

CLASSIFICATION AND MODELLING OF FACTORS WHICH INFLUENCE
STUDENTS ACADEMIC PERFORMANCE IN PUBLIC SECTOR DEGREE
COLLEGES OF SINDH PROVINCE

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Abstract

This study aimed to identify the factors influencing the academic performance of students enrolled in public sector science degree colleges of Sindh. Data were collected from 2,000 students selected from 38 colleges through a structured questionnaire using simple random sampling with good reliability (Cronbach's alpha = 0.8), and data were analyzed using SPSS (Version 27) and Excel (2016). Descriptive statistics summarized demographic characteristics, while binary logistic regression identified significant predictors of academic performance. Additionally, ROC analysis was also applied for data analysis. The findings reveal that demographic variables are significantly associated with academic performance. The logistic regression model was statistically significant ($\chi^2 = 982.071$, $p < 0.001$) and demonstrated good predictive accuracy with an overall classification rate of 81.6%. ROC analysis indicated that timely completion of syllabus (AUC = 0.710), and student satisfaction (AUC = 0.731), showed acceptable discriminatory power in predicting academic performance. The logistic regression results further revealed that all key predictors positively influenced academic performance. The odds of higher academic performance increased with assignment practices (OR = 2.074), timely completion of syllabus (OR = 2.321), teachers' dedication (OR = 3.084), and student satisfaction (OR = 9.888). This indicates that most institutional and instructional factors significantly enhance the likelihood of better academic outcomes, with student satisfaction showing the strongest effect among the predictors. This study concludes that academic performance in science degree colleges of Sindh is strongly influenced by instructional quality, classroom management, and institutional support. Strengthening teaching effectiveness, ensuring regular academic activities, and improving student engagement are essential for enhancing educational outcomes.

INTRODUCTION

Academic performance shows how well students achieve their educational goals. It reflects their learning outcomes, knowledge, and skills gained through education. In higher education, it is

usually measured by examination scores, percentage marks, or grade point averages. Education is important not only for personal growth but also for the development of society, as it helps improve skills, reduce poverty, promote

better health, and maintain social stability. However, public sector institutions in Pakistan face several problems such as limited resources, poor infrastructure, and lack of proper teacher training, which can negatively affect students' performance. Students' academic performance depends on many factors, including personal characteristics, socio-economic background, parental support, peer influence, mental health, and institutional environment. Although many studies have been conducted worldwide, there is still limited research focusing on students in public sector colleges of Sindh province. This study uses a binary logistic regression model to analyze the factors affecting academic performance. The results of this study will help policymakers and educators develop better strategies to improve students' academic outcomes in public sector higher education.

LITERATURE REVIEW

Pakistan is one of the lowest in terms of Education Development Index (EDI) and the same is given to Bangladesh and still lags behind many countries like Sri Lanka. The index is used in assessing the efficiency of nations in the provision of accessibility and quality of education. There has been serious concern hence among the policymakers and researchers in order to improve the academic performance of the students. Several researches have tried to define the factors behind academic performance and how the education opportunities can be extended in third world economies (UNESCO, 2022). Some studies have been conducted to determine the situation of education and influence on students' attendance in Pakistan.

According to Arslan & Zaman even with the efforts of the government of Pakistan and the government of Sindh to enhance the rate of enrollment and retention, the enrollment level is comparably low. The study found out that the enrolment rate stood at about 58 percent with 45 percent female participation and 69 percent male participation with Pakistan being ranked among the poorest countries in the world in terms of enrolment (Arslan & Zaman, 2014). In the same

vein, Habib et al. opined that the fact that certain areas have low enrollment is partly as a result of the perception of parents that schooling may not bring any immediate economic rewards. Consequently, there are families where the parents will rather have their children help with household chores or even in money-making ventures other than go to school (Habibullah & Ashraf, 2013).

The socio-economic status and family history are commonly known to be key factors of academic success. Shaikh et al. was able to determine that family income, social standing, parental counseling, peer associations, and the environment have a significant impact on the participation of students in education and their achievements in school (Shaikh et al., 2016). Similarly, Hijazi and Jabber et al. indicated that the behavior of students, the home environment, parental income, and family situations are very important in determining academic performance (Hijazi & Naqvi, 2006) (Jabbar et al., 2011).

Moreover, Danyial et al. stated that the level of education among parents and the involvement of students in extracurricular also might determine academic success in college level (M. Danyial, T. Nawaz, M. Aleem, 2011). The quality of the teachers and how they teach are also key determinants of academic performance of students. Metzler and Woessmann investigated the connection between student achievement and teacher performance and established that effective pedagogical practices and proficient teacher performance are strongly related with better performance (Metzler & Woessmann, 2012). On the same note, NajeebUllah et al. also highlighted that instructors have a crucial role in supporting students to learn by implementing the relevant instructional methods and aiding the acquisition of the essential academic skills (Ullah & Almani, 2022). Taal also pointed out the significance of professional competence to the teacher in providing quality education and enhancing the knowledge of the students concerning academic content (Taal, 1996).

