

Determinants of Academic Performance Among Undergraduate Students: Evidence from Selected Colleges of West Bengal, India

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Abstract

This study examines the factors influencing academic achievement among undergraduate students. Academic performance is measured using the total percentage of marks obtained in each semester. The analysis is based on primary survey data collected from colleges in West Bengal, India. The study assesses the academic performance among undergraduate students from different socio economic backgrounds using one-way ANOVA technique. Another important objective of the study is to evaluate the association between the academic performance and its determinants using logistic regression. Academic performance is considered as dichotomous variable in this study. The findings suggest that the likelihood of attaining strong academic outcomes increases for students who work hard, utilize their study time efficiently, own personal digital devices, attend classes regularly, and have mothers with at least a secondary level of education. Moreover, the findings highlight the importance of access to learning resources, parental education, and effective study behaviours in shaping student achievement. The results provide useful insights for policymakers and educational institutions seeking to enhance student success to ensure inclusive and equitable quality education for all.

Keywords: higher education, academic performance, undergraduate, primary survey, logistic regression

JEL Classifications: I23, I21, A22, C83, C25

1. Introduction

Higher education plays a crucial role in developing competent, intellectual, and productive human capital. It provides individuals with access to new social and economic opportunities, thereby enabling them to attain a better standard of living (Rai & Kaur, 2018). Through the collective application of knowledge, skills, and values, societies benefit from broader social,

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economic, cultural, and political progress. Recognizing this importance, enrolment in higher education has been steadily increasing worldwide. Students entering higher education bring with them diverse backgrounds, characteristics, and abilities, resulting in substantial heterogeneity within the student population (Simpson, 2006; Danilowicz-Gosele et al., 2014). Furthermore, the shift from the structured and guided environment of high school to the more autonomous learning context of higher education exposes students to heightened academic pressure, new socio-economic challenges, and increased personal responsibilities (Briggs et al., 2012; Munir et al., 2023). In this evolving educational landscape, intelligence alone is no longer seen as the sole predictor of academic success; a broader set of cognitive, emotional, and contextual factors now plays a significant role.

Academic performance refers to the systematic assessment and evaluation of a learner's progress in acquiring knowledge and achieving curriculum-based learning outcomes within a specified period (Yoghoobi et al., 2024). Multiple indicators are commonly used to measure academic achievement, including cumulative grade point average (CGPA), grade point average (GPA) (Tadese et al., 2022), standardized test scores, and prior academic records (Talib, 2012; Aramburo et al., 2017). In addition to these traditional measures, validated psychometric instruments such as the Academic Achievement Questionnaire (AAQ) (Bennett et al., 2009) and the Academic Task Performance Scale (Kiuru et al., 2014) are employed to capture behavioural and cognitive dimensions of students' academic functioning.

2. Literature Review

Academic performance reflects student learning outcomes and provides critical feedback for institutions. Existing literature identifies a range of determinants, from socio-economic conditions to institutional factors, that shape students' academic achievements.

2.1 Pedagogical, Motivational, and Personal Factors

Existing literature identifies several categorical determinants of academic performance, including pedagogical, psychological, and individual attributes. Quality teaching and effective pedagogical methods play a significant role in shaping students' academic outcomes, influenced by teachers' communication skills, relationships with students, attitudes, course preparation, and supervision (Trigwell et al., 1999; Kyriakides et al., 2009). Motivation has also been recognised as a critical predictor of academic success (Almalki, 2019). Personality traits have similarly been found to influence performance: Grehan et al. (2011) reported that personality traits and Emotional Intelligence (EI) are crucial for graduate students' academic and field performance, while Hakimi et al. (2011) observed that conscientiousness, agreeableness, and openness were particularly influential. Furthermore, Nonis and Hudson (2010) and Indreica et al. (2011) highlighted that study habits and effective time management substantially enhance academic achievement. Good study habits help students make optimal use of learning opportunities, reduce stress, prepare efficiently for assessments, and build transferable skills (Rabia et al., 2017). Attendance has also been consistently linked to performance, with regular participation in lectures and tutorials associated with higher academic grades (Lukkarinen et al., 2016; Matsoso & Iwu, 2017).

