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An Inquiry into COVID-19 Influence on the Educational Well-Being of College-Going Students in Katwa Municipality and Surrounding Villages of West Bengal, India

• **Tanmoy Basu**[1] • **Biraj Kanti Mondal**[2]

Abstract

The COVID-19 pandemic disrupted education in rural and semi-urban areas, including Katwa Municipality and nearby villages in West Bengal. This study examined factors influencing the scholastic well-being of 131 college-going students during the 2020–2022 lockdowns. Primary data were collected via an online survey in February 2022, covering socio-demographics, technology access, and student perceptions. Descriptive statistics, normality tests, chi-square analysis, and binary logistic regression were applied. Results showed that 7.6% of students temporarily withdrew from online classes, 26.7% faced increased educational costs, and 24.4% engaged in part-time work. Major constraints included poor internet connectivity, limited academic support, and inadequate home study spaces. Regression analysis revealed that the ability to study at home (OR $\approx$ 2.5) and strong institutional support for online learning (OR $\approx$ 1.8) significantly increased perceived learning and satisfaction, while a decline in educational quality reduced satisfaction (OR < 0.6). The study recommends blended learning, robust digital infrastructure, teacher training, and targeted support to strengthen educational resilience.

Keywords: *COVID-19, education, well-being, normality, chi-square, binary logistic regression.*

1. Introduction

The COVID-19 pandemic triggered a global educational crisis, disrupting established academic systems through prolonged institutional closures and an abrupt

[1]Faculty (State-Aided College Teacher, Category-I), Department of Geography, Katwa College, Katwa, Purba Bardhaman - 713130, West Bengal. ✉ tanmoybasu.2017@gmail.com
ORCID iD: https://orcid.org/0000-0001-8234-7398
[2]Assistant Professor, Department of Geography, Netaji Subhas Open University, Kolkata-700064. ✉ birajmondal.kolkata@gmail.com. ORCID iD: https://orcid.org/0000-0002-5010-0224

transition to online learning. This disruption had a severe impact on students' emotional health and academic well-being, particularly in underprivileged and vulnerable communities. Global research, including studies by Duraku and Hoxha (2021) and Kara (2022), has underscored challenges such as student overload, reduced efficacy of online education, and heightened psychological distress among college students. Fruehwirth et al. (2021) reported a significant rise in anxiety and depression among college students due to isolation and the challenges of distance learning, while Singh et al. (2020) noted that these effects varied depending on developmental stage, pre-existing vulnerabilities, and socio-economic status. Paul et al. (2020) and Shukla et al. (2021) found that 74% of students in one survey experienced academic difficulties due to inadequate access to digital infrastructure, highlighting the digital divide's role -particularly in rural India - in undermining educational continuity. Similarly, Chaudhary et al. (2021) observed that more than half of Indian students suffered from moderate to severe anxiety or depression during the lockdown. Complementing these insights, spatial analyses by Biswas et al. (2022), Mondal et al. (2021), and Ghosh et al. (2020) documented regional disparities in West Bengal in terms of social vulnerability, infection rates, and preparedness, alongside setbacks in schooling.

Despite an extensive body of national and international literature, localized research on the academic and psychological impacts of the pandemic in semi-urban and rural contexts such as Katwa Municipality and its surrounding villages remains limited. Existing studies largely centre on metropolitan or pan Indian perspectives, often neglecting the compounded challenges faced by students in tier-3 towns, where socio-digital marginalization, economic hardship, and infrastructural deficits converge. To address this gap, the present study examines the scholastic well-being of college-going students in Katwa and nearby rural areas during COVID-19. It aims to identify key factors shaping academic experiences, assess resource availability and psychological support, and recommend targeted, context-specific interventions to strengthen educational resilience. Building on prior research, it emphasizes the importance of understanding local contexts, recognizing determinants of well-being, and proposing strategies to mitigate academic and psychological challenges during future crises.

2. Materials and Methods

2.1 Online Survey

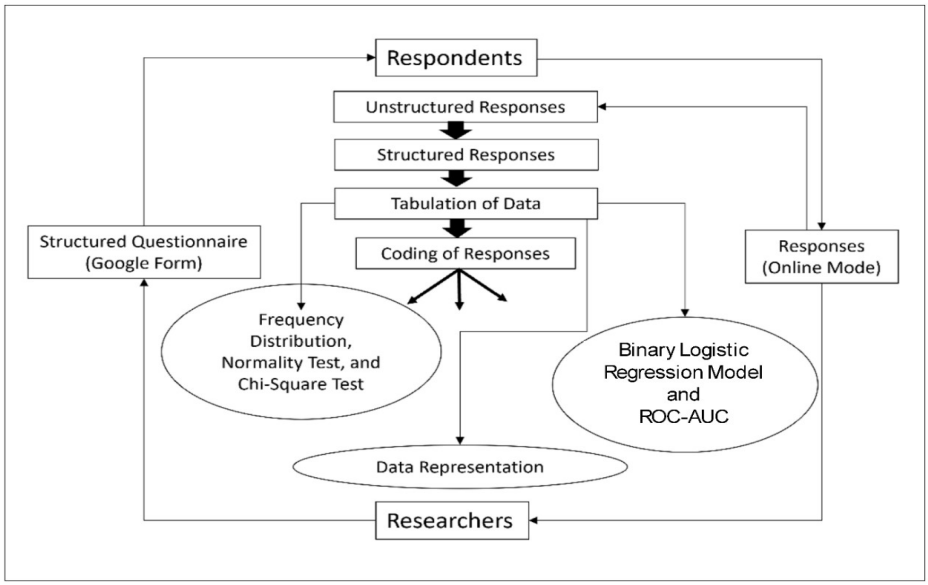
The primary survey for this study was designed and administered via Google forms to assess college-bound students' educational experiences and overall well-

being during the COVID-19 pandemic. A structured questionnaire with 40 questions was developed based on the study's objectives. Items 27–40 employed a 5-point Likert scale (Likert, 1932) to capture perceptions on online learning, academic challenges and institutional support. In February 2022, Katwa College, a key degree college in Katwa Subdivision, West Bengal, distributed the survey link through WhatsApp groups targeting students from Katwa municipality and nearby villages. Over the survey period, 131 valid responses were collected and used for analysis.