Academic achievement of the students is also enhanced by institutional and educational

backgrounds. According to Kimmani, Kara, and Njagi education is instrumental in bringing about the social development and in lowering inequalities and in the instance of schools; they were regarded successful when they could help students to realize good results in their studies (Kimani et al., 2013). Nonetheless, the issues that might interfere with the processes of effective teaching and learning include institutional difficulties like the lack of resources, poor infrastructure, and the inability of effective management practices to be achieved.

Academic performance is also largely influenced by the personal behaviors and practices of students in studying. According to Griffiths time management was a crucial skill that allows the student to plan his or her academic life and to face the difficulties he or she meets in the course of his or her studies successfully (Griffiths, 2003). On the same note, Beare, Caldwell, and Millikan stressed that proper planning and allocation of tasks will enable the students to manage their time more effectively and enhance their productivity (Beare, H., Caldwell, B. J., & Millikan, 2018). The statistical models have also been applied to study the determinants of academic achievement in several studies. Bereket and Kidus observed the academic performance of students in Wolaita Sodo University in Ethiopia in relation to the factors influencing their performance in terms of binary logistic regression model. They found that the priorities in selection of courses, family financial support, schedules of studying, peer pressure, parental education, and career expectations of students are important variables in influencing their academic performance (Zewude & Ashine, 2016).

Lastly, there is also education that is affected by wider social and community settings. Through Shields and Sandoval students were said to acquire valuable knowledge and aspects of life not only in the course of formal education but also in the course of interactions with relatives, classmates, and community members. They stressed the fact that quality education is a basic right that governments should provide to allow equal opportunities, and socio-economic progress

(Shields et al., 2020). Although there is abundant literature available on the determinants of academic performance, very little empirical studies have been carried out on the determinants of academic performance among the students undertaking their studies in the degree colleges run by the public sector in the Sindh province of Pakistan. Thus, the study will need some additional research to determine the most important pre-determinants of academic success in the given situation and offer some evidence-based solutions to enhance the academic performance.

Objectives of the study

1. To examine the relationship between teaching quality and students' academic performance.
2. To examine the administrative and academic-related factors associated with students' academic performance.
3. To determine the association between socio-economic factors and students' academic performance.
4. To identify the factors associated with students' academic performance.

Hypothesis of the study

H₀(1): Teaching quality has no statistically significant association with students' academic performance.

H₀(2): Administrative and academic-related factors have no statistically significant association with students' academic performance.

H₀(3): Socio-economic factors have no statistically significant association with students' academic performance.

H₀(4): Teacher and parental motivation have no statistically significant association with students' academic performance.

Research Methodology

This study was conducted to investigate the factors affecting the academic performance of students enrolled in public sector science degree colleges in Sindh Province. Below is a detailed description of the methodology adopted for the study, including the research design, study

variables, source of population, sample size determination, variables of identification, sampling technique, data collection instrument, data collection procedure, and statistical analysis methods.

Research Design

A college-based cross-sectional analytical study was conducted in public sector science degree colleges in Sindh, Pakistan. The respondents comprised students enrolled in ADS Part-I and Part-II. Data were collected from 2,000 students selected from 38 public sector science degree colleges across the six regions of Sindh. A survey research design was employed to collect primary data from the respondents using a structured questionnaire.

Study Variables

The variables included in this study are identified as predictor variables. The variables in the data set include gender, age, class, parents' education, parents' occupation, parents' monthly income, teach with dedication, give assignments to students, complete syllabus, conduct monthly tests, teaching standard, regular attendance, classes run regularly, college charge extra fees, administration shows interest, satisfaction with college administration, attend public library, laboratories are fully equipped, accessibility of reading material and references, environmental factor, study habit, peer impact, study time outside class, etc. These predictor variables were investigated for possible influence on binary response variable "Academic Performance".

Source of population

The students of science degree colleges of Sindh province affiliated to various general universities. Students who got admission in degree classes ADS Part-I and ADS Part-II and enrolled in the academic year 2023-24 and 2024-25 were being

counted as the population.

Sample Size Determination

The Margin of Error formula was used to figure out the sample size. Margin of error is the difference between a sample estimate and the true population value (American Statistical Association).

The total population of students included in the study was 30,578. A 95% confidence level was adopted, corresponding to a Z-value of 1.96. Since the actual population proportion was unknown, $p = 0.50$ was assumed, which provides the maximum variability and consequently a conservative sample-size estimate. Therefore, $q = 1 - p = 0.50$.