2.2 Lifestyle, Demographics, and Socio-Economic Status

For students in medical and health sciences, academic performance has been linked to lifestyle-related factors such as place of residence, breakfast habits, night study, and career choice autonomy (Stroebele et al., 2013; Reddy et al., 2017; Khan et al., 2020). Socio-economic status (SES), measured through parental education, occupation, income, and parenting style, has been widely recognized as a strong determinant of academic success (Graetz, 1995; Considine et al., 2002). Parents with higher educational attainment are better positioned to guide their children academically (Azhar et al., 2014; Tamayo et al., 2022). Conversely, financial constraints may force parents to prioritize basic needs over educational support, reducing encouragement for students (Azhar et al., 2014; Moore, et al., 2021). However, income is not always decisive: disadvantaged students may sometimes outperform their wealthier peers, a phenomenon termed *educational elasticity* (Ali et al., 2013; Danilowicz-Gosele, 2014).

2.3 Social Networks, Peer Influence, and Family Involvement

The role of social networks, peer support, and family involvement has also been widely examined. Studies reveal that social networking, family encouragement, and peer cooperation strongly shape students' academic outcomes (Fujiyama, et al., 2021; Zhao & Zhao, 2022). Excessive internet and social media use for non-academic purposes can hinder learning goals (Kubey et al., 2001; Upadhayay & Guragain, 2017), though judicious use has been shown to enhance learning outcomes (Basumatary & Kumar, 2020; Tafesse, 2022.). Cooperative peer support, including emotional assistance, knowledge sharing, and experience exchange, has further been linked with improved academic achievement (Chen et al., 2023). Similarly, positive parental involvement enhances self-esteem, academic self-efficacy, and reduces emotional distress, thereby contributing to stronger academic outcome (Wang & Sheikh-Khalil, 2014; Kim & Kim, 2021).

3. Research Gaps and Research Objectives

Although academic performance has been extensively researched, most studies have focused on professional programs such as management, business, medicine, and health sciences. In contrast, limited attention has been given to the factors shaping academic performance among undergraduate students in humanities, commerce, and science. To address this gap, the present study aims to identify the key determinants of academic performance among undergraduate college students of West Bengal. The research objectives include:

- a) To compare and evaluate the differences in mean academic scores (in percentage) across categories based on socio-demographic, student-related, teacher-related, institutional, and home-related factors.
- b) To explore and evaluate the determinants that significantly influence the academic performance of undergraduate students.

4. Methodological details

4.1 Data

4.1.1 Sample survey design and field investigation

The study is based on primary survey data collected from undergraduate colleges in West Bengal. Students from Humanities, Commerce, and Science in the 2nd and 4th semesters (CCF system) and the 6th semester (CBCS system) were randomly chosen. A total of 282 students responded through a Google Form survey, and after data cleaning, the final sample consisted of 266 students. The study gathered data on socio-demographic, student-related, institution-related, teacher-related, and home-related variables as independent factors. Data were collected between April and May 2025, which also serves as the reference period, as responses reflect students' current academic outcomes and associated factors. Table 1 summarizes all variables, including their abbreviations and coding schemes.

Table 1: Variables, Abbreviations, Coding, and Descriptions

Variable	Abbreviation	Coding
Total marks obtained in the semester examination (in %)	Y	1 = $\geq 65\%$ (equal or above average) 0 = $< 65\%$ (below average)
Gender	Gender	1 = Female 2 = Male
Caste	Caste	1 = ST; 2 = SC; 3 = OBC; 4 = General
Monthly Family Income (MFI)	Low_Inc/ Middle/ Upper_Middle/ High	1 = ₹0–20,000 (Low income) 2 = ₹20,001–50,000 (Middle income) 3 = ₹50,001–99,000 (Upper middle income) 4 = $\geq ₹99,001$ (High income)
Students' effort level	Hard_Work	1 = Never; 2 = Sometimes 3 = Always
Self-study hours per day	Study_Hr	Continuous variable
Computer/Tablet/Laptop ownership	Own_Device	1 = No (not ownership) 2 = Yes (ownership)
Use of institutional learning facilities	Ins_Learn_Faci	1 = Never uses; 2 = Sometimes 3 = Always

Internet accessibility in library	Internet_Lib	1 = Never uses; 2 = Sometimes 3 = Always
Teaching aids (such as charts, models, and projectors) used by teachers	Teach_Aid	1 = Never use; 2 = Sometimes 3 = Always
Distraction due to mobile/TV/social media	Distract	1 = No (Not distracted) 2 = Yes (Distracted)
Tutorial sessions beyond regular classes	Tutorial	1 = No (does not attend) 2 = Yes (attends)
Motivation for higher education from parents / teachers	Motivation	1 = No (not encouraged) 2 = Yes (encouraged)
Attendance	Attendance	1 = Never attends 2 = Sometimes attends 3 = Always attends
Language barrier in classroom	Lang_Barrier	1 = Yes (faces language barrier) 2 = No (no language barrier)
Father's education	Father_Edu	1 = Up to Class VIII 2 = Secondary; 3 = Higher Secondary; 4 = Graduate 5 = Above Graduate
Mother's education	Mother_Edu	1 = Up to Class VIII 2 = Secondary 3 = Higher Secondary 4 = Graduate 5 = Above Graduate

Source: Authors' compilation from primary survey data.

