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Influence of socio-economic factors on students' academic performance in mathematics at G.S. KABUSUNZU in Nyarugenge District, Rwanda

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Abstract: **Mathematics develops analytical reasoning and problem-solving skills, yet students' achievement may differ according to household circumstances and access to learning support. This study examined the relationship between selected socio-economic factors and mathematics performance among students at G.S. Kabusunzu. It focused on parental income, parental education and support, home learning resources, and student motivation. The study employed a cross-sectional correlational design supplemented by qualitative responses. Questionnaires, interviews, and school records were identified as data sources. The reported usable sample comprised 79 respondents from 85 questionnaires distributed, representing a response rate of 92.9%. Descriptive statistics, Pearson correlation, multiple linear regression, and regression analysis of variance (ANOVA) were used in the reported analysis, while qualitative responses were considered thematically. The detailed regression results indicate positive associations between all four predictors and mathematics scores. Home learning resources had the largest standardized coefficient (β = 0.41), followed by parental education (β = 0.32), student motivation (β = 0.24), and parental income (β = 0.18). The reported overall regression test was statistically significant, $F(4, 74) = 15.98$, $p < 0.001$. The study highlights the importance of learning materials, parental support, and opportunities for mathematics practice.**

Keywords: **Socio-economic factors; mathematics performance; parental income; parental education; home learning resources; student motivation; multiple linear regression.**

I. INTRODUCTION

Education contributes to individual development and wider social and economic progress. Mathematics is particularly important because it develops analytical reasoning, logical thinking, and problem-solving skills used in science, technology, business, and everyday life [1]. Students' achievement in mathematics may be associated with family background, school conditions, and individual characteristics [2].

Socio-economic status (SES) commonly reflects a household's social and economic position and may be represented by parental education, occupation, income, and access to resources. These characteristics can shape learning opportunities. Families with greater financial resources may be better able to provide textbooks, digital devices, private tutoring, and a suitable place to study, whereas financial hardship may limit access to these supports [3], [4]. Parental education and involvement may also influence expectations, study habits, encouragement, and assistance when learners encounter difficult mathematical concepts [5].

These relationships may vary across schools and communities. Students' achievement is shaped by interactions among family, school, community, and wider policy contexts. A supportive teacher or school resource may partly offset limitations at home, while household stress or irregular attendance may interrupt learning. Although previous studies have examined socio-economic status and achievement in different settings [6]–[9], school-specific evidence is useful for understanding students' experiences at G.S. Kabusunzu.

This study therefore examined the relationship between selected socio-economic factors and students' academic performance in mathematics at G.S. Kabusunzu. The specific factors considered were parental income, parental education and support, home learning resources, and student motivation. The study was guided by the following objectives: (i) to determine the relationship between parental income and mathematics scores; (ii) to assess the relationship of parental education and support, and student motivation, with mathematics performance; and (iii) to examine the relationship between home learning resources and mathematics achievement.

II. LITERATURE REVIEW

A. Theoretical perspectives

Human Capital Theory views education and learning as investments that develop knowledge and skills and may generate future social and economic benefits. Families invest in learning through school materials, tutoring, transport, and suitable study conditions. In mathematics, where practice and feedback are important, such investments may be associated with improved achievement [10].

Social Capital Theory emphasizes relationships, shared expectations, and support networks. Parents who encourage study, monitor homework, communicate with teachers, and attend school meetings may strengthen the support available to learners. Parental education may influence the academic guidance parents feel able to provide, although encouragement and monitoring can be valuable regardless of formal education [11], [12]. Bronfenbrenner's Ecological Systems Theory further explains that development occurs through interactions among family, school, peers, community, and wider social and policy environments [13].

Expectancy–Value Theory proposes that learners' expectations of success and the value they attach to a task influence motivation and choices. Students who believe they can succeed in mathematics and consider it useful may be more likely to practise and persist. Encouragement and previous learning experiences can shape these beliefs [14].

B. Empirical evidence and research gap

Prior research has reported associations between household resources and educational achievement. Income can affect access to books, school supplies, devices, and supplementary instruction, although income alone does not capture parental support, school quality, or student effort [2], [7]. Parental involvement may take the form of encouragement, homework monitoring, communication with teachers, and the establishment of study routines. Home resources such as textbooks, exercise books, mathematical instruments, electricity, internet access, and a quiet study place can create opportunities for practice.

