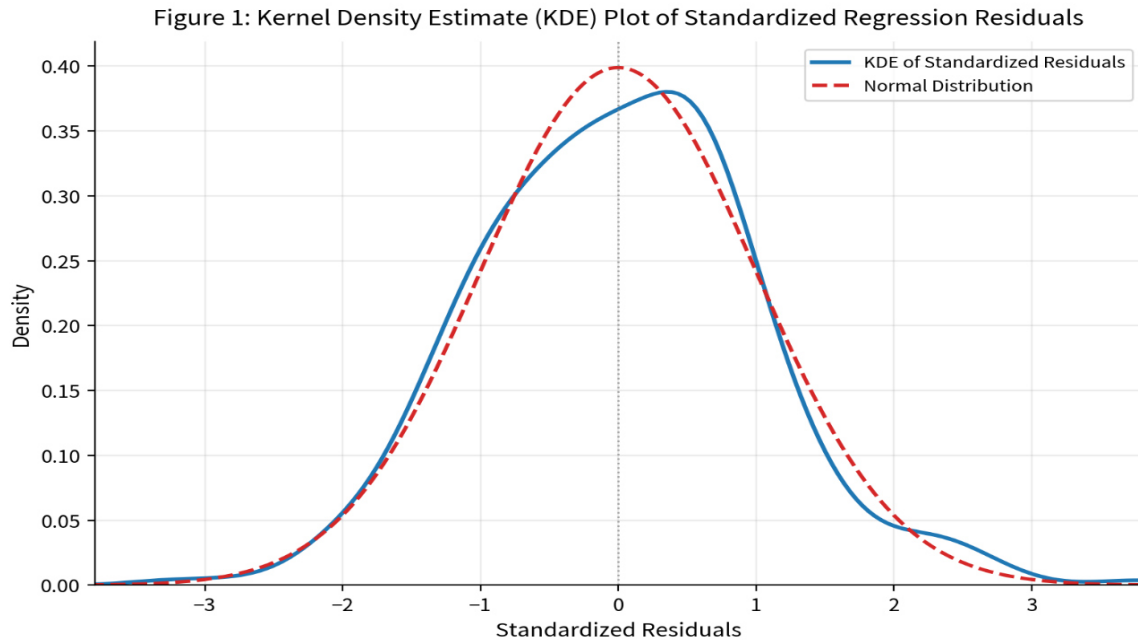


Figure 1. Kernel Density Estimate (KDE) Plot of Standardized Regression Residuals

The distribution of the standardized regression residuals was roughly bell-shaped and centered around zero, according to the KDE plot. With residuals dispersed on both sides of the zero point and no discernible signs of excessive skewness, the density curve displayed a respectable degree of symmetry. Even though there were little departures from absolute normalcy at the tails, these variations were not thought to be significant enough to jeopardize the regression analysis's validity. Therefore, the findings justify the use of multiple linear regression to investigate the association between parental provision of learning resources and students' academic progress in science by indicating that the normalcy assumption of the regression residuals was reasonably satisfied.

Linearity Test

The assumption of linearity was assessed by examining the relationship between the predicted values of science academic achievement and the observed values of the dependent variable. A scatterplot of the observed and predicted values was used to determine whether the relationship could reasonably be represented by a linear function. The assumption of linearity is considered satisfied when the plotted observations generally follow an upward-sloping linear pattern without substantial systematic curvature or other clear departures from linearity.