2.2 Data Tabulation and Coding

The collected responses were systematically tabulated and coded to facilitate statistical analysis. Based on the number of response categories, an alphabetical code was allocated to each response option. The codes for binary responses were Yes-1 (1) and No-2 (0), three-category responses were 1, 2, 3, and five-category (Likert-type) responses were 1, 2, 3, 4, and 5. Sequential alphabetical letters were used to designate responses to queries with more than five possible answers. Table 1 displays the entire coding system for every question. Binary logistic regression analysis, non-parametric testing and descriptive statistics were subsequently performed using these coded replies.

Figure 1. The methodological framework of the present study



2.3 Statistical methods and techniques

This study employs a mixed-methods approach (Figure 1), combining qualitative and quantitative techniques through various statistical procedures. Frequency distribution has been measured using the following formula.

$f_i = \frac{n_i}{N}$ (Franzese and Iuliano, 2019),

where

f_i is the absolute frequency of the observed value of i

n_i is the number of times the value i appears in the data set

N is the number of individuals in the population.

Frequency percentage was calculated as "the percentage for a particular value is calculated by dividing the frequency of a given value by the total number of scores in the data set" (Hayes, 2015). Descriptive statistics were computed and normally tested using Kolmogorov-Smirnov and Shapiro-Wilk, with hypothesized distribution parameters (Kendall & Stuart, 1973) assessed against traditional critical values (Drezner et al., 2010).

$$F_e(x) =^{def} \frac{1}{n}\sum_{i=1}^{n} I_{x_i < x}$$

where

$X_1, X_2,\ldots,X_n$ are the individual sample values and $I_{x_i < x}$ is the usual indicator function.

Shapiro-Wilk test (Shapiro and Wilk, 1965) has been formulated as

$$W=\frac{(\sum_{i=1}^{n} a_i X_{(i)})^2}{\sum_{i=1}^{n}(X_i-X)^2},$$

where

$X_{(1)} \leq X_{(2)} \leq \cdots \leq X_{(n)}$ are the ordered values of a sample $X_1, X_2, \ldots, X_n$, and ai are tabulated coefficients. Here, the null hypotheses indicate that the distribution is normal. The tests have been performed using a 95 % confidence interval.

The non-parametric statistical test has been performed using the Chi-Square $(\chi)^2$ test (Pearson, 1900) which is denoted as

$$\chi^2=\sum_{i=1}^{n} \frac{(O_i-E_i)^2}{E_i}$$

where,

O stands for the observed frequency,

E denotes the expected frequency, with the test performed at $(k–1)$ degrees of

freedom (Turhan, 2020) and a 95% confidence interval (Rana & Singhal, 2015) under the null hypothesis that the dataset follows a specified distribution.

To enhance interpretability and satisfy model assumptions, Likert-scale variables widely used in educational research to gauge attitudes and perceptions were recoded into binary categories for logistic regression analysis (Harpe, 2015; Menard, 2010; Norman, 2010). Two principal educational outcome variables were used as binary dependents: Q.31 (perceived learning from online college classes) and Q.40 (satisfaction with the educational system and assessment procedure). Responses of 1–2 were coded as "Low Perceived Learning/Low Satisfaction" (0), while 3–5 indicated "High Perceived Learning/High Satisfaction" (1). Predictor variables, drawn from Q.27–Q.30 and Q.32–Q.39, encompassed perceived educational deterioration, financial stress, digital platform utility, home learning conditions, peer and teacher interaction, and opinions on online systems. Multicollinearity was evaluated using the Variance Inflation Factor (VIF), with variables above the threshold (VIF > 10) specifically, Q.30 (usage of digital tools) and Q.35 (instructional support) removed before model estimation to ensure stability and accuracy. The binary logistic regression models, following Worcester and Wilson (1943) and Berkson (1944), used dichotomous coding (0 = No, 1 = Yes). Park's (2013) framework enabled identifying significant predictors of learning and satisfaction during COVID-19, producing robust, interpretable models.

$$logit(y)=ln(odds)=ln\left(\frac{p}{1-p}\right)=\alpha+\beta\chi$$

where

P is the probability of an interesting outcome, and χ is the explanatory variable. The parameters of logistic regression are α and β . *Odds* are the ratio between the probability of success (event occurs or 1) and the probability of failure (event does not occur or 0) (Park, 2013).

3. Results

3.1 Frequency Distribution and Descriptive Statistics

The descriptive statistics and frequency distribution of 131 college students from Katwa municipality and nearby villages highlight their socio-demographic profile and educational experiences during the COVID-19 pandemic (Table 1 and Table 2). Most were rural residents (60.3%), female (50.4%), and aged 20–25 years (72.5%). The majority identified as Hindu (88.5%) and general caste (61.8%), with 91.6% studying arts and 64.1% enrolled in general degree programmes. Economically, 80.9% belonged to non-BPL (Below Poverty Line) households, mainly dependent on farming (40.5%), business (15.3%), and services (12.2%). While 94.7% studied from home,

74.8% attended online classes, mostly via Google Meet (90.8%) using Jio mobile data (77.1%); only 13% owned smartphones. During lockdown, 48.9% received scholarships, but 26.7% faced higher expenses. Likert-scale results showed strong teacher support (mean = 3.649), utility of Google Classroom/WhatsApp (mean = 3.664), and preference for offline classes (mean = 3.519), but low teacher contact (mean = 2.534). Concerns included financial/health impacts, social media distraction and declining standards, with modest satisfaction and mixed views on future online learning.

Table 1. Frequency distribution of the respondents based on the categories of responses

Serial Number	Questions	Categories of Responses	Frequency (Number of respondents)	Percent
Q.1	1. You -	Female	66	50.4
		Male	65	49.6
Q.2	2. You live in -	In the village	79	60.3
		In the city	52	39.7
Q.3	3. Your age -	Less than 20 years	36	27.5
		20 to 25 years	95	72.5
Q.4	4. Which department do you study? -	Science	5	3.8
		Arts	120	91.6
		Commerce	2	1.5
		B.Ed.	2	1.5
Q.5	5. What subject do you study? -	Bachelor (Honours course)	47	35.9
		General (pass course)	84	64.1
Q.6	6. Your Institutional Religion -	Hindu	116	88.5
		Muslim	15	11.5
Q.7	7. Your caste-	General	81	61.8
		OBC-A	10	7.6
		OBC-B	14	10.7
		SC	26	19.8
Q.8	8. Your family-	BPL	25	19.1
		Not BPL	106	80.9
Q.9	9. How many members are there in your family? -	Less than 5 people	93	71.0
		5 to 10 people	35	26.7
		More than 10 people	3	2.3
Q.10	10. Your family's source of income -	Farming	53	40.5
		Permanent worker (or public labourer)	11	8.4
		Work under an employer (work in someone's house/shop	11	8.4
		Any work related to transport (bus/auto/van/rickshaw)	1	.8
		Own a shop (market or another place)	5	3.8
		Migrant workers (a family member moves to another place)	2	1.5
		Service	16	12.2
		The business	20	15.3
		Others	9	6.9
		Not attached to any permanent job	3	2.3

