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Article

Educational paradigm shift: Long-term ramifications of COVID-19 in the Indian context

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Abstract: The COVID-19 pandemic has brought about a significant transformation in the global educational landscape, which has far-reaching implications for learning systems. This study focuses on the impact of the pandemic on India's education sector, exploring its long-term consequences. The research delves into the enduring effects of COVID-19 and how it has reshaped traditional educational methods. The Indian education system has undergone a dynamic evolution, from the rapid integration of digital technologies to the redefinition of pedagogical approaches. The study employs surveys to comprehensively assess the multifaceted dimensions of adaptation. By synthesizing qualitative insights from 386 respondents, the research aims to contribute to a better understanding of the challenges, opportunities, and long-term implications of COVID-19. The hypothesis results show a significant difference among genders for factors 2 (consequences of COVID-19 on teachers, students, and teaching), 3 (impact of COVID-19 on education), and 4 (education system responses to COVID-19). In contrast, factor 3 is significant for education. Likewise, awareness factors 1 and 3 show that factors 1 (policies and strategies on education during COVID-19) and 5 (possible solutions and implementation) are significant for an application. Finally, binary logistic regression demonstrates that for gender factors three, education factors four, and five, online participation is significant for awareness factors one, three, and four. However, all of the factors are insignificant for an application. These findings can guide policy decisions, inform educational practices, and lay a valuable foundation for future research endeavours to shape a resilient, equitable, and innovative educational future.

Keywords: pandemic; COVID-19; education; Binary Logistic Regression; factor analysis

1. Introduction

The pandemic concept has a long history; however, many medical manuscripts do not describe it. There must have been various vital pandemics recorded throughout human history. Epidemic-related crises have significantly affected people's health, economies, and even global security. This article will look at the research on pandemics and evaluate the detrimental effects on education in Indian society.

The COVID-19 pandemic has caused the most widespread disruption of education systems in history, and it has irreversibly altered the functioning and outcomes of education, affecting approximately 1.6 billion students in over 190 countries across all continents. Closures of schools and other learning spaces have affected 94% of the world's student population, rising to 99.4% in low- and lower-middle-income countries (U.N., 2020).

COVID-19, a recent pandemic in early 2020, has challenged humanity in every way, including economics, health, and community life. According to reports, more than 40% of the world's population is confined to their houses, demonstrating how vulnerable science is to pandemic preparedness (Gupta, 2020; Rashid and Yadav, 2020). Undoubtedly, the lockdown helped slow infection transmission throughout the community but also caused widespread disturbance. People trapped between landscape boundaries, schools, factories, businesses, many construction projects, and social and religious festivities and gatherings have long been prohibited (Dar and Lone, 2021; Kapasia et al., 2020; Tarkar, 2020). The COVID-19 outbreak significantly impacted educational activities worldwide, resulting in extensive closures (Rana and Daniel, 2023). It caused significant disruptions in academic activities as well as career plans. Numerous countries shuttered schools as part of the global campaign to combat COVID-19 and halt the coronavirus epidemic.

Because of a recent coronavirus outbreak that has spread worldwide, numerous countries have ordered the closure of all educational institutions. Learners and educational institutions have had to defend their students from viral exposure, which is more likely in a highly socialized student population (UNESCO, 2020). Even though lockdown and social isolation are the only options to halt the spread of COVID-19 by interrupting the transmission chain, the closure of educational institutes has significantly impacted students. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) monitored over 100 nations that conducted countrywide closures, affecting over 290 million students worldwide (UNESCO, 2020).

However, despite leading to many holes in this area globally, a digital solution may not meet the required learning level. India takes precautions to prevent the spread of the virus, closing 90% of schools and putting postgraduate education at risk. All academic sessions and board exams were halted at this critical juncture. As a result, the e-learning system advances to optimize and overcome this challenge to protect the economy's and development's future (Agarwal et al., 2021; Sahoo et al., 2021). Again, it solved only a few private schools' problems. Non-affordable schools have no more access to the network or the instructional system.

Furthermore, connection to the network is not possible in several Indian districts. Remote learning requires a reliable power supply and an unbroken system if physical limits do not constrain it. Simultaneously using numerous processes also causes network congestion (Gape et al., 2021; Onyema et al., 2020).