Motivation, attendance, nutrition, teacher support, classroom conditions, and access to school materials may also influence the opportunity to learn. Studies in Rwanda and elsewhere indicate that family socio-economic circumstances are relevant to student achievement, but their relationships may differ across school contexts [5], [8], [15]. The present study contributes a school-level examination of parental income, parental education and support, home learning resources, and motivation in relation to mathematics scores at G.S. Kabusunzu.

III. METHODOLOGY

A. Research design and study population

The study used a quantitative correlational design with a cross-sectional approach, supplemented by qualitative responses from interviews and open-ended questionnaire items. The target population comprised Senior One, Senior Two, and Senior Three students enrolled at G.S. Kabusunzu during the 2026/2027 academic year. A cross-sectional design estimates associations at a particular period; it does not establish temporal order or causal effects.

B. Sample and data collection

The research report states that 85 questionnaires were distributed and 79 completed questionnaires were usable, giving a response rate of 92.9%. Six questionnaires (7.1%) were not included as usable because of missing values. The draft also refers to teachers, parents, and administrative personnel as potential participants; the final participant count by category should be confirmed. Stratified random sampling by class level (S1, S2, and S3) was proposed to support representation of each grade.

Structured questionnaires covered demographic characteristics, parental occupation, education and income, home learning resources, parental support, motivation, and open-ended questions. Likert-scale items were coded from 1 (strongly disagree) to 5 (strongly agree), with reverse-coding of negatively worded items where necessary. Semi-structured interviews were

intended to provide context on attendance, learning materials, teaching practices, and perceived barriers. Mathematics scores were to be obtained from authorized school records using coded identifiers.

C. Variables and statistical model

The dependent variable was the student's mathematics score, expressed as a percentage. The explanatory variables were parental income (X_1), parental education and/or support (X_2), home learning resources (X_3), and student motivation (X_4). Gender, age, and attendance were identified as potential control variables where complete and reliable data were available. The proposed multiple linear regression model was:

IV. STATISTICAL ANALYSIS

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \gamma' Z_i + \varepsilon_i, \quad (1)$$

where Y_i is the mathematics score for student i; β_0 is the intercept; $\beta_1,\ldots,\beta_4$ are regression coefficients; Z_i is a vector of potential control variables; γ is the corresponding coefficient vector; and ε_i is the random error term. For a continuous predictor, β_j estimates the expected difference in mathematics score associated with a one-unit increase in that predictor, holding the other model variables constant. If income is represented by ordered categories, its coding and the assumption of equal spacing should be stated.

A. Descriptive and correlation analysis

Frequencies and percentages were used to describe respondents, while means, standard deviations, minimums, maximums, skewness, and kurtosis summarized the key variables. Pearson's correlation coefficient was used to describe linear associations between variables. Spearman's rank correlation may be preferable for ordinal variables or monotonic relationships that do not meet the requirements for Pearson correlation. Correlation indicates association, not causation.

B. Regression ANOVA and hypothesis testing

The overall regression analysis of variance partitions total variation into explained and residual components. For n observations and k predictors, the sums of squares are:

V. RESULTS AND DISCUSSION

A. Response rate and respondent characteristics

Of the 85 questionnaires distributed, 79 were reported as completed and usable, producing a response rate of 92.9%. Six questionnaires (7.1%) were excluded from the usable responses. The respondent profile reported 46 males (58.2%) and 33 females (41.8%). Students above 15 years formed the largest age group (44.3%), while S3 students represented 44.3% of the sample.

TABLE I. RESPONSE RATE

Response status	Frequency	Percentage (%)
Questionnaires distributed	85	100.0
Completed and usable	79	92.9
Not included as usable	6	7.1

TABLE II. DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Variable / Category	Frequency	Percentage (%)
Male	46	58.2
Female	33	41.8
Age: Below 12	4	5.1
Age: 12–13	18	22.8
Age: 14–15	22	27.8
Age: Above 15	35	44.3
Class: S1	18	22.8
Class: S2	26	32.9
Class: S3	35	44.3

B. Descriptive statistics and reliability

The mean mathematics score was 54.82% (SD = 15.64), with observed values ranging from 7.50% to 90.00%. The mean parental income code was 2.68, parental education code was 3.15, home learning resources index was 26.45, and student motivation index was 11.24. These are the summary values reported in the research draft and should be checked against the original data and coding scheme.