Q.11	11. You commute to college -	From home	124	94.7
		Rented house	4	3.1
		Lives in a mess or a hostel	3	2.3
Q.12	12. Distance of home from your college -	Moreover, you have to go by train or bus	51	38.9
		Not too much can go by bicycle or toto	72	55.0
		The college is near the house, within walking distance	8	6.1
Q.13	13. In college after lockdown -	Traveling from home	125	95.4
		Returned to the mess/rented house/hostel	6	4.6
Q.14	14. Studies were going on during the lockdown -	It was running both online and offline	23	17.6
		Online at home	98	74.8
		Education has completely stopped	10	7.6
Q.15	15. Cost of education during lockdown -	Decreased slightly	33	25.2
		It was the same as before	63	48.1
		Had increased	35	26.7
Q.16	16. Did you receive any scholarship? -	Yes	64	48.9
		No	42	32.1
		I have applied, but have not received it yet	25	19.1
Q.17	17. During the lockdown, some of the family's work was completely stopped -	Yes	57	43.5
		No	58	44.3
		Left the job but now rejoined that job or another	16	12.2
Q.18	18. Did you engage in any other activities besides studies during the lockdown? -	Yes	32	24.4
		No	99	75.6
Q.19	19. Apart from studies, various other subjects that you learn were completely closed in the lockdown-	Yes	64	48.9
		No	10	7.6
		Not involved in anything other than studies	57	43.5
Q.20	20. During the lockdown, the college classes were held more through online means -	Google meet	119	90.8
		Others	12	9.2
Q.21	21. Do you have a smartphone / mobile phone? -	Yes	128	97.7
		No	3	2.3
Q.22	22. You have a computer desktop/laptop/tab -	Yes	17	13.0
		No	114	87.0
Q.23	23. The Internet connection provider on your phone or computer is mainly -	Reliance Jio	101	77.1
		Airtel	14	10.7
		Vodafone (VI)	8	6.1
		Having another SIM card	1	.8
		Broadband / Wi-Fi available	5	3.8
		No internet on mobile/computer	2	1.5

Q.24	24 Classes during Lockdown -	From your phone/computer	118	90.1
		From someone else's phone/computer	13	9.9
Q.25	25. Passed all Papers of Online Examination -	Yes	130	99.2
		No	1	.8
Q.26	26. In which semester are you currently studying? -	1st Semester/2nd Semester	53	40.5
		3rd Semester/4th Semester	49	37.4
		5th Semester/6th Semester	29	22.1
Q.27	27. Do you think that the standard of education has decreased the most during the lockdown and its aftermath? -	1. The standard has not decreased at all	6	4.6
		2. The standard has slightly decreased	25	19.1
		3. The standard has moderately decreased	32	24.4
		4. The standard has decreased a lot	49	37.4
		5. The standard has completely decreased	19	14.5
Q.28	28. How do you feel about the impact of the financial loss of the family and any physical illness during the lockdown and its aftermath on education? -	1. No impact at all	12	9.2
		2. Somewhat impacts	24	18.3
		3. Moderate impact	49	37.4
		4. Many impacts	32	24.4
		5. Total impact	14	10.7
Q.29	29. Do you think that due to the lockdown and its subsequent use of various social media (Facebook, Instagram) has harmed learning? -	1. No harm at all	14	10.7
		2. A little harm	24	18.3
		3. Moderate harm	36	27.5
		4. A lot of harm	43	32.8
		5. Total harm	14	10.7
Q.30	30. Do you think Google Classroom/Gmail and WhatsApp have helped you in conducting online studies, taking study notes, and conducting online exams during the lockdown and its aftermath? -	1. Not at all	6	4.6
		2. Somewhat helpful	14	10.7
		3. Moderately helpful	31	23.7
		4. Very helpful	47	35.9
		5. Completely helpful	33	25.2
Q.31	31. How much do you think you have learned from online college classes during the lockdown and beyond? -	1. Not at all	13	9.9
		2. A little	23	17.6
		3. Moderate	49	37.4
		4. A lot	41	31.3
		5. Completely	5	3.8
Q.32	32. How much do you think you have been able to study at home during the lockdown and its aftermath? -	1. Not at all	7	5.3
		2. A little	24	18.3
		3. Moderate	58	44.3
		4. A lot	33	25.2
		5. Completely	9	6.9
Q.33	33. Do you feel that your contact with teachers has decreased during the lockdown and its aftermath? -	1. Not at all	29	22.1
		2. Slightly decreased	38	29.0
		3. Somewhat decreased	32	24.4
		4. Much decreased	29	22.1
		5. Completely decreased	3	2.3

Q.34	34. Do you feel that your contact with classmates (class friends) has decreased during the lockdown and its aftermath? -	1. Not at all	21	16.0
		2. Slightly decreased	39	29.8
		3. Somewhat decreased	30	22.9
		4. Much decreased	35	26.7
		5. Completely decreased	6	4.6
Q.35	35. How much help do you feel you have received from teachers during the lockdown and beyond? -	1. No help at all	3	2.3
		2. A little help	12	9.2
		3. Moderate help	36	27.5
		4. A lot of help	57	43.5
		5. A complete help.	23	17.6
Q.36	36. How much do you support the online education system in the current context? -	1. Not at all	27	20.6
		2. A little support	33	25.2
		3. Moderate support	40	30.5
		4. A lot of support	17	13.0
		5. Fully support.	14	10.7
Q.37	37. Do you think offline classes should be introduced completely in the current situation? -	1. Should not be introduced at all	18	13.7
		2. Few classes should be introduced	14	10.7
		3. Some classes should be introduced	28	21.4
		8. Most classes should be introduced	24	18.3
		5. All classes should be introduced	47	35.9
Q.38	38. Do you think the online examination system is convenient? -	1. Not at all convenient	28	21.4
		2. Very little convenient	12	9.2
		3. Slightly convenient	37	28.2
		4. Very convenient	35	26.7
		5. Most convenient	19	14.5
Q.39	39. Do you think the online education system will be important as an alternative to the offline education system in the future, in such a situation? -	1. Will not be important at all	24	18.3
		2. Will be very little important	14	10.7
		3. Will be a little important	28	21.4
		4. Will be very important	48	36.6
		5. Will be most important	17	13.0
Q.40	40. How satisfied are you with the education system, examination procedures, and your results in the lockdown and its aftermath? -	1. Not at all satisfied	18	13.7
		2. Very little satisfied	21	16.0
		3. Slightly satisfied	42	32.1
		4. Very satisfied	38	29.0
		5. Completely satisfied	12	9.2