The COVID-19 pandemic rocked the world to its core, and its repercussions were felt in India's educational system, compelling institutions, teachers, and students to venture into uncharted terrain and accept a 'new normal'. This study begins by thoroughly examining the long-term effects of this unusual crisis on the nation's educational fabric. This study delves further into the critical and long-term changes within the educational environment, going beyond the immediate challenges of transitioning to online education. This inquiry seeks to untangle the complex network of alterations and adaptations brought forth by the epidemic, from technological pedagogical practices to raising educational goals. This study aims to shed light on the education sector's resilience and the fundamental trends that are reshaping the future of learning in India to provide a more accurate assessment of the long-term

repercussions. This changing scenario has put students, educators, and families to the test, spurring innovations in teaching methods and re-evaluating education policies to meet the developing requirements of a quickly changing society (Panakaje et al., 2022; Sharma et al., 2022).

Further, this study primarily identifies any difference among factors retrieved from the data based on the demographic profile to predict the model. Thus, the core objective of the study can be:

To systematically identify and analyze the multifaceted factors that contribute to the positioning of COVID-19 within the Indian education system, aiming to provide comprehensive insights into the challenges and opportunities presented by the pandemic.

To assess and gauge respondents' awareness regarding the factors influencing COVID-19's impact on the Indian education system, thereby contributing to a nuanced understanding of the prevailing knowledge and perceptions surrounding these crucial aspects.

To find out if there are any differences in the factors that came from the primary goal based on the demographics of the respondents. This will help us understand if there are any differences in how people from different groups think about, know about, or have experienced the effects of COVID-19 on the Indian education system.

This research component will shed light on the emerging debate surrounding the global pandemic's revolutionary impact on educational systems worldwide. As countries struggle with the many issues posed by COVID-19, the literature has become an invaluable source of insight into the numerous ways in which education has adapted and grown. This review examines existing scholarly works, policy documents, and empirical studies, addressing significant themes such as the rapid transition to online learning, the digital divide, pedagogical advances, and the socioeconomic implications for students. This literature review aims to lay the groundwork for a nuanced understanding of how the Indian education sector has navigated the complexities introduced by the pandemic, identifying gaps in current understanding and providing a contextual backdrop for the subsequent empirical investigation into the long-term effects on education in India by synthesizing the existing knowledge base.

According to Quentin (2014), the issue of school closures is a topic of contention since it has the potential to have spillover impacts on several pupils attending receiving schools. The impact of this issue extends to the overall educational experience and academic performance, particularly among students with special needs or learning issues that necessitate more physical support and supervision (Larsen, 2020). As a result of the ongoing COVID-19 pandemic, educational institutions such as schools and colleges have been compelled to suspend their operations indefinitely. Consequently, educational institutions and students alike must diligently pursue completing their designated curricula within the specified timeframe. This striving has presented particular challenges, fostering novel opportunities for educational innovation. Upon conducting a thorough analysis, it becomes evident that numerous additional elements are also detrimentally impacted. These encompass several aspects, such as faculty recruitment, student examination cycles, and student counselling. One further aspect that contributes to the detriment of students' personal development is the decline in face-to-face communication, which plays a significant role in fostering

self-confidence. This quality is compromised in the digital realm. Currently, India needs more funding to surmount students' obstacles and impediments. The proposed optimal resolution is implementing effective measures to address the epidemic, mitigating its prolonged impact on India's economy, particularly on school-going youngsters.

To the potential chagrin of specific individuals, youngsters have yet to be instructed to predominantly return home for recreational activities. The rationale for closing schools during the pandemic is rooted in the notion that students should pursue their educational endeavors remotely from the comfort of their homes to avoid significant omissions. According to Bjorklund and Salvanes (2010), the COVID-19 pandemic has highlighted the importance of families in facilitating education. It is commonly seen as a supplementary aspect of engagement with information. However, it can be regarded as highly commendable in the first scenario. Parents enhance their children's arithmetic skills by engaging in activities that involve counting or emphasizing simple mathematical issues in everyday life. This can be done through various means, such as incorporating mathematical concepts during visits to historical landmarks or museums. The present surge in global homeschooling is highly effective.

Therefore, it is doubtful that global homeschooling will consistently serve as a viable replacement for the educational opportunities forfeited due to the absence of traditional schooling. Although it may yield occasional inspiration, anger, happiness, and frustration, its capacity to supplant the educational experience schools provide remains entirely determined. Nevertheless, it is crucial to acknowledge that there are likely substantial variations across families regarding their support for facilitating their children's educational pursuits. When attempting to teach a subject that one may not fully understand, the variability in the amount of time available for instructional purposes, the non-cognitive support offered by parents, the accessibility of resources (such as access to high-quality online materials), and the degree of knowledge all pose difficulties in facilitating a child's learning. Hence, this phenomenon will increase the discrepancy in human capital development among individuals who display arrogant behavior (Oreopoulos and Stevens, 2006).