5. Results and Discussion

In the Exploratory Data Analysis (EDA) section, the dataset is analyzed using descriptive statistics, visualizations, and box plots to understand the distribution of variables, identify patterns, and detect potential outliers.

5.1 Data visualization

Following the descriptive statistics, interactive charts and filtering tools are used to further explore underlying patterns and insights in the data.

Figure 1: Visualization of Students' Data through an Interactive Dashboard

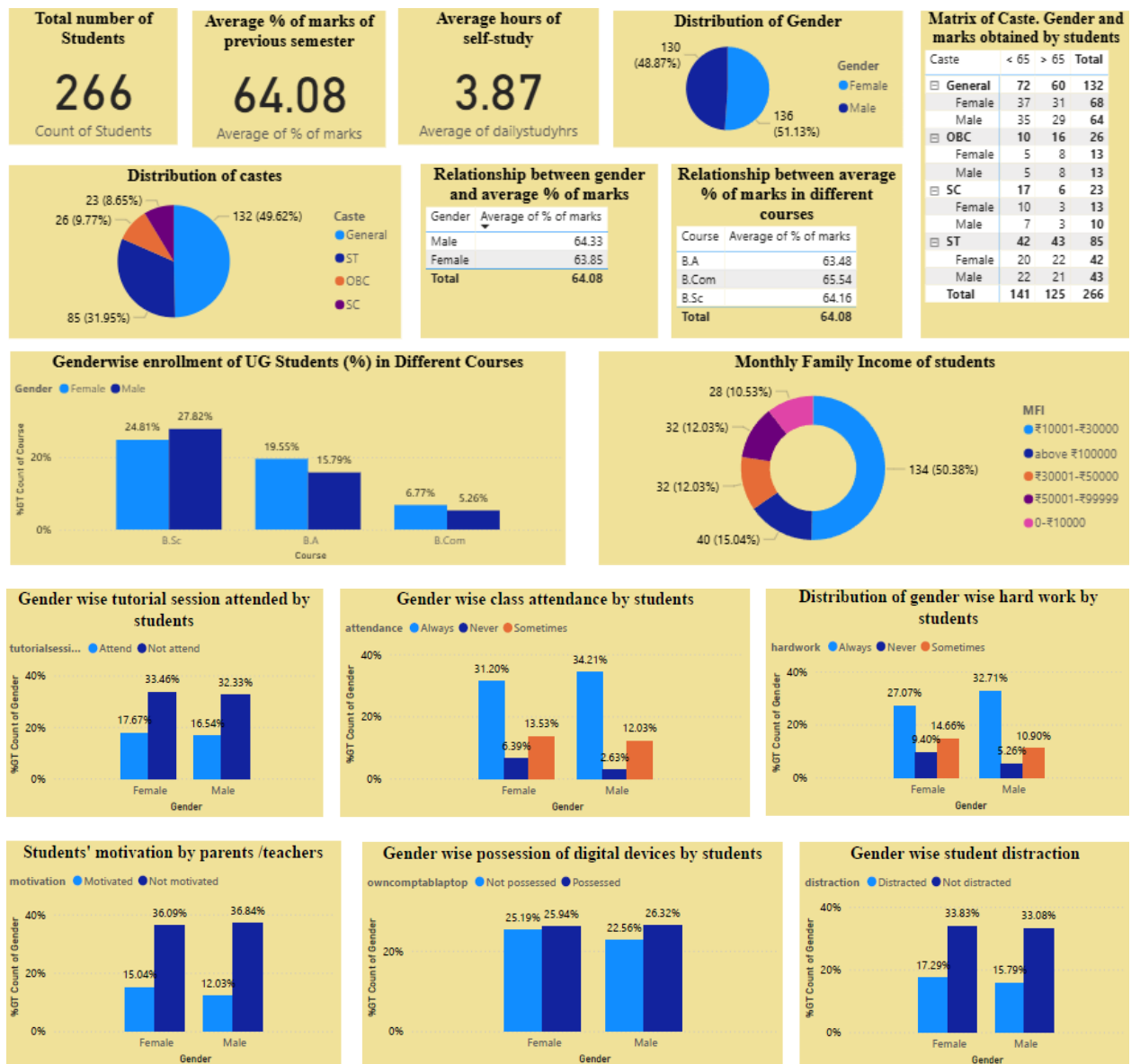


Figure 1 presents the analysis of the 266 students considered in the study, comprising 51 percent females and 49 percent males from semesters 2, 4, and 6. Among them, 49.62 percent belong to the General category, 31.95 percent to ST, 9.77 percent to OBC, and 8.65 percent to SC. On average, students spend about four hours daily on self-study in addition to classroom learning and achieve a mean score of 64.08 percent in the previous semester. Male students averaged 64.33 percent, while female students averaged 63.85 percent. Across courses, average marks were 63.48 percent for B.A., 65.54 percent for B. Com, and 64.16 percent for B.Sc.

A higher proportion of female students in the General category (nearly 12 percent) obtained above 65 percent marks. Over 50 percent of students come from families with a monthly income between ₹10,001 and ₹30,000. Most students attend classes regularly, work diligently, and remain self-motivated. Regarding digital access, 25.94 percent of females and 26.32 percent of males possess personal digital devices.

5.2 Inferential statistical test: Analysis of Variance (ANOVA)

To assess and compare variations in the mean academic scores (in percentage) across different categorical variables such as caste, parental education, attendance, attention during class, hard work, digital devices ownership, language barriers, institutional learning facilities, internet availability in the college library, use of teaching aids, participation in tutorial sessions, and distractions from mobile phones, a one-way Analysis of Variance (ANOVA) is employed.

The hypotheses tested were as follows:

- **Null Hypothesis (H_0):** There is no statistically significant difference in the mean academic scores among the groups being compared.
- **Alternative Hypothesis (H_1):** At least one pair of group means differs significantly.