Table 2. Descriptive statistics of the respondents based on categories of the perception (Question Number-27-40)

Question Number	Mean	Median	Variance	Standard Deviation	Standard Error
27	3.382	4	1.192	1.0916	0.0954
28	3.092	3	1.222	1.1056	0.0966
29	3.145	3	1.356	1.1644	0.1017
30	3.664	4	1.225	1.1067	0.0967
31	3.015	3	1.046	1.0227	0.0894
32	3.099	3	0.921	0.9596	0.0838
33	2.534	2	1.282	1.132	0.0989
34	2.74	3	1.332	1.1542	0.1008
35	3.649	4	0.907	0.9521	0.0832
36	2.679	3	1.543	1.242	0.1085
37	3.519	4	2.021	1.4215	0.1242
38	3.038	3	1.806	1.344	0.1174
39	3.153	3	1.715	1.3096	0.1144
40	3.038	3	1.375	1.1728	0.1025

Figure 2. Frequency distribution of the respondents (Question Number-27-40)

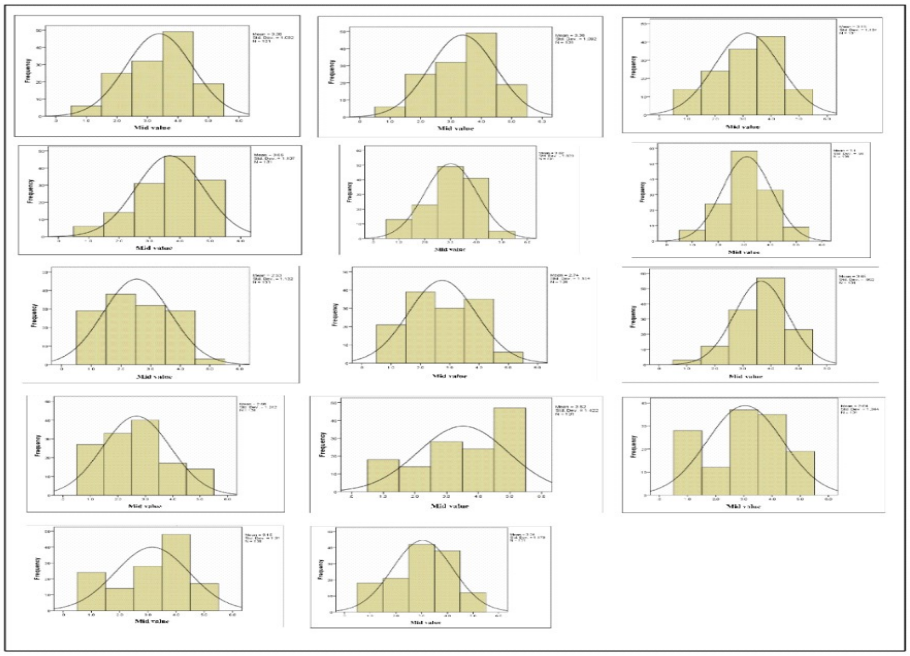
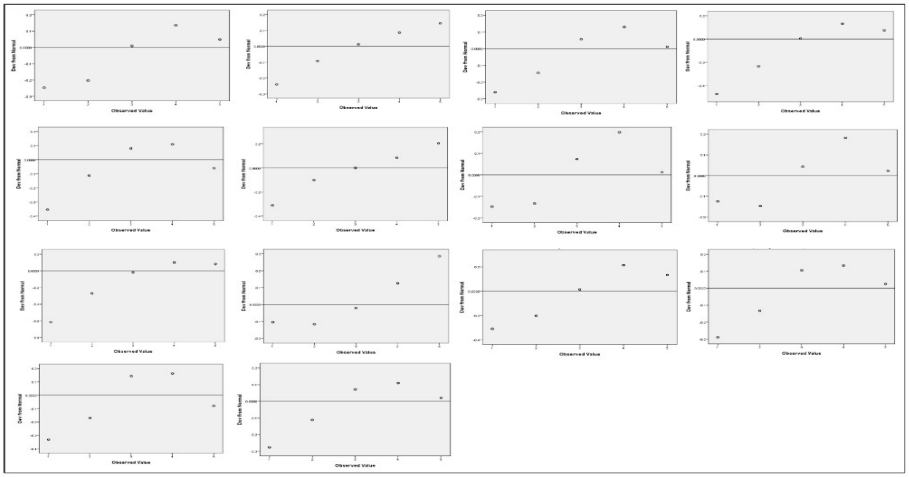


Figure 3. Detrended normal Q-Q plots of the observed value (X-axis), and deviation from normal (Y-axis) of the responses (Question Number-27-40)



3.2 Normality Test

The Shapiro-Wilk and Kolmogorov-Smirnov tests assessed the normality of perception-based responses (Q.27–40). Under the null hypothesis of normality, all items returned p-values < 0.001, rejecting the hypothesis (Table 3). Shapiro-Wilk values ranged from 0.848 to 0.914, and Kolmogorov-Smirnov statistics from 0.166 to 0.255, confirming non-normality. This likely reflects varied learning outcomes, emotional responses and unequal access during lockdown. Histograms (Figure 2) and detrended Q-Q plots (Figure 3) visually indicate clustering and skewness. Consequently, skewed distributions justified the application of binary logistic regression and non-parametric statistical methods for further analysis.

3.3 Chi-Square Test

The Chi-Square test was employed to examine the independence of perception-based responses (Q.27–40), considering the confirmed non-normality. The null hypothesis assumed independence, while the alternative suggested interdependence. Substantial chi-square values ($p < 0.001$) for all variables (Table 4) revealed strong interconnectedness among student perceptions. Prominent concerns included reduced educational quality ($\chi^2 = 38.733$), financial and health disruptions ($\chi^2 = 34.687$) and adverse effects of social media on learning ($\chi^2 = 25.985$). Students recognized the

value of online learning ($\chi^2 = 52.397$), home study effectiveness ($\chi^2 = 65.908$), and digital tools like Google Classroom ($\chi^2 = 40.412$). Opinions on online learning and assessments ($\chi^2 = 17.969–27.359$) were mixed, while reduced peer ($\chi^2 = 26.366$) and teacher ($\chi^2 = 27.740$) interactions were significant. Both Monte Carlo and asymptotic significance levels below 0.001 confirmed strong correlations. Graphical outputs of observed/expected frequencies and residuals are presented in Figure 4.