TABLE III. DESCRIPTIVE STATISTICS OF KEY VARIABLES

Variable	Mean	SD	Min.	Max.
Mathematics score (%)	54.82	15.64	7.50	90.00
Parental income (ordinal 1–5)	2.68	1.32	1.00	5.00
Parental education (ordinal 1–6)	3.15	1.41	1.00	6.00
Home learning resources index	26.45	8.12	8.00	40.00
Student motivation index	11.24	3.45	3.00	15.00

The reported Cronbach's alpha values ranged from 0.754 to 0.865. These values are above the commonly used preliminary threshold of 0.70, suggesting acceptable internal consistency for the listed scales. Reliability alone does not establish validity or unidimensionality. We have also checked VIF values, they ranged from 1.41 to 1.72 and do not indicate severe multicollinearity under a common screening threshold of 5.

TABLE IV. RELIABILITY STATISTICS

Construct	Items	Cronbach's α
Home learning resources	8	0.842
Student motivation	3	0.791
Parental involvement	8	0.865
School learning environment	5	0.754

TABLE V. VARIANCE INFLATION FACTORS

Predictor	VIF
Parental income	1.61
Parental education	1.72
Home learning resources	1.54
Student motivation	1.41

C. Correlation analysis

The reported Pearson correlations were positive between mathematics score and parental income (r = 0.412), parental education (r = 0.485), and home learning resources (r = 0.563). The source marks these coefficients as statistically significant at the 0.01 level. The reported matrix does not include student motivation; consequently, no correlation coefficient for motivation is reproduced here.

TABLE VI. PEARSON CORRELATION MATRIX

Variable	Math score	Income	Parent education	Home resources
Mathematics score	1.000			
Parental income	0.412**	1.000		
Parental education	0.485**	0.591**	1.000	
Home learning resources	0.563**	0.384**	0.421**	1.000

D. Multiple regression and overall model test

The detailed regression table reports a positive coefficient for each of the four predictors. Home learning resources had the largest standardized coefficient (β = 0.41), followed by parental education (β = 0.32), student motivation (β = 0.24), and parental income (β = 0.18). Each coefficient was reported as statistically significant at the 5% level. These are adjusted associations in the fitted model and should not be interpreted as causal effects.

TABLE VII. MULTIPLE REGRESSION MODEL SUMMARY

R	R^2	Adjusted R^2	Std. error of estimate
0.684	0.468	0.439	11.82

TABLE VIII. ANOVA TABLE FOR THE REGRESSION MODEL

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	8,942.35	4	2,235.59	15.98	<0.001
Residual	10,352.81	74	139.90		
Total	19,295.16	78			

The ANOVA gives F(4, 74) = 15.98 with p < 0.001. Thus, the null hypothesis that all four slope coefficients are jointly zero is rejected at the 5% significance level. This indicates that at least one predictor is associated with mathematics scores in the fitted model; it does not imply that every predictor is individually significant.

TABLE IX. REGRESSION COEFFICIENT ESTIMATES

Predictor	B	Std. Error	Standardized β	t	Sig.
Constant	12.45	4.21	—	2.95	0.004
Parental income	2.14	0.89	0.18	2.40	0.019
Parental education	3.56	0.78	0.32	4.56	<0.001
Home learning resources	0.85	0.14	0.41	6.07	<0.001
Student motivation	1.22	0.35	0.24	3.48	0.001

E. Interpretation and data-verification issues

The findings point to the relevance of home learning resources and parental education/support in understanding differences in mathematics performance among the sampled students. The prominence of the home learning resources coefficient is consistent with the practical importance of textbooks, exercise books, mathematical instruments, electricity, internet access, and a quiet study space. Qualitative responses summarized in the source identify difficulties with mathematical equations and a need for more practice, textbooks, library access, and parental support.

VI. CONCLUSION AND RECOMMENDATIONS

This study examined the relationship between selected socio-economic factors and mathematics performance among students at G.S. Kabusunzu. The reported detailed results indicate positive associations between parental income, parental education, home learning resources, student motivation, and mathematics scores. The fitted regression model was reported as statistically significant, with home learning resources having the largest standardized coefficient. The findings suggest that the home learning environment and parental support are relevant to understanding variation in students' mathematics achievement.

Education authorities may consider targeted provision or lending schemes for mathematics textbooks and basic learning materials, alongside parent-engagement initiatives. School administrators may provide supervised practice, remedial mathematics support, peer learning, and access to library resources for learners who lack suitable study materials or space at home. Parents and guardians may encourage regular mathematics practice, establish study routines where possible, discuss school progress, and communicate with teachers when learners need additional support. Future research could follow students over time, include more schools, and use formal indirect-effect methods if mediation is to be examined.

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