The ANOVA test determines whether significant differences exist among the groups. However, it does not identify which specific group means are significantly different from others. To determine the exact pair(s) of groups exhibiting significant mean differences, the *Bonferroni Correction test* is applied. The results presented below include only those factors that were found to be statistically significant in the ANOVA analysis.

5.2.1 Comparison of Mean Academic Scores across Castes

For the categorical variable caste, students were classified into four groups: (i) General, (ii) OBC, (iii) SC, and (iv) ST. Table 2 presents the results of the one-way ANOVA for caste.

Table 2: Analysis of Variance - Caste

Source	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-Statistic	p-value (Prob > F)
Between groups	1.696	3	0.5654	2.29	0.0783
Within groups	64.56	262	0.2464		
Total	66.25	265	0.25003		
Bartlett's test for equal variances: $\chi^2(3) = 0.4517$, Prob> $\chi^2 = 0.929$					

Source: Authors' calculation

The ANOVA test result ($F = 2.29$, $p = 0.0783$) suggests that the null hypothesis can be rejected at the 10% level of significance, implying a marginally significant difference in mean academic performance among caste groups.

To identify the specific group pairs that differed significantly, a Bonferroni test was conducted. The test results reveal that the mean academic scores of the SC and OBC groups differ significantly at the 10% level of significance ($p = 0.079$), while no significant differences are observed among other caste group pairs.

5.2.2 Comparison of Mean Academic Scores of students who possess and not to possess own digital device(s)

For the categorical variable ownership of a computer/laptop/tablet, the respondents were divided into two groups: (i) those who do not own such a device, and (ii) those who do. Table 3 presents the results of the one-way ANOVA conducted for this variable.

Table 3: Analysis of Variance -Ownership of Computer/Laptop/Tablet (No = 1, Yes = 2)

Source	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-Statistic	p-value (Prob > F)
Between groups	1.412064	1	1.412064	5.75	0.0172
Within groups	64.84733	264	0.245634		
Total	66.2594	265	0.250035		
Bartlett's test for equal variances: $\chi^2(1) = 0.0506$; Prob> $\chi^2 = 0.822$					

Source: Authors' calculation

The ANOVA results (Table 3) show that the p-value (0.0172) is less than 0.05, leading to the rejection of the null hypothesis. This indicates a statistically significant difference in mean academic scores between students who possess a personal computer/laptop/tablet and those who do not.