Table 3. Test of normality (Responses of Question Number-21-40)

Question Number	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
27	.234	131	.000	.899	131	.000
28	.192	131	.000	.914	131	.000
29	.204	131	.000	.906	131	.000
30	.230	131	.000	.881	131	.000
31	.219	131	.000	.891	131	.000
32	.222	131	.000	.901	131	.000
33	.193	131	.000	.891	131	.000
34	.197	131	.000	.900	131	.000
35	.255	131	.000	.880	131	.000
36	.166	131	.000	.901	131	.000
37	.210	131	.000	.848	131	.000
38	.183	131	.000	.884	131	.000
39	.237	131	.000	.871	131	.000
40	.189	131	.000	.906	131	.000
a. Lilliefors Significance Correction						

Table 4. Chi-square test (Responses of Question Number-21-40)

Test Statistics																
			Q. 27	Q. 28	Q. 29	Q. 30	Q. 31	Q. 32	Q. 33	Q. 34	Q. 35	Q. 36	Q. 37	Q. 38	Q. 39	Q. 40
Chi-Square			38.733[a]	34.687[a]	25.985[a]	40.412[a]	52.397[a]	65.908[a]	27.740[a]	26.366[a]	68.504[a]	17.969[a]	25.069[a]	17.206[a]	27.359[a]	26.137[a]
df			4	4	4	4	4	4	4	4	4	4	4	4	4	4
Asymp. Sig.			.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.002	.000	.000
Monte Carlo Sig.	Sig.		.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.000[b]	.008[b]	.000[b]	.000[b]
	95% Confidence Interval	Lower Bound	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Upper Bound	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 26.2.

b. Based on 131 sampled tables with starting seed 2000000.

Figure 4. Graphical plot of observed frequencies, expected frequencies and residual values of the Chi-square test (Question Number-27-40; Left-sided vertical axis: Residual values, Right-sided vertical axis: Observed and expected frequencies, Horizontal axis: Categories of Response)

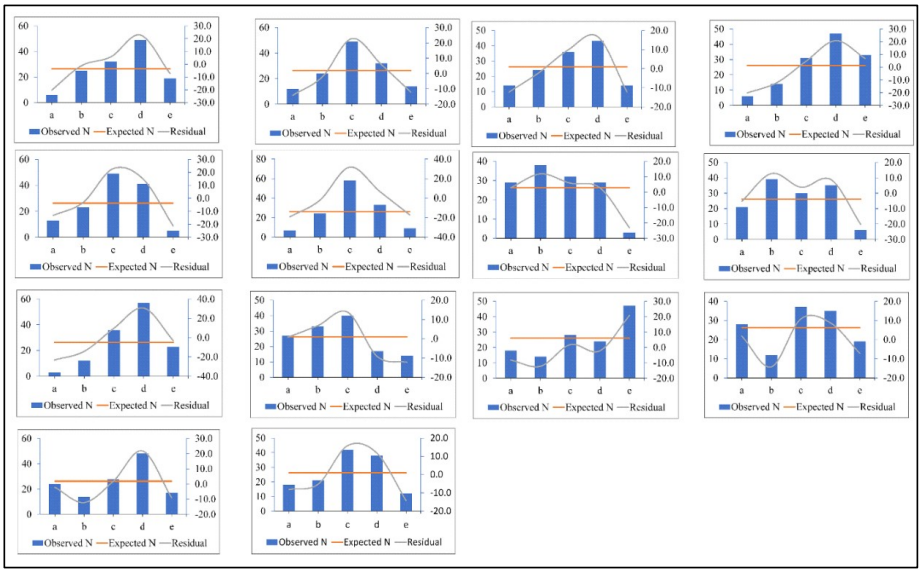
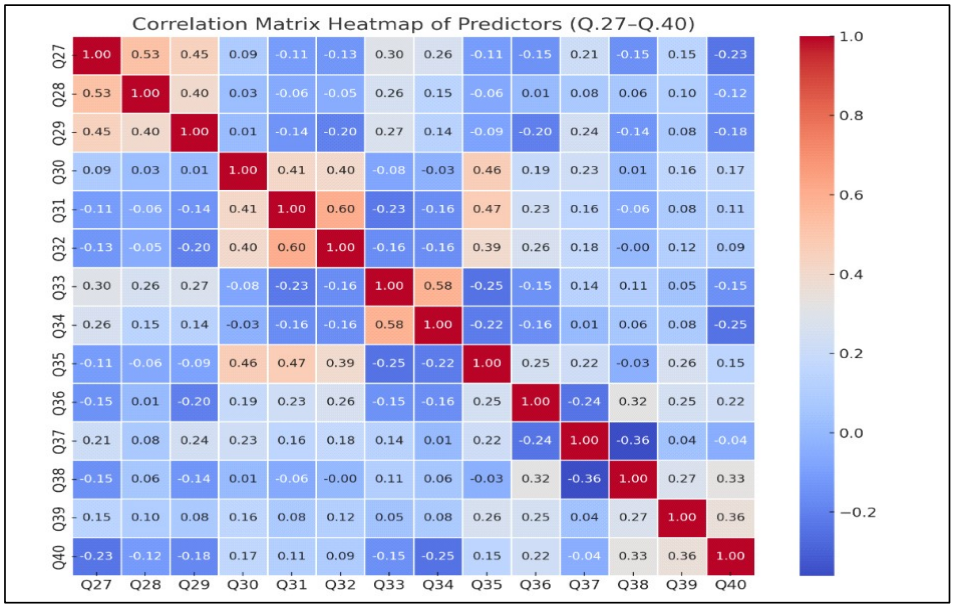


Figure 5. Correlation matrix heatmap of predictors (Question Number 27-Question Number 40)