The following finite population formula was used:

$$\text{The Margin of Error (MOE)} = \frac{z * \sqrt{p * (1 - p)}}{\sqrt{(N - 1) * n / (N - n)}}$$

Where:

n = sample size = 2000

N = total population size = 30,578

Z = Z-value at 95% confidence level = 1.96

p = estimated population proportion = 0.50

$q = 1 - p = 0.50$

e = margin of error

The corresponding margin of error was calculated by rearranging the above formula:

$$\text{MOE} = \frac{z * \sqrt{p * (1 - p)}}{\sqrt{(N - 1) * n / (N - n)}}$$

Substituting the values:

$$\text{MOE} = \frac{1.96 * \sqrt{0.5 * (1 - 0.5)}}{\sqrt{(30578 - 1) * 2000 / (30578 - 2000)}}$$

$$\text{MOE} = 0.98 / 46.259 = \pm 0.0211$$

$$\text{MOE} = 0.0211 * 100 = \pm 2.118$$

Or

$$\text{MOE} = \pm 2.12$$

Thus, for a total population of 30,578, a sample of 2,000 respondents was selected, corresponding to an estimated margin of error of approximately $\pm 2.12\%$ at the 95% confidence level.

Table 1. Sample Size (n) of Science Degree Colleges in Sindh Province.

Sr no:	Region	Affiliated with University	Total Colleges Population	Sample Size of Colleges
1	Hyderabad	University of Sindh Jamshoro	36	9
2	Mirpurkhas	University of Sindh Jamshoro	17	4
3	Shaheed Benazirabad	SBBU SBA	31	8
4	Sukkur	Shah Abdul Latif University	21	5
5	Larkana	Shah Abdul Latif University	13	3
6	Karachi	Karachi University	33	9
	//////	Total	152	38

Source: College Education Department Govt. of Sindh (2024-25).

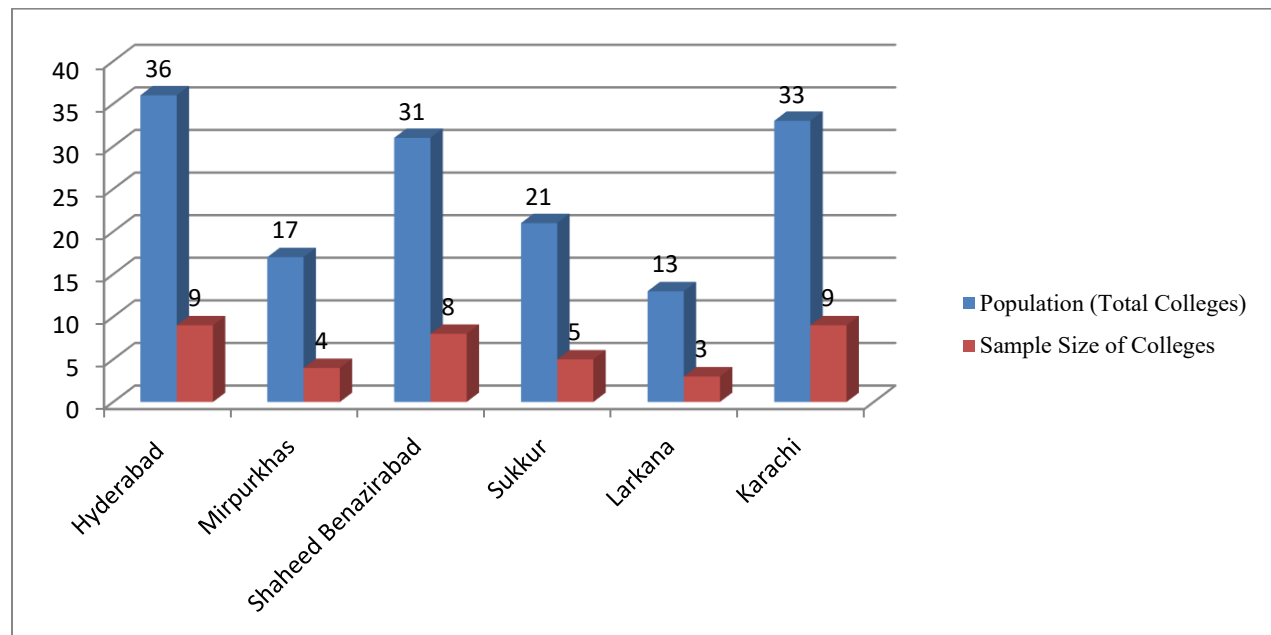


Figure 1. Sample Size (n) of Science Degree Colleges in Sindh Province

Variables of Identification

The response variable of this study is “Academic Performance of students” which has two binary results on students’ performance “which are not good” which gets a code of 0, and “which are good” which gets a code of 1.

Data Collection Methods

Both primary and secondary sources were used to collect the data. A well-structured questionnaire was designed and distributed among students to

gather the required information. Cronbach’s alpha was used to determine the reliability of the questionnaire. Data obtained were evaluated based on descriptive statistics, exploratory data analysis (EDA) as well as the binary logistic regression model in order to determine the variables that contribute to academic performance students.