The finding suggests that ownership of such digital devices positively influences academic performance. A personal computer or laptop or tablet enables students to store a large volume of learning materials in electronic formats, eliminating the need for physical storage. Moreover, access to diverse online resources, digital textbooks, and academic software enhances students' learning efficiency and engagement. In the context of modern higher education, personal digital devices such as computers, laptops, or tablets play a pivotal role in supporting and improving students' academic outcomes.

5.2.3 Comparison of Mean Academic Scores of Students Based on Hard Work

For the categorical variable hard work, respondents were classified into three groups based on their self-reported effort levels: (i) never, (ii) sometimes, and (iii) always. Table 4 presents the results of the one-way ANOVA conducted for the variable hard work.

Table 4: Analysis of Variance-Hard Work

Source	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-Statistic	p-value (Prob > F)
Between groups	3.5485	2	1.77425	7.44	0.0007

Within groups	62.7109	263	0.238444		
Total	66.2594	265	0.250035		
Bartlett's test for equal variances: $\chi^2(2) = 2.3844$, Prob> $\chi^2 = 0.304$					

Source: Authors' calculation

The results of the one-way ANOVA presented in Table 4 show that the p-value (0.0007) is less than 0.01, leading to the rejection of the null hypothesis of equal mean academic scores across groups. This indicates a statistically significant difference in mean academic performance among students categorized by their level of hard work. Now, to determine which specific group means differ significantly, a Bonferroni correction test was performed. P-value of the coefficients are written in parenthesis.

The Bonferroni test results reveal that the mean academic scores differ significantly between the 'sometimes' and 'never' groups at the 5% level of significance ($p = 0.033$), and between the 'always' and 'never' groups at the 1% level of significance ($p = 0.000$). These findings indicate that students who consistently engage in hard work tend to achieve significantly higher academic scores compared to those who put less effort. This highlights the strong positive association between diligence and academic performance.

5.3. To explore and evaluate the determinants influencing the academic performance of undergraduate students.

This study empirically investigates the factors influencing college students' academic achievement across four broad dimensions: (i) **socio-economic and demographic characteristics** (gender, caste, monthly family income, mother's education, and father's education); (ii) **home-related support** (ownership of a computer, laptop, or tablet); (iii) **institutional and learning environment** (internet library, institutional learning facilities, teaching aids and language barrier in the classroom); and (iv) **personal effort and behaviour** (daily study hours, distraction, motivation, hard work, and attendance). A detailed description of all the variables under these dimensions is provided below.

- a. Gender of the student (Gender_i): In many parts of society, parents still prioritize sons' higher education (Cochran-Jackson, 2022), viewing investment in daughters as less beneficial since they typically marry into another family. Besides, Human capital theory (Becker, 1964) suggests that returns from women's education depend on their ability to convert learning into income and social status. Consequently, women's lower educational participation is often linked to greater household responsibilities and limited labour market opportunities (Hadjar et al., 2014). Thus, gender continues to be an important factor influencing access to higher education and academic performance.
- b. Caste of the student (Caste_i): In India, students from Scheduled Castes (SC), Scheduled Tribes (ST), and Other Backward Classes (OBC) are often socially and economically disadvantaged. Although various scholarships exist to support these groups, many still face barriers to human capital development due to limited awareness of educational and

employment opportunities (Bagde et al., 2016). Thus, caste may be a significant determinant of students' likelihood of continuing and succeeding in higher education.