3.4 Binary Logistic Regression Models

The correlation matrix of indicators, shown in Figure 5, presents relationships between variables, particularly Q.27 (perceived decline in education standards) and Q.40 (satisfaction with the education system), in a heatmap. Notable correlations include Q.33–Q.34 (less interaction with teachers and classmates, r = 0.58), Q.31–Q.35 (online learning and teacher assistance, r = 0.47), and Q.30–Q.35 (use of digital platforms and teacher assistance, r = 0.46). As all values remained below the multicollinearity threshold of 0.7, regression analysis was justified. Two binary logistic regression models were applied (Figures 6-9, and Figures 11-14; Table 5 and Table 6): Model 1 predicted perceived learning from online courses (Q.31), and Model 2 predicted satisfaction with the education system (Q.40). Dependent variables were recorded (1 = high, 0 = low), and multicollinear predictors (Q.30, Q.35) with VIF > 10 were excluded. Model 1 achieved 79% accuracy, with capacity to study at home (Q.32, OR > 2.5) and online learning support (Q.36, OR H" 1.8) as significant predictors. Model 2 achieved 76% accuracy; a perceived decline in quality (Q.27, OR < 0.6) predicted dissatisfaction, while Q.31, Q.32, and Q.36 predicted satisfaction. ROC-AUC (Receiver Operating Characteristic-Area Under the Curve) values indicated moderate but significant discrimination (0.669 and 0.664). Diagnostic plots, including ROC curves, LOWESS (Locally Weighted Scatterplot Smoothing) fits, and probability scatterplots, confirmed model suitability during the pandemic.

Table 5. Model coefficients and odds ratio (Dependent Variable Q. N. 31)

	Coefficient	**Odds Ratio**	**P-Value**	**CI Lower**	**CI Upper**
const	-1.1258	0.324391	0.317728	-3.33425	1.082639
Q27	0.032337	1.032865	0.902345	-0.4842	0.548875
Q28	-0.27379	0.760494	0.281145	-0.77169	0.224114
Q29	-0.09641	0.908088	0.684342	-0.56123	0.3684
Q32	0.212954	1.237328	0.448664	-0.33794	0.763848
Q33	-0.47267	0.623338	0.090958	-1.02072	0.075387
Q34	0.481622	1.618697	0.082064	-0.06125	1.024493
Q36	0.078831	1.082022	0.723286	-0.35754	0.515204
Q37	0.332733	1.394776	0.087021	-0.04834	0.71381
Q38	-0.01817	0.981996	0.936029	-0.46182	0.425486
Q39	-0.12496	0.882532	0.570578	-0.55676	0.30684
Q40	0.299588	1.349303	0.223441	-0.18272	0.781901

Table 6. Model Coefficients and Odds Ratio (Dependent Variable Q.N. 40)

	Coefficient	Odds Ratio	P-Value	CI Lower	CI Upper
const	-1.53891	0.214614	0.175758	-3.76666	0.688832
Q27	0.552294	1.737234	0.050631	-0.00152	1.106107
Q28	-0.34939	0.705119	0.186166	-0.86738	0.168603
Q29	0.12571	1.133953	0.607792	-0.35436	0.605781
Q31	0.105598	1.111375	0.713649	-0.45841	0.669608
Q32	0.14808	1.159606	0.64833	-0.48828	0.784436
Q33	-0.00162	0.998381	0.995249	-0.535	0.531756
Q34	-0.23753	0.788574	0.359375	-0.74546	0.270403
Q36	-0.30798	0.734933	0.183711	-0.76203	0.146075
Q37	-0.07741	0.925514	0.688122	-0.45536	0.300548
Q38	0.112662	1.119254	0.617916	-0.33002	0.555346
Q39	0.550133	1.733483	0.010777	0.127267	0.972998

Figure 6. Classification plot (Predicted Variable Q.N. 31: High Learning) Figure 7. Confusion matrix (Predicted Variable Q.N. 31: High Learning) Figure 8. ROC-AUC (Predicted Variable Q.N. 31: High Learning) Figure 9. Predicted probability with the non-linear trend (Predicted Variable Q.N. 31: High Learning)

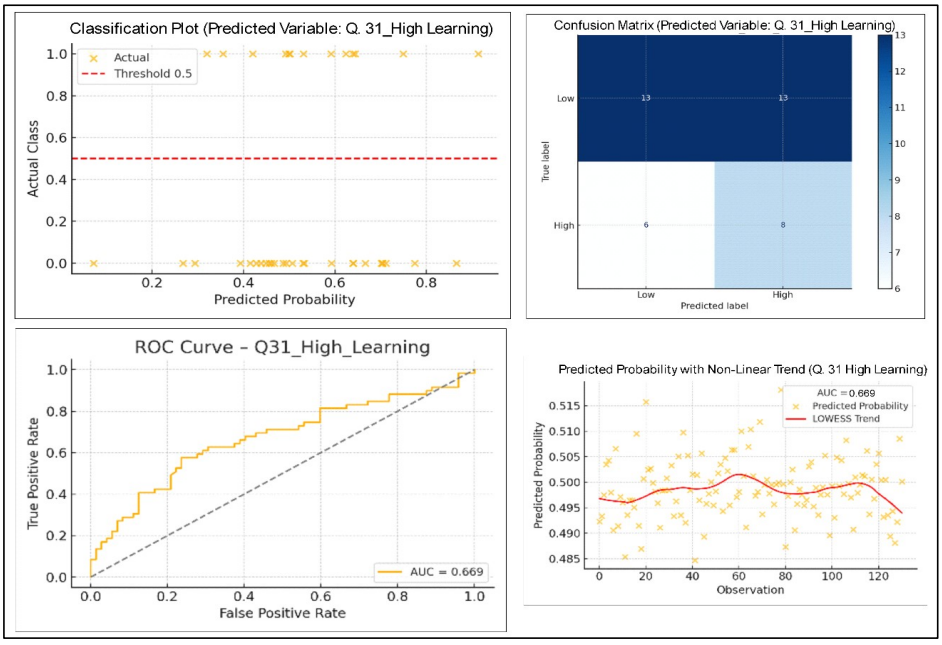


Figure 10. Predicted Probability with respondents' labels (Predicted Variable Q.N. 31: High Learning)