The global education landscape has experienced significant disruptions due to the closure of educational institutions, including schools, colleges, and universities. This interruption not only affects the delivery of instruction but also coincides with a crucial evaluation period, leading to the postponement or cancellation of numerous examinations (Bokde et al., 2020; Joshi and Gupta, 2021). In numerous countries across the globe, educational institutions, including schools and colleges, have implemented the practice of advancing students to higher grade levels. The cancellation of internal examinations is perceived as having limited importance. However, the primary objective is to provide families and instructors with the child's progress information. The absence of this information delays the identification of both exceptional aptitude and educational challenges, which can harm the child's prospects (Andersen and Nielsen, 2020).

The extensive and swift evolution process has significantly impacted pupils across various age cohorts (Hasan and Bao, 2020). According to Odriozola-Gonzalez et al. (2020), the anticipated ramifications of the disease's ongoing transmission, travel limitations, and nationwide closure of educational establishments will substantially

impact students' academic progress, social interactions, and psychological well-being. The advent of the coronavirus illness (COVID-19) has given rise to an unparalleled global public health emergency. In order to mitigate the transmission of the virus, India adopted emergency measures that imposed limitations on non-essential public movements (Saha et al., 2020). Aucejo et al. (2020) discovered that the COVID-19 epidemic disproportionately affected students from low-income families. Due to decreased family budget, limited access to digital resources, and the high cost of internet connectivity, the students' academic lives have been disrupted. According to Lee (2020), a significant number of kids globally, estimated at 1.5 billion, are currently experiencing a lack of access to primary education. This deprivation has been found to have a profound psychological effect on their overall well-being.

The closing of educational institutions necessitated a swift shift from traditional in-person learning to digital learning platforms (Kapasia et al., 2020; Larson, 2020). The potential of online learning as a viable substitute for traditional learning has been noted in previous research, as a meta-analysis by Cook (2009) contends that online learning is comparable to and superior to traditional forms of learning. In order to enhance the e-learning experience, educational institutions must adhere to the norms and recommendations set out by government organizations. In recent times, educational institutions such as universities and colleges have increasingly used online evaluation tools to replace conventional examinations. This emerging domain presents a novel challenge for educators and learners alike, with the assessment process expected to exhibit a more significant margin of error than conventional practices (Piopiunik, 2020). This implies that amplifying candidates' signals will likely reduce matching efficiencies for recent graduates in the labor market, potentially leading to diminished profit growth and increased work displacement (Fredriksson, 2018).

Furthermore, the alterations in the students' daily regimen, such as reduced engagement in outdoor activities, disrupted sleep schedules, and adherence to social distancing measures, have impacted their psychological welfare. In their study, Cao et al. (2020) employed the 7-item Generalized Anxiety Disorder Scale (GAD-7) as a diagnostic instrument to evaluate individuals with anxiety disorders, panic disorders, and social phobia. Additionally, the study conducted by Ye et al. (2020) examines the mediating effects of resilience, coping strategies, and social support in managing psychological disorders.

Pujari (2020) remarked that due to the closure of schools, students, teachers, and parents face numerous issues in India. Therefore, online education is preferable, practical, and timely, but it presents difficulties for low-income families and students. According to UNESCO (2020b) research, the rapid transition to online learning has been problematic even for students, instructors, and parents in countries with solid ICT infrastructure and internet connectivity, which need to be improved. Developing countries often need more resources to provide enough training for students, parents, and teachers to provide quality online education (Piopiunik, 2020; Rawal, 2021). Therefore, after the COVID-19 pandemic is finished, the school system should train students to adjust to new learning environments easily. Education systems in underdeveloped nations may need help from the rest of the world in order to future-proof their institutions, staff, students, and parents (Zhu and Liu, 2020).

The importance of technology in defining the future of education in India is a recurring issue in the literature, with arguments centered on the possible long-term influence of digital learning platforms and the need for regulatory reforms to provide fair access to quality education. The current body of literature is crucial for comprehending the complexities of the pandemic's impact on Indian education. It offers crucial insights for future study and policy development in this volatile subject.

2. Materials and methods

In this study, a rigorous methodology was employed to investigate the multifaceted impacts of pandemic. The following paragraphs outlined the research design, data collection methods, and analytical approaches undertaken to comprehensively explore the repercussions of this unprecedented global health crisis on educational institutions across Delhi and National capital region (NCR) of India.

2.1. Research design

The research design was crafted to provide a systematic framework for examining the effects of the pandemic on various dimensions of education system. A qualitative methodology was adopted to attain the objectives of the study that incorporates 20 statements on the 'Adapting to the New Normal: Assessing the Long-Term Effects of COVID-19 on Education in India.'