- c. Monthly family income (MFI_i): Family income is a key determinant of educational quality (Kinsler & Pavan, 2011). Higher monthly income allows parents to provide the necessary resources, learning materials, and a supportive environment that motivates children to complete their college education and achieve better academic outcomes.
- d. Hard work ($Hard_Work_i$): Consistent effort and perseverance are vital predictors of academic excellence. Students who exhibit greater diligence and dedication are more likely to attain superior academic results (Rau & Durand, 2000).
- e. Daily Study Hours ($Study_Hr_i$): Students who devote a few hours daily to studying beyond classroom sessions tend to reinforce their understanding of course materials and complete assignments efficiently, which positively influences their academic achievement (Torenbeek, et al., 2013).
- f. Own computer / tablet / laptop (Own_Device_i): Possession of personal digital devices such as computers, tablets, or laptops enhances students' ability to complete assignments, access online resources, and participate in digital learning activities, thereby improving their academic performance (Valdivia-Yábar & López, 2022).
- g. Institutional learning facility ($Ins_Learn_Fac_i$): Institutional support in the form of smart classrooms, scholarships, academic clubs, debates, and extracurricular activities promotes awareness, engagement, and academic sincerity among students, which can significantly improve their learning outcomes (Rugutt & Chemosit, 2005).
- h. Internet in library ($Internet_Lib_i$): Access to internet-enabled library facilities enables students to explore online study materials and academic databases alongside traditional hardcopy resources, enriching their learning experience (Torres-Díaz et al., 2016; Soria, et al., 2014).
- i. Teaching aids ($Teaching_Aids_i$): The use of audiovisual tools, maps, projectors, laboratory facilities, and other modern teaching aids makes learning more interactive, engaging, and effective (Manthra Prathoshni, et al., 2018).
- j. Distraction ($Distract_i$): Higher levels of distraction mainly digital devices and social network platforms reduce concentration and hinder comprehension (Feng et al., 2019; Dietz & Henrich, 2014)., thereby adversely affecting students' academic achievement.
- k. Tutorial session ($Tutorial_i$): Tutorial sessions conducted after regular classes provide personalized guidance, help clear doubts, and enhance conceptual understanding, which in turn strengthens academic performance (Clarke & Lane, 2005).
- l. Motivation ($Motivation_i$): Both self-motivation and encouragement from parents or teachers play a crucial role in guiding students toward consistent academic effort and success (Wu, 2019; Trevino & DeFreitas, 2014).

- m. Attendance (Attendance_i): Higher attendance rates ensure greater exposure to lectures, discussions, and academic activities, which directly contribute to improved academic achievement (Credé et al., 2010).
- n. Language barrier in the classroom (Lang_Barrier_i): Many students experience communication gaps with teachers due to language barriers during classroom interactions. Hence, it is essential to examine whether such language barriers significantly influence students' academic achievement at the college level (Berman & Cheng, 2001).
- o. Mother's education (Mother_Edu_i): Mother's education is strongly associated with children's learning outcomes, as educated mothers tend to provide academic support, motivation, and guidance (Banerji et al., 2013; Monaghan, 2017).
- p. Father's education (Father_Edu_i): Father's education plays a crucial role in shaping the family's educational aspirations, determining access to academic resources, and providing academic guidance to children, all of which significantly influence their overall academic performance (Baoyan & Minggang, 2015; Yang, 2025).

5.3.1 Logistics Regression Analysis

To identify which predictors are most likely to influence academic performance in higher education, we employed a logistic regression model. The general form of the logistic regression equation in log-odds form is expressed as:

$$\log \frac{P(Y=1)}{1-P(Y=1)} = \beta_0 + \sum_{i=1}^n \beta_i X_i \quad \dots\dots\dots (1)$$

Where, $P(Y = 1)$ is the probability that the dependent variable Y equals 1.

$\frac{P(Y=1)}{1-P(Y=1)}$ represents the odds¹ of the event occurring.

β_0 is the intercept.

β_i are the coefficients corresponding to the predictor variables X_i

Thus, the odds of the event can be written as:

$$\frac{P(Y=1)}{1-P(Y=1)} = e^{\beta_0 + \sum_{i=1}^n \beta_i X_i} \quad \dots\dots\dots (2)$$

Each coefficient β_i represents the odds ratio² (OR) associated with a one-unit increase in X_i . The odds ratio is calculated as:

$$\text{Odd Ratio (OR) for } X_i = e^{\beta_i} \quad \dots\dots\dots (3)$$

The marginal effect of a categorical variable measures the change in predicted probability of the outcome variable when the categorical variable changes from reference group (0) to

¹ chance of event happening / chance of not happening

² Ratio of two odds (odds when X=1 divided by odds when X=0).

treatment group (1) assuming other variables at their mean. It is computed as:

$$ME \text{ of } X_k = \Pr(Y = 1|X, X_k = 1) - \Pr(Y = 1|X, X_k = 0) \dots \dots \dots (4)$$

Where, ME is the marginal effect of the categorical variable X_k .