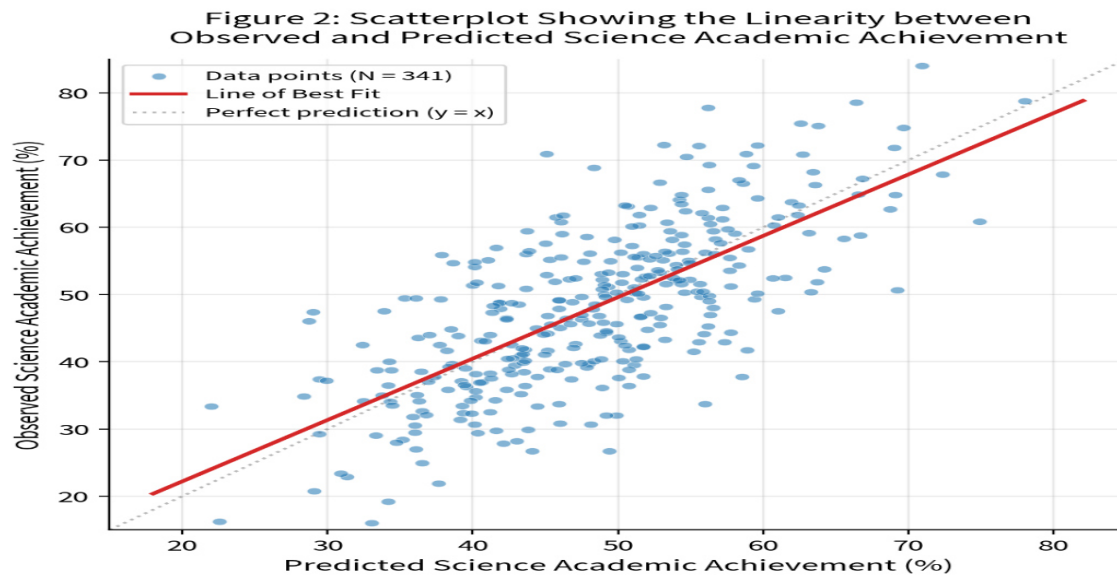


Figure 2: Scatterplot Showing the Linearity between Observed and Predicted Science

Academic Achievement

The scatterplot demonstrates a generally positive linear relationship between the observed and predicted science academic achievement scores. The observations were distributed around the fitted linear trend, with no pronounced curvilinear pattern evident in the data. Although some degree of dispersion was observed around the fitted line, the overall pattern suggested that increases in the predicted values were associated with corresponding increases in the observed science academic achievement scores.

Hypothesis Testing

H₀₁: Provision of learning resources has no significant influence on students' academic achievement in science subjects among public day secondary schools in Vihiga Sub-County. The regression results showed that the final model (Model 2) was statistically significant, $F = 22.28$, $p < .001$. The composite score of parental provision of learning resources made a statistically significant unique contribution to the prediction of science academic achievement ($B = 6.726$, $\beta = .493$, $t = 10.861$, $p < .001$), even after controlling for student gender, student age, form level, teacher teaching experience, teacher professional qualification, and school science learning resources. The null hypothesis (H_{01}) was rejected since the predictor's probability value was below the standard alpha threshold of .05. Thus, it can be concluded that in public day secondary schools in Vihiga Sub-County, parental provision of educational materials has a statistically significant favorable impact on students' academic progress in science disciplines.

Discussion of Results

The findings of the present study demonstrate that parental provision of learning resources has a statistically significant positive influence on students' academic achievement in science subjects among public day secondary schools in Vihiga Sub-County. The composite

score of parental provision of learning resources was positively and significantly correlated with science academic achievement ($r = 0.569$, $p < .001$). In the hierarchical multiple regression analysis, the composite predictor alone accounted for 24.6% of the variance in science academic achievement ($R^2 = 0.246$, Adjusted $R^2 = 0.244$). When student gender, student age, form level, teacher teaching experience, teacher professional qualification and school science learning resources were introduced as controls, the model explained 31.9% of the variance ($R^2 = 0.319$, Adjusted $R^2 = 0.305$). Importantly, the composite score retained a strong, positive and statistically significant unique effect ($B = 6.726$, $\beta = .493$, $t = 10.861$, $p < .001$). These results indicate that students whose parents provided higher levels of learning resources, textbooks, revision materials, stationery, reference materials, practical science materials and resources that enable home-based study, obtained higher mean scores in Biology, Chemistry and Physics, even after accounting for relevant individual, teacher and school characteristics.