2.2. Data collection

The data was collected through online survey using Google forms. The link of survey was forwarded to different residents of Delhi and NCR. Convenience sampling was used in present study and 386 participants participated in the online survey. Respondents were asked to respond based on a 1 to 5 point. Likert scale from 'strongly disagree' to 'strongly agree.' Respondents' general profile includes gender, education, awareness, online participation, and online teaching and learning applications.

2.3. Analytical approach

Based on the first objectives of our study, which is uni-variate in nature, we apply the Kaiser-Meyer-Olkin (KMO) measure of Sampling Adequacy/Bartlett's Test of Sphericity to extract the factors which are easy to assess and suitable to the respondent data for factor analysis. In particular, the KMO index is recommended when the cases to variable ratio are more diminutive than 1:5. The KMO index value ranges between zeros to one, with 0.50 considered suitable for factor analysis. Bartlett's Test of Sphericity should be significant ($p < 0.05$) for the appropriate factor analysis. Then Descriptive analysis is used to compare the mean among the factors derived from factor analysis to achieve our second objective.

For the third objective of our study, we apply the independent-sample t-test to identify the difference between the selected demographic variable and the factors obtained. The proposed hypotheses for the demographic profile of surveyed respondents— Gender, Education status, Awareness of the term Covid-19 pandemic, Online class participation and Online teaching & learning applications, i.e. application used delineated below in **Table 1.**

Table 1. Hypothesis formulation.

H_{o1}:	There is no significant difference among genders and the factors retrieved from the first objective.
H_{A1}:	There is a significant difference among genders and the factors retrieved from the first objective.
H_{o2}:	There is no significant difference between education and the factors retrieved from the first objective.
H_{A2}:	There is a significant difference between education and the factors retrieved from the first objective.
H_{o3}:	There is no significant difference between awareness and the factors retrieved from the first objective.
H_{A3}:	There is a significant difference between awareness and the factors retrieved from the first objective.
H_{o4}:	There is no significant difference between participation and the factors retrieved from the first objective.
H_{A4}:	There is a significant difference between participation and the factors retrieved from the first objective.
H_{o5}:	There is no significant difference between the application used and the factors retrieved from the first objective.
H_{A5}:	There is a significant difference between the application used and the factors retrieved from the first objective.

In line with the prior studies (Khan, 2022; Khan et al., 2020, 2021; Khan and Khan, 2016), the logistic regression model used for the study to achieve the objective as below:

$$ln\left[\frac{\pi}{1-\pi}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5$$

where π; Probability of Pandemic and its impact education, α; intercepts, x_1, x_2, x_3, x_4, x_5, are independent variables that are likely to be the factor retrieved from first objectives β_1, β_2, β_3, β_4, β_5 are coefficients of regression.

3. Results and discussion

Table 2. Demographic profile.

Particulars		**Number**	**Percentage**
Gender	Male	194	50.26
	Female	192	49.74
Education	Primary	159	41.00
	Higher Education	227	59.00
Awareness about COVID 19	Yes	363	94.04
	No	23	5.96
Online Participation	Yes	332	86
	No	54	14
Application Used	Zoom	139	36.02
	Other Applications	247	63.98

The questionnaire sought to test respondents' understanding of numerous terms, such as the 'COVID-19 pandemic' and its implications for the education system's ability to adjust to the new normal: The Long-Term Impacts of COVID-19 on Education in India. Furthermore, the inquiry tried to ascertain whether respondents were taking online classes and, if so, their specific application. **Table 2** shows the demographic characteristics of the respondents. According to the data, there were 194 male and 192 female responses, indicating that the survey received roughly equal participation from both genders. Based on age groups, education can be divided into

two major areas. The primary group includes individuals aged 6 to 16, with a sample size of 159 respondents.

On the other hand, the higher category includes individuals over 16, with a sample size of 227 respondents. The proportion of primary education is 41 percent, while higher education accounts for 59 percent. Among the 386 participants surveyed, a significant majority of 94% demonstrated awareness of the term 'COVID-19 pandemic' and understood its implications for the school sector. Of the individuals surveyed, 86% engage in online class attendance, with 36% explicitly utilizing the Zoom program.

Table 3. KMO, Bartlett's tests and commonalities for each research variable.