Statistical Analysis

Exploratory data analysis has been performed by using percentage, measure of central tendency and measure of dispersion. The data was presented graphically and in tabular format. Chi-Square Test of Independence was used to test qualitative/categorical variables. Binary Logistic Regression Model techniques were used for the final testing of hypothesis, and the techniques of advance statistical modeling were also used and the optimal model is generated. Data analysis has been done using the statistical software SPSS V-27 and Excel (2016).

Statistical Techniques

The collected data were coded, entered, and analyzed using appropriate statistical techniques. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the characteristics of the respondents and study variables. The reliability of the research instrument was assessed using Cronbach's Alpha. Cross-tabulation and the Chi-square test of association were employed to examine the relationships between categorical variables and students' academic performance. Since the dependent variable was binary, binary logistic regression analysis was used as the principal inferential statistical technique to identify the factors significantly associated with students' academic performance. Odds ratios (OR) with their corresponding 95% confidence intervals (CI) were estimated to determine the strength and direction of associations. Statistical significance was evaluated at the 5% significance

level ($p < 0.05$).

Classification

Classification is the systematic process of grouping data into homogeneous categories based on shared characteristics. In this study, students' academic performance was classified into two categories: above 60% marks and 60% marks or below. This binary classification was used as the dependent variable in the binary logistic regression analysis.

Binary Logistic Regression Analysis

Binary logistic regression predicts a binary response variable, which could represent two classes such as "Good / Not Good", or "Ok / Not Ok". The outcome is usually coded as 1 and 0.

Let Y be the dichotomous variable representing academic performance of students, more than 60% (1) or less than 60% (0).

Formula for binary logistic regression in terms of predicting the significant effect of factors on academic performance of students can be defined as follows:

$$Y = \text{Log} \left(\frac{P}{1-P} \right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

Where Y is dependent variable "Academic Performance", β_0 is the intercept, $\beta_1, \beta_2, \dots, \beta_k$ are the coefficients and $X_1, X_2, \dots, X_k$ are predictors.

ANALYSIS & DISCUSSION

In this study, a sample of 2,000 respondents was analyzed to investigate the factors affecting their academic performance.

Table 2. Descriptive Statistics Analysis of Respondents

Demographic Factors	Category	Frequency and Percentage
Gender	Male	1065(53.25%)
	Female	935(46.75%)
Age	(18-19)years	928(46.4%)
	(20-21) years	1072(53.6%)
Class	ADS-I	604(30.2%)
	ADS-II	1396(69.8%)
	Illiterate	209(10.5%)
	Primary	324(16.2%)

Father's Education	Secondary	356(17.8%)
	Intermediate	441(22.1%)
	Graduation	417(20.9%)
	Masters	253(12.7%)
Mother's Education	Illiterate	584(29.2%)
	Primary	561(28.1%)
	Secondary	332(16.6%)
	Intermediate	290(14.5%)
Father's Occupation	Graduation	171(8.6%)
	Masters	62(3.1%)
	Govt. Employee	632(31.6%)
	Semi Govt. Employee	180(9%)
Father's Monthly Income	Private Employee	264(13.2%)
	Self-Employee	364(18.2%)
	Other	560(28%)
	(15,000-50,000)	1245(62.3%)
Family Members	(51,000- 1 Lac)	499(25%)
	> 1 Lac	256(12.8%)
	1-5	585(29.3%)
	6-10	952(47.6%)
Study at home	< 10	463(23.2%)
	(1-2) hour	839(42%)
	(3-4) hours	768(38.4%)
	> 4 hours	393(19.7%)
Parents Help in study	Some Times	933(46.7%)
	Everyday	784(39.2%)
	Never	283(14.1%)
How much time Watch TV / Use mobile phone?	(1-2) hour	1172(58.6%)
	(3-4) hours	595(29.8%)
	> 4 hours	233(11.6%)
How much time Play game?	1 hour	802(40.1%)
	2 hours	601(30.1%)
	> 2 hours	236(11.8%)
	None	361(18.1%)
Medium of Instruction	English	1344(67.2%)
	Sindhi	381(19%)
	Urdu	275(13.8%)
Discipline in College	Strict	629(31.5%)
	Normal	988(49.4%)
	Relaxed	383(19.1%)
%age In last Examination	> 60%	1270(63.5%)
	< 60%	730(36.5%)

Source: Survey Data (2024-25).