In our study the model with predictors is expressed as-

$$\log \frac{P(Y=1)}{1-P(Y=1)} = \beta_0 + \beta_1 \text{Gender}_i + \beta_2 \text{Caste}_i + \beta_3 \text{Low_Inc}_i + \beta_4 \text{Middle_Inc}_i + \beta_5 \text{Upper_Middle_Inc}_i + \beta_6 \text{Hard_Work}_i + \beta_7 \text{Study_Hr}_i + \beta_8 \text{Own_Device}_i + \beta_9 \text{Ins_Learn_Faci}_i + \beta_{10} \text{Internet_Lib}_i + \beta_{11} \text{Teach_Aid}_i + \beta_{12} \text{Distract}_i + \beta_{13} \text{Tutorial}_i + \beta_{14} \text{Motivation}_i + \beta_{15} \text{Attendance}_i + \beta_{16} \text{Mother_Edu}_i + \beta_{17} \text{Father_Edu}_i + \beta_{18} (\text{Inc} * \text{Mother_Edu})_i + \beta_{19} (\text{Inc} * \text{Father_Edu})_i + \beta_{20} (\text{Teach_Aid} * \text{Lang_Barrier})_i \dots \dots \dots (5)$$

In this study, academic performance (Y) represents the total marks obtained in the semester examination (in percentage) and has been converted into a binary variable, where $Y = 1$ denotes an above-average score ($\geq 65\%$) and $Y = 0$ indicates a below-average score ($< 65\%$). Variables are used in equation (2) are already explained in the Table 1.

Table 5: Result of Logistic regression; Regressor (Y): Students' Academic Performance

Predictors ³	Odd Ratio (e^{β_i})	Std. Err	z	P>z	95% Confidence Interval		ME of X_k
Gender (Male)	1.327	0.367	1.02	0.307	0.771	2.283	0.059
Caste (SC)	0.365	0.198	-1.85	0.064	0.125	1.059	-0.212
Low_Inc	2.078	0.821	1.85	0.064	0.958	4.509	0.154
Middle_Inc	1.812	0.847	1.27	0.203	0.725	4.528	0.125
Upper_Middle	1.897	0.834	1.46	0.145	0.801	4.492	0.135
Hard_Work (Always)	2.521	0.750	3.11	0.002	1.407	4.517	0.194
Study_Hr	1.220	0.089	2.73	0.006	1.058	1.408	0.042
Own_Device (Yes)	1.899	0.551	2.21	0.027	1.076	3.352	0.135
Ins_Learn_Faci (Yes)	0.927	0.384	-0.18	0.855	0.412	2.087	-0.016
Internet_Lib (always)	0.778	0.313	-0.62	0.534	0.354	1.714	-0.053

³ Parentheses of the variables indicate the treatment category coded as 1 in the model; the reference category is coded as 0.

Teach_Aid (always)	0.937	0.346	-0.18	0.86	0.454	1.933	-0.014
Distract (Yes)	0.977	0.290	-0.08	0.936	0.546	1.747	-0.005
Tutorial (Yes)	0.556	0.167	-1.96	0.05	0.309	1.001	-0.123
Motivation (Yes)	0.614	0.219	-1.36	0.173	0.305	1.237	-0.102
Attendance (Always)	1.666	0.490	1.74	0.083	0.936	2.966	0.107
Mother_Edu (Secondary)	2.162	0.824	2.02	0.043	1.024	4.563	0.162
Father_Edu (Graduate)	0.991	0.352	-0.02	0.981	0.495	1.987	-0.002
Low_Inc * Mother_Edu	0.237	0.152	-2.24	0.025	0.067	0.834	-0.303
Low_Income * Father_Edu	1.215	0.511	0.46	0.644	0.533	2.770	0.041
Teach_Aid * Lang_Barrier	1.377	0.574	0.77	0.444	0.608	3.118	0.067
Constant	0.113	0.070	-3.54	0.000	0.034	0.378	
No. of observations = 266	LR chi²(20) = 44.61		Pseudo R² =0.121		Prob > chi² = 0.0012		
Hosmer Lemeshow chi² (8) = 6.18; Prob > chi² = 0.6271							

Source: Source: Authors' calculation

5.3.2 Discussion

In Table 5, the goodness of fit of the model was assessed using the Hosmer–Lemeshow test. A p-value (0.63) greater than 0.05 indicated that the model adequately fits the data. The analysis reveals that SC students were significantly less likely to achieve good academic performance compared to other social groups ($OR = 0.365 < 1$). This suggests a substantially lower likelihood of securing good grades for SC students. The marginal effect indicates that their predicted probability of academic improvement is reduced by 21 percentage points relative to other groups, holding all other variables constant. These results reflect the persistent structural disadvantages faced by SC students including poorer early schooling, limited financial resources for educational materials and private tutoring, and experiences of caste-based discrimination which continue to hinder their academic progress.

Students from low-income households have significantly higher odds of achieving good academic outcomes ($OR = 2.08 > 1$). Their predicted probability of academic improvement is 15.4 percentage points higher than students from other income groups. Despite socioeconomic constraints, strong intrinsic motivation, parental expectations, perseverance, and positive support from teachers, peers, and relatives may help the students overcome challenges and perform well academically.