KMO	0.720	
Bartlett's Test of Sphericity	1520.39	*P*-value
Df	105	0.000
Statements	Initial	Extraction
1. Will this Pandemic affect the education system?	1.00	0.756
2. Is Pandemic a threat to education?	1.00	0.707
3. To some extend Pandemic effect on education is positive	1.00	0.696
4. School authorities made children aware of this Pandemic	1.00	0.549
5. The school authorities are taking necessary steps in this situation	1.00	0.716
6. The schools are taking health measures on priority, providing every possible convenience	1.00	0.666
7. During Covid-19 gaining knowledge has become harder for students	1.00	0.583
8. Online teaching is a good alternative in the current scenario	1.00	0.599
10. Schools are using proper Online apps for teaching	1.00	0.680
11. Teachers are giving their best to teach students	1.00	0.573
13. Science teachers are facing difficulties in online teaching	1.00	0.572
14. Students face difficulty in learning from Mobile Phones	1.00	0.585
15. There is a network issue in the online study	1.00	0.565
16. Lockdown is a solution for controlling this Pandemic	1.00	0.751
18. The Pandemic will be eradicated by the next semester	1.00	0.635
Extraction Method: Principal Component Analysis.		

The surveyed questionnaire inquired about nineteen statements apart from the demographic questions, Covid-19 Pandemic and its impact on the education system. Out of these nineteen statements, four comments dropped due to their low values of commonalities, i.e. less than 50% as depicted in **Figure 1**.

The KMO (0.72) and Bartlett's tests at a significance level of 0.000 (sig 0.001 is rejecting) for crisis response in **Table 3** indicate that factor analysis is suitable for these statements. In all statements, the factor larger than 0.05 suggests that the statements can optimally explain variances of their related factors, and thus the questions are significant.

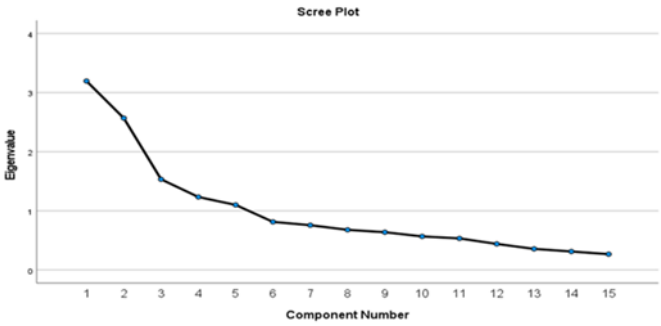

Figure 1. Scree plot.

Table 4 presents the total variance explained presently in exploratory factor analysis for the factors. Policies & Strategies on education during COVID-19 (factor 1) shows approximate 21.311% of the difference. For consideration of Consequences of COVID-19 on teachers, students, and teaching (factor 2), it is 17.127% of the variance, for Impact of COVID-19 on education (factor 3), it is 10.224% of the variance, for Education system responses to COVID-19 (factor 4), it is 8.230% of the difference, and for Possible solutions and implementation (factor 5), it represents the 7.335% of the variance, with the total cumulative per cent is 64.227%.

Table 4. Total variance explained.

Factor Title	% of variance	Cumulative %
Policies & Strategies on education during COVID-19	21.311	21.311
Consequences of COVID-19 on teachers, students, and teaching	17.127	38.438
Impact of COVID-19 on education	10.224	48.662
Education system responses to COVID-19	8.230	56.892
Possible solutions and Implementation	7.335	64.227

Table 5. Rotated component matrix.

Factor No.	Statements	Factor Loading	Factor Title	Cronbach's Alpha
1	5. The school authorities are taking necessary steps in this situation	0.844	Policies & Strategies on education during COVID-19	0.821
	6. The schools are taking health measures on priority, providing every possible convenience	0.789		
	10. Schools are using proper Online apps for teaching	0.786		
	11. Teachers are giving their best to teach students	0.736		
2	4. School authorities made children aware of this Pandemic	0.647	Consequences of COVID-19 on teachers, students, and teaching	0.647
	14. Students face difficulty in learning from Mobile Phones	0.745		
	15. There is a network issue in the online study	0.723		
	13. Science teachers are facing difficulties in online teaching	0.695		
3	1. Will this Pandemic affect the education system?	0.855	Impact of COVID-19 on education	0.733
	2. Is Pandemic a threat to education?	0.804		
	7. During COVID-19 gaining knowledge has become harder for students	0.545		
4	3. To some extend Pandemic effect on education is positive	0.828	Education system responses to COVID-19	0.489
	18. The Pandemic will be eradicated by the next semester	0.681		

Table 5. (*Continued*).

Factor No.	Statements	Factor Loading	Factor Title	Cronbach's Alpha
5	16. Lockdown is a solution for controlling this Pandemic	0.851	Possible solutions and Implementation	0.113
	8. Online teaching is a good alternative in the current scenario	0.405		

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser. Normalization.
a. Rotation converged in 7 iterations.