Demographic Findings:

According to table 2 out of the 2,000 respondents, 53.25% were males, and 46.75% were females. Students with ages of 20-21 years (53.6%) made slightly higher percentage, whereas those aged 18-19 years (46.4%). ADS-II was used to enroll the majority of the students (69.8%), with ADS-I having (30.2%) respectively. The education levels of parents indicated that 10.5% of their fathers and 29.2% of their mothers had never had formal education at any time. With respect to the socio-economic status, 31.6% of fathers or guardians were government workers and most families (62.3%) were in low-income

category that earned between 15,000 and 50,000 per month. In terms of studying, 42% of the students studied 1-2 hours per day at home, whereas 46.7% of student received parental support with their studies periodically. When it comes to leisure activities, 58.6% of respondents viewed television or use mobile phone and 40.1% tended to play regular games. Also, 67.2% of the students were taught in English and approximately half (49.4%) students were contented with college discipline. Nevertheless, 36.5% of students were performing inadequate academically with marks less than 60% in their last examination.

Table 3. Classification of Socio-demographic Factors.

Demographic Factors	Category	Academic Performance		
		Above than 60%	Below than 60%	Total
Gender	Male	684(53.9%)	381(52.2%)	1065(53.3%)
	Female	586(46.1%)	349(47.8%)	935(46.8%)
Age	(18-19)years	620(66.8%)	308(3.2%)	928(46.4%)
	(20-21) years	650(60.6%)	422(39.4%)	1072(53.6%)
Class	ADS-I	399(31.4%)	205(28.1%)	604(30.2%)
	ADS-II	871(68.6%)	525(71.9%)	1396(69.8%)
Father's Education	Illiterate	127(10%)	82(11.2%)	209(10.5%)
	Primary	204(16.1%)	120(16.4%)	324(16.2%)
	Secondary	212(16.7%)	144(19.7%)	356(17.8%)
	Intermediate	286(22.5%)	155(21.2%)	441(22.1%)
	Graduation	273(21.5%)	144(19.7%)	417(20.9%)
	Masters	168(13.2%)	85(11.6%)	253(12.7%)
Mother's Education	Illiterate	364(28.7%)	220(30.1%)	584(29.2%)
	Primary	351(27.6%)	210(28.8%)	561(28.1%)
	Secondary	201(15.8%)	131(17.9%)	332(16.6%)
	Intermediate	200(15.7%)	90(12.3%)	290(14.5%)
	Graduation	112(8.8%)	59(8.1%)	171(8.6%)
	Masters	42(3.3%)	20(2.7%)	62(3.1%)
Father's Occupation	Govt. Employee	421(33.1%)	211(28.9%)	632(31.6%)
	Semi Govt. Employee	89(7%)	91(12.5%)	180(9%)
	Private Employee	154(12.1%)	110(15.1%)	264(13.2%)
	Self-Employee	246(19.4%)	118(16.2%)	364(18.2%)
	Other	360(28.3%)	200(27.4%)	560(28%)
Father's Monthly Income	(15,000-50,000)	807(63.5%)	438(60%)	1245(62.3%)
	(51,000- 1 Lac)	292(23%)	207(28.4%)	499(25%)
	> 1 Lac	171(13.5%)	85(11.6%)	256(12.8%)

Study at home	(1-2) hour	509(40.1%)	330(45.2%)	839(42%)
	(3-4) hours	502(39.5%)	266(36.4%)	768(38.4%)
	> 4 hours	259(20.4%)	134(18.4%)	393(19.7%)
Family Members	1-5	379(29.8%)	206(28.2%)	585(29.3%)
	6-10	591(46.5%)	361(49.5%)	952(47.6%)
	< 10	300(23.65)	163(22.3%)	463(23.2%)
Parents Help in study	Some Times	591(46.5%)	342(46.8%)	933(46.7%)
	Everyday	525(41.3%)	259(35.5%)	784(39.2%)
	Never	154(12.1%)	129(17.7%)	283(14.2%)
How much time Watch TV / Use mobile phone?	(1-2) hour	789(62.1%)	383(52.5%)	1172(58.6%)
	(3-4) hours	337(26.5)	258(35.3%)	595(29.8%)
	> 4 hours	144(11.3%)	89(12.2%)	233(11.7%)
How much time Play game?	1 hour	510(40.2%)	292(40%)	802(40.1%)
	2 hours	381(30%)	220(30.1%)	601(30.1%)
	> 2 hours	138(10.9%)	98(13.4%)	236(11.8%)
	None	241(19%)	120(16.4%)	361(18.1%)
Medium of Instruction	English	869(68.4%)	475(65.1%)	1344(67.2%)
	Sindhi	238(18.7%)	143(19.6%)	381(19.1%)
	Urdu	163(12.8%)	112(15.3%)	275(13.8%)
Discipline in College	Strict	394(31%)	235(32.2%)	629(31.5%)
	Normal	635(50%)	353(48.4%)	988(49.4%)
	Relaxed	241(19%)	142(19.5%)	383(19.2%)

Source: Survey Data (2024-25).