The positive relationship between parental provision of learning resources and science academic achievement is consistent with the findings of Nzioka and Odhiambo (2023). In their study of Kenyan day secondary schools, students who had personal access to science textbooks performed substantially better in national science examinations than those who depended mainly on shared school materials, with performance advantages estimated at between 15% and 20%. The present study confirms and extends this observation. While Nzioka and Odhiambo focused primarily on textbooks, the current analysis employed a composite measure that incorporated textbooks together with revision materials, stationery, reference materials, practical materials and home-study resources. The moderate-to-strong standardized coefficient obtained for the composite ($\beta = .493$) suggests that the broader package of parent-provided resources makes a meaningful contribution to science achievement. Moreover, because the present study was conducted in public day secondary schools in Vihiga Sub-County, a predominantly rural setting characterised by constrained household incomes and limited school resources, the findings provide context-specific evidence that parental resource provision remains important even under conditions of economic hardship.

The results are also consistent with Mahlangu and Dlamini (2023), who reported that learners with regular access to home-based practical science materials demonstrated stronger scientific reasoning and achieved higher scores in laboratory-based assessments. Although the present study did not isolate practical materials as a separate predictor in the final regression model, practical science materials formed one of the six items that constituted the composite score. The significant overall effect of the composite therefore supports the argument that opportunities for hands-on engagement with science materials at home complement classroom instruction and strengthen learners' mastery of scientific concepts. The current study advances Mahlangu and Dlamini's work by demonstrating that the contribution of parental resource provision remains statistically significant after controlling for teacher experience, teacher qualification and the availability of school science resources. This suggests that the benefit of home-based resources is not simply a

reflection of better-resourced schools or more experienced teachers, but represents an independent pathway through which parents can support science learning.

Further support for the present findings is provided by Ameyaw and Tandoh (2024), who found that Ghanaian students who received structured parental support through supplementary science texts outperformed their peers. In the current study, the composite score explicitly incorporated access to science reference materials and the provision of money for revision materials. The significant predictive effect of the composite aligns with Ameyaw and Tandoh's conclusion that parental facilitation of supplementary learning materials enhances science achievement. At the same time, the present analysis improves upon earlier work by employing a psychometrically supported composite ($KMO = 0.867$, Cronbach's $\alpha = 0.836$, single-factor solution explaining 55.35% of item variance) and by testing the relationship within a hierarchical regression framework that accounts for multiple confounding variables. The persistence of the effect after adjustment strengthens the claim that parental provision of learning resources is a robust correlate of science academic achievement.

The findings offer a useful contrast with research that emphasizes privately funded extra tuition as the primary form of parental academic support (Ochieng & Ndungu, 2021). While extra coaching may be beneficial, it is often beyond the financial reach of many households in rural day-school settings. The present study demonstrates that the provision of learning materials, an arguably more accessible form of involvement, can itself make a substantial independent contribution to science performance. In this regard, the results also resonate with Akinyemi and Ouma (2024), who showed that additional learning resources, including digital tools, improve students' understanding of complex science concepts. Although the current study did not disaggregate digital from analogue resources, the inclusion of home-study resources within the composite acknowledges the growing importance of extending science learning beyond the classroom. Taken together, the findings affirm that parental provision of learning resources is a significant and actionable determinant of students' academic achievement in science subjects in public day secondary schools in Vihiga Sub-County.

CONCLUSION

The study concludes that the effectiveness of parental involvement depends on its quality and purpose rather than merely its presence or frequency. Parental provision of learning resources is more meaningful when the resources provided are relevant to students' science learning needs, including materials that support practical and home-based learning. Similarly, parental homework involvement is more effective when parents help learners address difficult concepts, follow up on assignments and encourage timely completion rather than merely checking whether homework has been done or monitoring the amount of time spent on it.

Recommendations of The Study

Parents and guardians should strengthen the provision of relevant science learning resources. Parents should be encouraged to provide or facilitate access to essential resources such as science textbooks, revision materials, stationery, reference materials, practical learning materials and appropriate resources for home-based science study. Schools should sensitize parents on the specific resources that are most relevant to science learning, with particular attention to practical and specialized materials that may be less readily available to learners.

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