Table 5 provides the rotation component matrix, indicating that five elements can be retained. The potential names for these factors are also provided alongside the corresponding assertions. The initial component, consisting of five assertions, might be called 'Policies and Strategies on Education During the COVID-19 Pandemic. The second component, which consists of three statements, may be referred to as 'The Consequences of COVID-19 on Teachers, Students, and Teaching.' The third element, including three statements, can be called 'The Impact of COVID-19 on Education.' Lastly, the fourth factor, consisting of two statements, can be designated as 'Responses of the Education System to the COVID-19 Pandemic.' The final element, consisting of two statements, might be called possible solutions and implementation.

Table 6. Descriptive statistics.

Factor Title	N	Minimum	Maximum	Mean	Std. Deviation	Inference
Policies & Strategies on education during COVID-19	386	1	5	3.840	0.842	3
Consequences of COVID-19 on teachers, students, and teaching	386	1.33	5	4.150	0.813	1
Impact of COVID-19 on education	386	1	5	4.149	0.854	2
Education system responses to COVID-19	386	1	5	2.952	1.057	5
Possible solutions and Implementation	386	1	5	3.702	0.901	4

In order to assess the level of awareness among the components, it is necessary to compare the mean values of the elements as outlined in **Table 6**. The analysis reveals that the mean score value of factor 2, specifically about the consequences of COVID-19 on teachers, students, and teaching, exhibits the highest value among all factors. On the other hand, factor 4, namely the responses of the education system to the COVID-19 pandemic, exhibits the lowest mean value but the most significant standard deviation compared to the other factors.

This study aims to investigate the equivalence of variables derived from various factors, specifically the demographic profile. These factors include gender (male and female), education level (primary and higher education), awareness about COVID-19 (yes and no), online participation (yes and no), and usage of a specific application (yes and no). According to the findings of Levene's test, the variance is homogeneous across all factors except for factors two, three, and four. The process of estimating means is of great importance in understanding the implications of COVID-19 on teachers, students, and teaching, as well as the effects of COVID-19 on education and the responses of the education system to this crisis. These findings are presented in **Table 7**, which reveals a notable divergence in opinions between females and males,

with females expressing disagreement and males agreeing. Therefore, it is acknowledged that the initial alternative hypothesis is true for factors 2, 3, and 4.

Table 7. Group statistics on gender and levene's test for equality of variance.

Gender		N	Mean	Std. Deviation	Std. Error Mean	F	Sig.	t	df	Sig. (2-tailed)
Factor 1	Female	191	0.079	0.974	0.070	0.390	0.533	1.533	384	0.126
	Male	195	–0.077	1.022	0.073			1.534	383.705	0.126
Factor 2	Female	191	0.040	1.081	0.078	4.497	0.035	0.787	384	0.432
	Male	195	–0.040	0.914	0.065			0.785	371.07	0.433
Factor 3	Female	191	–0.172	1.168	0.085	10.659	0.001	–3.399	384	0.001
	Male	195	0.169	0.768	0.055			–3.385	327.549	0.001
Factor 4	Female	191	–0.049	0.946	0.068	4.320	0.038	–0.954	384	0.341
	Male	195	0.048	1.051	0.075			–0.955	381.296	0.340
Factor 5	Female	191	0.080	0.946	0.068	1.591	0.208	1.562	384	0.119
	Male	195	–0.079	1.046	0.075			1.564	381.603	0.119

Levene's test on education reveals the presence of equal variance among the factors explained except factor three, suggesting that the Primary and Higher education variance is not the same. Primary education includes ages between 6–16 years, and higher education comprises 16 years onwards. Mean estimation for factor three, i.e., Impact of COVID-19 on education is significant and reveals that mean values for primary education are in the disagreement zone, and higher education is in the agreement zone for these factors as delineated in **Table 8**. Hence the second alternative hypothesis is valid for factor 3, and it is accepted.

Table 8. Group statistics on education and Levene's test for equality of variance.