Table 3 reveals that demographic variables have a significant correlation with the academic performance of students. Male students (53.3%) have a slight advantage in earning above 60% marks over female students (46.8%), whereas students aged 18-19 years (46.4%) do better compared to their counterparts aged 20-21 years (53.6%). As to the class, students of ADS-II (69.8%) have better academic performance than those of ADS-I (30.2%). There is also a higher parental education linked with better performance the students with their fathers having an intermediate (22.1%) and graduation (20.9%) education level perform better than the students with illiterate fathers (10.5%).

Equally, the mother education indicates that students whose mothers are educated (intermediate 14.5%, graduation 8.6%) have

better results compared to students whose mothers are not educated (29.2%). Children of higher-income families (>1 lac: 12.8%) are slightly higher in results than their lower-income counterparts. Even study habits, with students studying 3-4 hours (38.4%) and more than 4 hours (19.7%) hours getting better marks while those spending 3-4 hours or less on Mobile/ TV (29.8%) and more than 2 hours on games (11.8%) are more likely to fall below 60%. Parental support also has a positive effect, with the students who have regular support (39.2%) performing better compared to those who have no support (14.2%). Also, academic performance of students who study in English medium (67.2%) and students who undergo stringent discipline (31.5%) are relatively high.

Hypothesis Testing

Table 4. Binary Logistic Regression Analysis

		Variables in the Equation						95% C.I. for EXP(B)	
		B	S.E.	Wald	Df	Sig.	Exp(B)	Lower	Upper
Step 1 ^a	Attendance	.729	.143	26.010	1	.000	2.074	1.567	2.745
	RunClasses	.842	.143	34.716	1	.000	2.321	1.754	3.070
	ChargeExtraFees	.256	.167	2.359	1	.125	1.292	.932	1.791
	FunctionalCollegeLibrary	.295	.188	2.465	1	.116	1.343	.929	1.939
	SyllabusAvailable	-.185	.154	1.436	1	.231	.831	.615	1.124
	PurchaseSyllabus	-.021	.149	.020	1	.887	.979	.731	1.312
	AdminstrationShowInterest	-.218	.167	1.715	1	.190	.804	.580	1.114
	SatisfiedWithCollegeInfrastructure	-.011	.180	.004	1	.950	.989	.694	1.408
	FunctionalComputerLab	-.171	.180	.907	1	.341	.843	.593	1.198
	UseComputerForStudies	-.116	.166	.488	1	.485	.891	.644	1.233
	AttendPublicLibrary	.184	.150	1.493	1	.222	1.202	.895	1.614
	LabortoriesFullyEquipped	-.363	.175	4.296	1	.038	.696	.494	.980
	TourPrograms	.004	.152	.001	1	.977	1.004	.745	1.353
	SportFestival	-.242	.178	1.857	1	.173	.785	.554	1.112
	ParentsDay	-.191	.170	1.251	1	.263	.826	.592	1.154
	CollegeHoldConferences	.187	.181	1.071	1	.301	1.206	.846	1.718
	MonitoringTeams	.119	.173	.475	1	.491	1.127	.803	1.581
	TeachWithDedication	1.041	.148	49.431	1	.000	2.833	2.119	3.788
	GiveAssignments	1.126	.150	56.008	1	.000	3.084	2.296	4.142
	TakeTuition	.226	.165	1.880	1	.170	1.254	.907	1.734
	AttendCoachingCenter	-.190	.157	1.479	1	.224	.827	.608	1.123
	TeachersProvideNotes	-.220	.162	1.849	1	.174	.803	.584	1.102
	CompleteSyllabus	1.691	.144	137.143	1	.000	5.425	4.088	7.200
	ConductMonthlyTests	-.529	.157	11.312	1	.001	.589	.433	.802
	AskQuestions	-.281	.190	2.186	1	.139	.755	.520	1.096
	DiscussAcademicProblems	-.347	.163	4.524	1	.033	.707	.514	.973
	SufficientTeachers	.061	.166	.137	1	.711	1.063	.768	1.473
	TeachingStandard	2.291	.148	241.020	1	.000	9.888	7.404	13.205
	SatisfiedWithCollegeAdministration	.031	.172	.031	1	.859	1.031	.735	1.445
	StudentsOrganizations	.236	.157	2.266	1	.132	1.267	.931	1.723
	JoinedStudentPolitics	-.120	.151	.638	1	.425	.887	.660	1.191

StrikesImpactStudy(1)	.090	.151	.355	1	.551	1.094	.814	1.471
BasicFacilitiesAvailable	.185	.161	1.323	1	.250	1.204	.878	1.651
InternetFacility	-.385	.170	5.101	1	.024	.681	.487	.950
CombineStudy	.136	.151	.811	1	.368	1.145	.853	1.539
Constant	-3.160	.330	91.946	1	.000	.042		