Hard-working students were more than twice as likely to achieve good academic performance ($OR = 2.23 > 1$). Their probability of achieving better academic outcomes increases by 19.43% compared to others. Daily study hours also showed a positive influence ($OR = 1.22 > 1$). As a continuous variable, it suggests that each additional hour of study increases the likelihood of good academic performance by 4.2%. Consistent effort, disciplined study routines, and strategic learning approaches likely support deeper understanding, higher retention, and improved confidence, contributing to better academic results.

Students with their own digital devices (computer, laptop, or tablet) are almost twice as likely to achieve good academic performance ($OR = 1.9 > 1$) than their counterparts. Access to e-books, online classes, virtual labs, and digital learning materials may enhance study efficiency. The model shows a 13.5% higher probability of performance improvement for these students compared to those without such devices.

Impact of Tutorial Sessions: Students who attended tutorial sessions are less likely to achieve good academic grades ($OR = 0.56 < 1$). Marginal effect analysis indicates a 12.3% lower probability of academic improvement for students who take tutorials compared to self-tutored students. Poorly designed tutorials may limit students' self-study time, reduce rest, or provide repetitive content, leading to diminishing returns and lower academic performance.

Regular attendance significantly increases the odds of achieving good academic scores ($OR = 1.67 > 1$). It enhances academic performance by nearly 11% compared to irregular attendees. Attending classes regularly helps students follow lessons sequentially, improves understanding, promotes punctuality and discipline, and supports active classroom engagement, all of which contribute to stronger academic outcomes.

Students whose mothers completed secondary education are more than twice as likely to perform well academically ($OR = 2.16 > 1$) compared to other reference groups. The marginal effect shows a 16% higher likelihood of good performance. Educated mothers may provide greater academic support, better learning environments, and positive educational expectations.

Among low-income families, students with educated mothers are less likely to achieve good academic results ($OR = 0.24 < 1$). Their probability of academic success is 30 percentage points lower than the counterparts. Despite maternal education, financial hardship can restrict access to essential learning resources, create stressful home environments, and reduce opportunities for cognitive stimulation. Educated mothers in low-income households may also be burdened with heavy work responsibilities, limiting the time available for academic guidance.

In the study, variables such as family income, availability of teaching aids, and fathers' higher education are not significantly associated with academic performance. These relationships may become significant in larger or more diverse samples, with additional predictors, or when alternative analytical methods are applied.

6. Conclusion and policy implications

This study has tried to shed light on the relative influences of some key factors and their impact on students' academic performance. The ANOVA results indicate that the mean marks of OBC and SC students, students owning digital devices, and those who reported working hard differed

significantly from their respective counterparts. Furthermore, the findings from the binary logistic regression analysis reveals that students who worked hard, used their daily study hours effectively, owned personal digital devices, attended classes regularly, and have mothers with at least secondary-level education have significantly higher odds of achieving good academic performance compared to their counterparts.

In terms of policy implications, our findings indicate that institutions should implement remedial classes and organize awareness programmes and workshops for faculty, staff, and students to address caste discrimination and social exclusion. Such initiatives would help identify and eliminate barriers that impede the academic progress of underserved students. Moreover, tutorial sessions should include well-structured lesson plans, problem-solving activities, and constructive feedback to monitor students' progress and identify areas needing further support. Given that access to a computer, laptop, or tablet significantly enhances the academic performance of undergraduate students, institutions may consider providing financial assistance, offering subsidized devices, or establishing borrowing facilities to ensure students can access digital tools during their studies. Institutions should also encourage and recognize hard-working students by introducing reward systems and integrating effective learning strategies such as mind mapping for visual organization of information and structured note-taking focused on key concepts, thereby fostering students' intrinsic motivation. Teachers and parents should guide students in making their study hours more effective and inclusive. This includes care for the mental health of students by encouraging regular short breaks to prevent fatigue and maintain concentration, and helping students create realistic study schedules that balance multiple subjects efficiently.

7. Future study

Future research should incorporate a broader range of factors beyond the variables already examined in the study. These may include the application of technology in the learning environment, the impact of artificial intelligence on learning outcomes, access to academic and digital resources, students' mental health and classroom attention, parental employment status, religion, and students' overall level of conceptual understanding. Furthermore, the use of longitudinal data to track student performance over time would allow for a deeper assessment of academic progression.

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