Education		N	Mean	Std. Deviation	Std. Error Mean	F	Sig.	t	df	Sig. (2–tailed)
Factor 1	PRIMARY	158	0.072	1.052	0.084	0.796	0.373	1.171	384	0.243
	HIGHER	228	–0.05	0.961	0.064			1.152	317.627	0.250
Factor 2	PRIMARY	158	0.039	0.947	0.075	1.93	0.165	0.638	384	0.524
	HIGHER	228	–0.03	1.036	0.069			0.649	356.121	0.517
Factor 3	PRIMARY	158	–0.02	1.200	0.095	5.94	0.015	–0.33	384	0.741
	HIGHER	228	0.014	0.836	0.055			–0.31	260.07	0.756
Factor 4	PRIMARY	158	–0.14	1.007	0.080	0.53	0.466	–2.36	384	0.019
	HIGHER	228	0.099	0.985	0.065			–2.39	333.07	0.019
Factor 5	PRIMARY	158	–0.13	0.972	0.077	0.54	0.463	–2.05	384	0.041
	HIGHER	228	0.086	1.012	0.067			–2.06	346.336	0.040

Levene's test for the awareness of the COVID-19 reveals the same variance among the factors, except for factors one and three, where awareness represents knowledge about the term Pandemic. Mean estimation for factors one and three, i.e., Policies & Strategies on education during COVID-19 and Impact of COVID-19 on education, reveals a significant mean difference suggesting that about 361 respondents agreed that they are aware of the term Pandemic. Only 25 respondents are not aware

of the Pandemic, as depicted in **Table 9**. Hence, we accept the third alternate hypothesis for factors 1 and 3.

Table 9. Group statistics on awareness and Levene's test for equality of variance.

Awareness		N	Mean	Std. Deviation	Std. Error Mean	F	Sig.	t	df	Sig. (2-tailed)
Factor 1	YES	361	0.025	0.972	0.051	8.662	0.003	1.844	384	0.066
	NO	25	–0.355	1.313	0.263		-	1.421	25.855	0.167
Factor 2	YES	361	0.021	0.989	0.052	1.153	0.284	1.551	384	0.122
	NO	25	–0.299	1.133	0.227			1.377	26.593	0.180
Factor 3	YES	361	0.072	0.855	0.045	65.520	0.000	5.590	384	0.000
	NO	25	–1.041	1.968	0.394	-	-	2.809	24.631	0.010
Factor 4	YES	361	–0.021	1.009	0.053	1.216	0.271	–1.603	384	0.110
	NO	25	0.309	0.816	0.163			–1.929	29.335	0.063
Factor 5	YES	361	–0.006	1.001	0.053	0.087	0.768	–0.453	384	0.651
	NO	25	0.088	0.995	0.199	-	-	–0.455	27.475	0.652

Levene's test for the dependent variable 'Online participation in classes' depicts the same variance for all the factors. The mean value for all factors is insignificant and suggests that 333 respondents agreed. In comparison, 53 respondents disagreed with the above-said factor shown in **Table 10**. Therefore, all the null hypotheses are accepted for every factor, reflecting no significant difference among the participants.

Table 10. Group statistics on participation and Levene's test for equality of variance.

Online participation		N	Mean	Std. Deviation	Std. Error Mean	F	Sig.	t	df	Sig. (2–tailed)
Factor 1	YES	333	0.088	0.97	0.053	1.15	0.29	4.4	384	0.00
	NO	53	–0.551	1.01	0.139			4.3	68.2	0.00
Factor 2	YES	333	0.002	1.02	0.056	2.75	0.1	0.1	384	0.93
	NO	53	–0.011	0.86	0.118			0.1	77.2	0.92
Factor 3	YES	333	0.033	1.0	0.055	0.19	0.66	1.7	384	0.10
	NO	53	–0.209	0.98	0.135		-	1.7	70.3	0.10
Factor 4	YES	333	–0.029	1.0	0.055	0.03	0.86	–1.4	384	0.15
	NO	53	0.183	0.98	0.134		-	–1.5	70.7	0.15
Factor 5	YES	333	–0.021	1.0	0.055	0.00	0.997	–1.1	384	0.30
	NO	53	0.133	0.98	0.135			–1.1	70.3	0.29

Levene's test depicts the same variance for all the factors except for factors one and five, i.e., Policies & Strategies on education during COVID-19 and possible solutions and implementation. The mean value for all the factors is not significant, as shown in **Table 11**. Hence, we accept the fifth alternate hypothesis for the factor 1 and 5, reflecting no significant difference among the application used.

Table 11. Group statistics on app used and Levene's test for equality of variance.