According to Table 4, the binary logistic regression analysis revealed that several teaching-related, institutional, and learning-related factors were significantly associated with students' academic performance. Teaching with dedication (OR = 2.833, $p < 0.001$) and teachers' assignment practices (OR = 3.084, $p < 0.001$) were positively associated with the odds of achieving above 60% marks. Similarly, completion of the syllabus (OR = 5.425, $p < 0.001$) and teaching standards (OR = 9.888, $p < 0.001$) demonstrated strong positive associations with academic performance. Among these factors, teaching standards showed the largest positive association, with the relevant category having approximately 9.89 times the odds of achieving above 60% marks compared with the reference category. In contrast, monthly testing practices (OR = 0.589, $p = 0.001$) were associated with 41.1% lower odds of achieving above 60% marks. Likewise, fully equipped laboratories (OR = 0.696, $p = 0.038$) and internet facilities (OR = 0.681, $p = 0.024$) were significantly associated with 30.4% and 31.9% lower odds of achieving above 60% marks, respectively, in the coded categories compared with their reference categories.

Regarding study habits and learning resources, internet facility was the only statistically significant predictor among purchasing the syllabus, taking private tuition, availability of basic facilities, and internet facility. Purchasing the syllabus (OR = 0.979, $p = 0.887$) was associated with 2.1% lower odds of achieving above 60% marks, whereas taking private tuition (OR = 1.254, $p = 0.170$) and the availability of basic facilities (OR = 1.204, $p = 0.250$) were associated with 25.4% and 20.4% higher odds, respectively. However, none of these associations was statistically significant. Internet facility (OR = 0.681, $p = 0.024$, 95% CI: 0.487–0.950), on the

other hand, showed a statistically significant negative association, corresponding to 31.9% lower odds of achieving above 60% marks in the coded category relative to the reference category. Furthermore, teachers' provision of notes (OR = 0.803, $p = 0.174$) and students' asking questions (OR = 0.755, $p = 0.139$) were associated with 19.7% and 24.5% lower odds of achieving above 60% marks, respectively; however, these associations were not statistically significant. Discussing academic problems with teachers (OR = 0.707, $p = 0.033$) was significantly associated with academic performance and corresponded to 29.3% lower odds of achieving above 60% marks in the coded category compared with the reference category. Similarly, the availability of sufficient teachers (OR = 1.063, $p = 0.711$) was associated with 6.3% higher odds of achieving above 60% marks, but this association was not statistically significant.

Overall, the findings indicate that teaching standards, completion of the syllabus, assignment practices, dedicated teaching, monthly testing practices, fully equipped laboratories, internet facilities, and discussion of academic problems were statistically significant predictors of students' academic performance in their respective regression analyses. Teaching standards exhibited the strongest positive association, whereas monthly testing practices, fully equipped laboratories, internet facilities, and discussion of academic problems showed significant negative associations. Nevertheless, these negative associations should be interpreted cautiously in light of the coding and reference categories of the variables. Moreover, the findings represent statistical associations and do not establish causal relationships between the explanatory variables and students' academic performance.

Table 5. Model summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1642.893	.388	.531

Table 5 shows the model summary of the binary logistic regression indicated the -2 Log Likelihood value of 1642.893, which is fair fit of the model to the observed data. The Cox and Snell R^2 value is 0.388 that means the predictor variables explain around 38.8% of the variance in students' academic performance. In addition, the Nagelkerke R^2 value of 0.531 shows that the

model accounts for 53.1% of the variation in academic performance. This shows that the academic, teaching and institutional factors that were incorporated into the model have a considerable account for the academic achievement of students and have a good predictive power.

Table 6. Goodness of fit (Model Diagnostic)

Omnibus Tests of Model Coefficients			
	Chi-square	Df	Sig.
Step	982.071	35	.000
Block	982.071	35	.000
Model	982.071	35	.000

Table 6 reveals the overall significance of binary logistic regression model was assessed through Omnibus Test of Model Coefficients. The results showed that the model with the independent variables was statistically significant, $\chi^2(35) = 982.071$ and $p < .001$. This means that the presence of the predictor

variables in the model significantly enhanced the model's prediction power over the absence of predictor variables in the model. So, the factors selected in this study as educational, instructional, institutional, and student-related factors together explain the meaningful differences in students' academic achievement.

Table 7. Classification

	Observed	Predicted		
		Percentage		Percentage Correct
		Below than 60%	Above than 60%	
Percentage	Below than 60%	506	224	69.3
	Above than 60%	144	1126	88.7
Overall Percentage				81.6

According to the table 7, the binary logistic regression model is strong predictor. The model correctly classified 69.3% students whose academic performance is less than 60% and 88.7% students whose academic performance is more than 60%. The overall accuracy of the

model was 81.6%, which shows a good level of prediction accuracy. These findings indicate that the chosen predictor variables such as teaching standards, syllabus completion, assignment practices, teacher dedication, and regular conduct of classes, provide good discrimination between

students with lower and higher academic performance. The relatively higher prediction accuracy of the students with a score of more

than 60% highlights that the model is more effective at predicting for academically successful students.