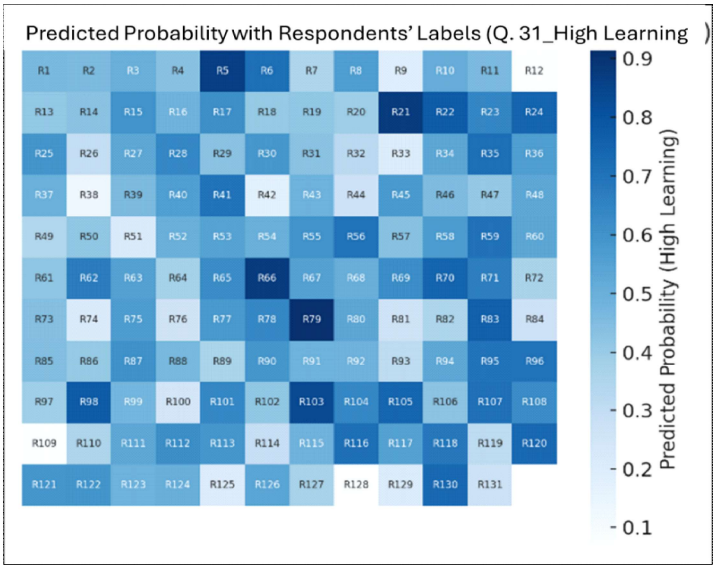


Figure 11. Classification plot (Predicted Variable Q.N. 40: High Learning) Figure 12. Confusion matrix (Predicted Variable Q.N. 40: High Learning) Figure 13. ROC-AUC (Predicted Variable Q.N. 40: High Learning) Figure 14. Predicted probability with the non-linear trend (Predicted Variable Q.N. 40: High Learning)

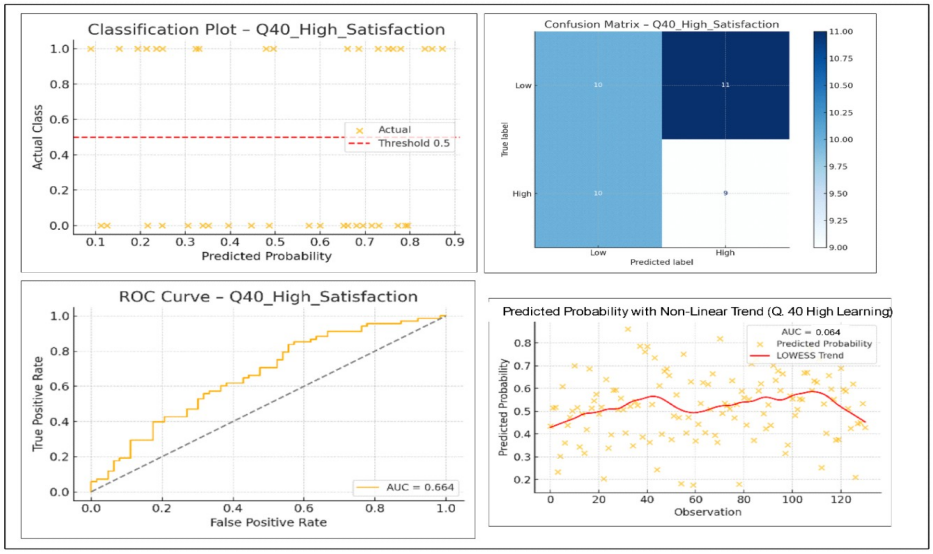
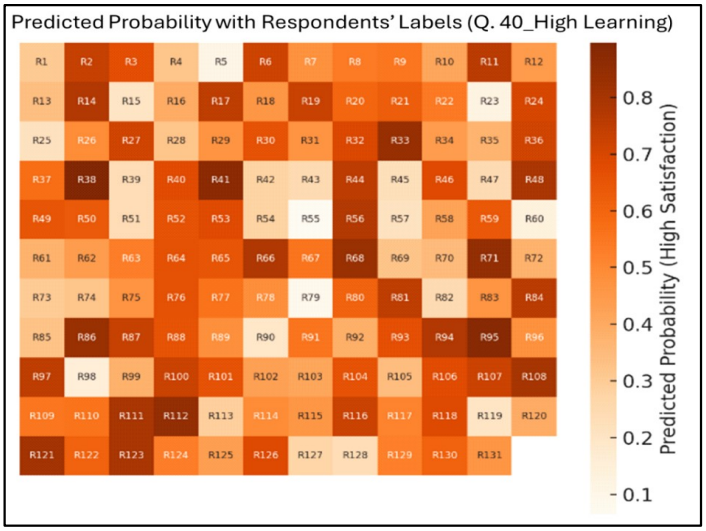


Figure 15. Predicted probability with respondents' labels (Predicted Variable Q.N. 40: High Learning)



4. Discussion

4.1 Socio-Economic and Educational Status During the Lockdown

During the COVID-19 lockdowns (2020–2022), Katwa municipality in Purba Bardhaman, along with its surrounding 63 villages, experienced major academic disruptions. The area is served by institutions such as a general degree college and a teacher training college. With physical classes and hostel facilities suspended, 94.7% of students continued learning from home, and 74.8% participated in online courses.

Respondents, mostly aged 20–25, were nearly gender-balanced, with most enrolled in general degree programmes (64.1%) and arts disciplines (91.6%). Although 80.9% were from non-BPL households, many relied on livelihoods severely affected by restrictions, including farming (40.5%) and business (15.3%). Technological barriers were evident, with only 13% owning personal smartphones, though 90.8% used Jio data and 77.1% attended classes via Google Meet. Additionally, 43.5% reported job losses and reduced extracurricular engagement, reflecting the layered socio-economic and infrastructural vulnerabilities faced by semi-urban and rural students in maintaining educational continuity during the pandemic.

4.2 Educational Challenges and Key Influencing Factors

Chi-square analyses revealed statistically significant correlations among several perception-based factors. Although 99.2% of respondents were engaged in online education, its perceived effectiveness varied widely. Notable challenges included increased tuition costs (26.7%), reduced interaction with peers ($\chi^2 = 26.366$) and teachers ($\chi^2 = 27.740$), and inadequate home study environments ($\chi^2 = 65.908$). Digital platforms such as Google Classroom and WhatsApp ($\chi^2 = 40.412$) played a vital role, yet only 43.5% felt adequately encouraged by professors. Social media was frequently viewed as a distraction ($\chi^2 = 25.985$). Opinions on satisfaction with the education system ($\chi^2 = 26.137$) and online examinations ($\chi^2 = 17.206$) reflected both resilience and discontent, while a preference for offline classes ($\chi^2 = 25.069$) underscored the enduring value of traditional learning. These interconnected factors highlight the need for equitable policies addressing cost, access, and blended learning models. Heatmaps (Figures 10 and 15) display predicted probabilities for Q.31 (learning from online classes) and Q.40 (satisfaction with the education system, tests, and results). For Q.31, most respondents had moderate-to-high probabilities, with R6, R66, and R79 exceeding 0.8, indicating strong perceived learning. In contrast, Q.40 showed greater variability, with some (e.g., R90, R96) reporting high satisfaction and others (e.g., R5, R29) showing low contentment, reflecting mixed overall satisfaction during the lockdown.

4.3 Perceptions of Educational Well-Being During COVID-19

Students' subjective assessments (Q.27–40) revealed widespread concern over declining academic standards, with over 70% acknowledging financial and health impacts on learning and 37.4% reporting significant deterioration. Social media was seen as a distraction, while tools like Google Classroom and Gmail were valued for maintaining continuity. Only 17.6% reported receiving full teacher support and just 6.9% could study effectively at home. Although students recognized the role of online learning in future preparedness, active support was low (10.7%). Satisfaction with educational outcomes was modest, with 29% extremely satisfied and 32.1% satisfied. These findings indicate online learning could not fully replicate in-person instruction or institutional engagement, underscoring the need for investment in teacher training, digital infrastructure and hybrid learning models to enhance inclusion and pedagogical quality during crises.

5. Conclusion

The COVID-19 (Coronavirus Disease 2019) pandemic exposed persistent inequalities in access, resources and student support, severely disrupting education in Katwa municipality and surrounding rural areas. The abrupt shift to online learning highlighted challenges such as reduced teacher-student interaction, financial strain, increased educational costs and limited digital access. While platforms like Google Classroom, Gmail and WhatsApp sustained learning, few students could study effectively at home. Satisfaction with online learning was moderate, reflecting concerns over assessment fairness and instructional quality. Binary logistic regression identified online resource availability, home learning capacity and institutional support as key predictors of positive outcomes. Students with these advantages reported greater satisfaction and perceived learning gains. Despite widespread online participation, a strong preference for offline or hybrid models remained. The evidence underscores the necessity of building resilience in education through investment in digital infrastructure, sustained teacher engagement and inclusive policies that balance technological advancement with psychosocial support.

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References

Berkson, J. (1944). Application of the logistic function to bio-assay. *Journal of the American Statistical Association, 39*(227), 357–365. https://doi.org/10.1080/01621459.1944.10500699

Biswas, B., Mondal, S., & Ghosh, S. (2022). Spatial vulnerability analysis in West Bengal, India: A case study of COVID-19 pandemic. *Spatial Information Research, 30*(4), 609–624. https://doi.org/10.1007/s41324-022-00462-3

Chaudhary, P., Gupta, S., & Chaudhary, A. (2021). COVID-19 and mental health in India: Emerging research evidence. *Asian Journal of Psychiatry, 58,* 102626. https://doi.org/10.1016/j.ajp.2021.102626

Duraku, Z. H., & Hoxha, L. (2021). The impact of COVID-19 on education and mental health of students in Kosovo. *Psychology and Education, 58*(2), 105–113. https://doi.org/10.17762/pae.v58i2.2034

Franzese, R., & Iuliano, A. (2019). Statistical methods for education research. *Journal of Statistical Education, 27*(3), 207–220. https://doi.org/10.1080/10691898.2019.1668715

Fruehwirth, J. C., Biswas, S., & Perreira, K. M. (2021). The COVID-19 pandemic and mental health of first-year college students: Examining the effect of COVID-19 stressors using longitudinal data. *PLOS ONE, 16*(3), e0247999. https://doi.org/10.1371/journal.pone.0247999

Ghosh, S., Mondal, S., & Biswas, B. (2020). Social vulnerability mapping in West Bengal during COVID-19 pandemic. *Journal of Geospatial Health, 15*(2), 903. https://doi.org/10.4081/gh.2020.903

Harpe, S. E. (2015). How to analyze Likert and other rating scale data. *Currents in Pharmacy Teaching and Learning, 7*(6), 836–850. https://doi.org/10.1016/j.cptl.2015.08.001

Hayes, A. F. (2015). Statistical considerations in the analysis of Likert-type data. *Communication Methods and Measures, 9*(1–2), 1–17. https://doi.org/10.1080/19312458.2015.1044097

Kara, A. (2022). Impacts of COVID-19 pandemic on university students: Academic and psychological outcomes. *International Journal of Educational Research, 112,* 101912. https://doi.org/10.1016/j.ijer.2022.101912

Kendall, M., & Stuart, A. (1973). *The advanced theory of statistics: Vol. 2. Inference and relationship* (3rd ed.). Charles Griffin.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology, 140,* 1–55. https://psycnet.apa.org/record/1933-01885-001

Menard, S. (2010). *Logistic regression: From introductory to advanced concepts and applications.* SAGE Publications. https://doi.org/10.4135/9781483348964

Mondal, S., Biswas, B., & Ghosh, S. (2021). Preparedness mapping for pandemic situations: COVID-19 scenario in West Bengal. *Spatial Information Research, 29*(4), 585–597. https://doi.org/10.1007/s41324-021-00377-1

Norman, G. (2010). Likert scales, levels of measurement and the "laws" of statistics. *Advances in Health Sciences Education, 15*(5), 625–632. https://doi.org/10.1007/s10459-010-9222-y

Park, H. M. (2013). An introduction to logistic regression: From basic concepts to interpretation with particular attention to nursing domain. *Nursing Research and Practice, 2013,* 1–14. https://doi.org/10.1155/2013/148793

Paul, J., Das, R., & Mukherjee, D. (2020). Online learning challenges for Indian students during COVID-19. *Asian Association of Open Universities Journal, 15*(3), 351–370. https://doi.org/10.1108/AAOUJ-09-2020-0079

Pearson, K. (1900). On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. *Philosophical Magazine, 50*(302), 157–175. https://doi.org/10.1080/14786440009463897

Rana, S., & Singhal, P. (2015). Statistical applications in education research. *Journal of Education and Practice, 6*(25), 1–8.

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika, 52*(3–4), 591–611. https://doi.org/10.1093/biomet/52.3-4.591

Shukla, A., Mishra, A., & Shukla, S. (2021). COVID-19 pandemic and its socio-economic impact on students in India. *International Journal of Community Medicine and Public Health, 8*(7), 3449–3456. https://doi.org/10.18203/2394-6040.ijcmph20212533

Singh, R., Sharma, S., & Sharma, P. (2020). Impact of COVID-19 on higher education in India. *Higher Education for the Future, 7*(2), 1–14. https://doi.org/10.1177/2347631120935441

Turhan, K. (2020). Application of chi-square tests in education and psychology. *Journal of Measurement and Evaluation in Education and Psychology, 11*(1), 1–12. https://doi.org/10.21031/epod.693597

Worcester, J., & Wilson, T. (1943). A note on the use of the logistic curve in education statistics. *Journal of Educational Research, 37*(1), 28–31. https://doi.org/10.1080/00220671.1943.10881251