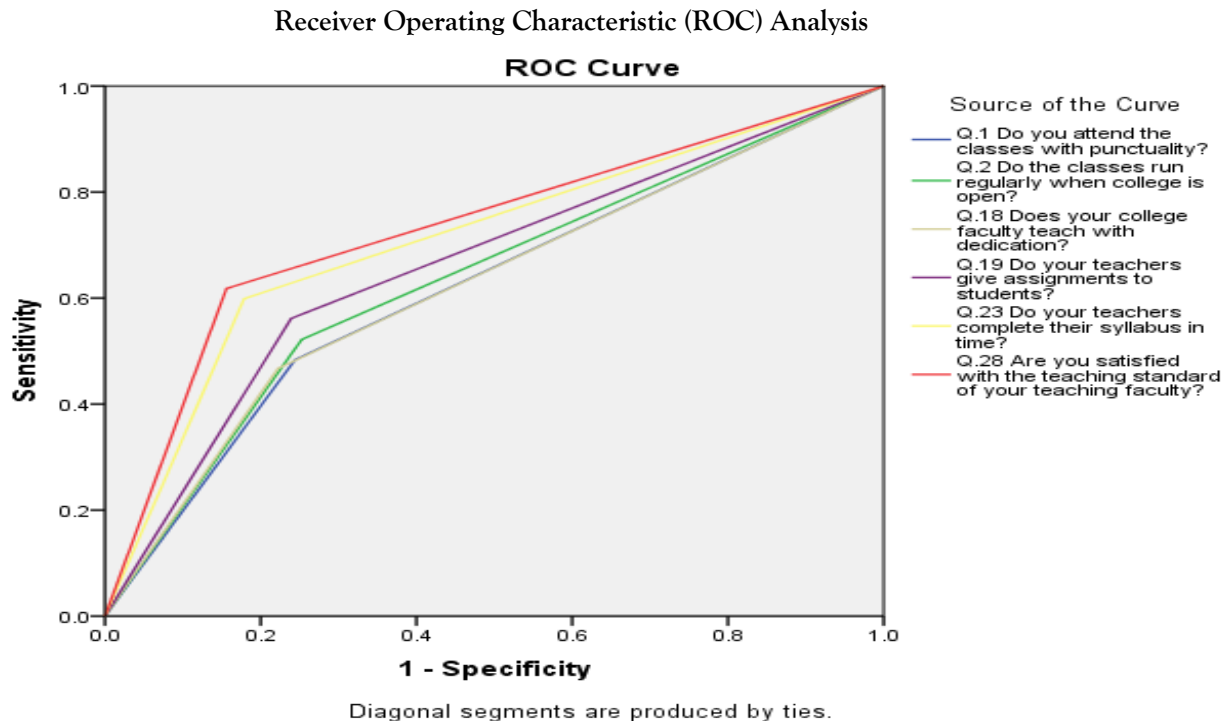


Table 8. Interpretation of ROC Analysis

Variable	AUC	Interpretation
Faculty teach with dedication	0.623	Fair predictor
Teachers give assignments	0.661	Fair predictor
Teachers complete syllabus in time	0.710	Good predictor
Satisfaction with teaching standard	0.731	Good predictor
Attend classes with punctuality	0.620	Fair predictor
Classes run regularly	0.635	Fair predictor

Table 8 describe the ROC analysis, the items of satisfaction with teaching standards (AUC=0.731) and timely completion of syllabus (AUC=0.710) were highest predictors of the academic performance of students. The discriminatory power of all selected teaching-related variables were found to be good (AUC > 0.60), indicating their significant role in influencing students' academic achievement.

Conclusion

The study concludes that teaching quality is the most important predictor of students' academic performance in public-sector science degree colleges of Sindh. Teaching standard, timely syllabus completion, regular assignment provision, and teachers' dedication significantly increased the likelihood of students achieving above 60% marks. However, several student-related and institutional factors showed no statistically significant associations with academic

achievement. Discussing academic problems was significantly associated with 29.3% lower odds of achieving above 60% marks. Overall, improving teaching quality, strengthening teachers' commitment, and ensuring effective academic practices through coordinated efforts by teachers, students, college administrations, parents, and education authorities can help improve students' academic performance.

Recommendations

Based on the findings of the study, the following recommendations are proposed:

- Teachers should adopt interactive, student-centered, and activity-based teaching strategies.
- Science colleges should provide adequate laboratories, libraries, internet facilities, and updated learning resources.
- Academic and psychological counseling, mentoring, tutoring, and remedial support should be provided to struggling students.
- Colleges should organize seminars, career counseling, and motivational programs to improve academic engagement and future orientation.
- Parents should be actively involved in students' academic development through regular communication.

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