Application used		N	Mean	Std. Deviation	Std. Error Mean	F	Sig.	t	df	Sig. (2-tailed)
Factor 1	ZOOM	140	0.068	0.927	0.078	6.278	0.013	0.93	383	0.351
	OTHERS	245	–0.031	1.035	0.066			0.96	316.17	0.337
Factor 2	ZOOM	140	–0.042	1.021	0.086	0.219	0.640	–0.59	383	0.556
	OTHERS	245	0.021	0.990	0.063			–0.584	282.09	0.560
Factor 3	ZOOM	140	–0.012	0.902	0.076	0.213	0.645	–0.187	383	0.852
	OTHERS	245	0.008	1.056	0.067			–0.195	327.55	0.846
Factor 4	ZOOM	140	–0.093	0.937	0.079	2.069	0.151	–1.368	383	0.172
	OTHERS	245	0.052	1.034	0.066			–1.405	313.3	0.161
Factor 5	ZOOM	140	0.071	0.931	0.079	4.25	0.040	1.076	383	0.283
	OTHERS	245	–0.043	1.038	0.066			1.108	315.8	0.269

Based on the variables used in this study, the regression equation is given as follows:

$$ln\left[\frac{\pi}{1-\pi}\right] = \alpha + \beta_1 fac_1 + \beta_2 fac_2 + \beta_3 fac_3 + \beta_4 fac_4 + \beta_5 fac_5$$

where $fac_{1;}$ represents Policies & Strategies on education during COVID-19, $fac_{2;}$ represents how the Pandemic affects teachers, students, and teaching, $fac_{3;}$ represents Impact of COVID-19 on education, $fac_{4;}$ represents Education system responses to COVID-19, and $fac_{5;}$ represents Possible solutions and implementation.

A logistic regression analysis was performed to examine the impact of demographic and knowledge factors on actions implemented to manage a pandemic in a professional setting. The regression analysis is in line with earlier studies conducted by Faisal (2022) and Faisal and Naushad (2021). The study included a sample of 386 respondents. The metrics for controlling a pandemic in a professional context include the coefficient estimate findings, standard errors, Wald statistics, significance levels, and odds ratio for the parameters of the logistic regression model, as depicted in **Table 12**. The statistical analysis showed that the entire model test compared a significant outcome to a constant-only model. This showed that, when looked at as a whole, the predictors could tell the difference between people of different genders. The chi-square value was 18.256, with a *p*-value of less than 0.003 and degrees of freedom equal to 5. The value of Nagelkerke's R2, which was found to be 0.62, suggests a statistically significant association between the prediction and grouping variables. The Cox and Snell R2 values are determined to be 0.046, while the two log-likelihoods are calculated to be 516.802. The overall accuracy rate for predictions was 57.5%, with a success rate of 60% for males and 55% for females.

The statistical significance of a comparable test conducted on the whole model, as compared to a constant model, suggests that the predictors collectively showed a reliable ability to differentiate across levels of education (Chi-Square = 11.775, $p <$ 0.038 with df = 5). The Nagelkerke's R2 value of 0.41 suggests a limited strength of association between prediction and grouping. The coefficient of determination, as measured by Cox and Snell R2, is 0.030. Additionally, the log-likelihood value is calculated to be 510.570. The overall accuracy rate for predictions was 63.5%, with a

success rate of 24.7% for primary-level predictions and 90.4% for higher-level predictions.

The statistical analysis revealed that the test comparing the complete model to a constant model yielded a significant result (Chi-Square = 32.542, $p < 0.00$ with df = 5). This suggests that the predictors in the model reliably differentiate between individuals who are aware of the term 'pandemic' and those who are not. The Nagelkerke's R2 value of 0.212 suggests a limited association between prediction and grouping. The coefficient of determination, as measured by Cox and Snell R2, is 0.081, whereas the log-likelihood value is 152.650. The overall accuracy rate for predictions was 93.5%, with a success rate of 99.7% for optimistic predictions and 4.0% for pessimistic predictions.

When comparing the predictors, there was a statistically significant difference between the complete model and a constant model. This means that the predictors consistently told the difference between people who take online classes (Chi-Square = 22.996, $p < 0.00$ with df = 5). The Nagelkerke's R2 value of 0.105 suggests a limited association between prediction and grouping, indicating a poor relationship. The coefficient of determination, as measured by Cox and Snell R2, is found to be 0.058. Additionally, the log-likelihood value is calculated to be 285.837. The overall accuracy rate for predictions was 85.2%, with a success rate of 98.8% for positive outcomes and 0% for adverse outcomes.

The statistical analysis revealed that the test comparing the full model to a constant model yielded significant results (Chi-Square = 4.352, $p < 0.00$ df =5). This indicates that the predictors, taken as a whole, consistently differentiated between the two applications regarding their suitability for online instruction. The Nagelkerke's R2 value of 0.015 suggests a limited association between the prediction and grouping variables, indicating a weak relationship. The coefficient of determination, as measured by Cox and Snell R2, is 0.011. Additionally, the two log-likelihood values are calculated to be 500.369. The overall accuracy rate for prediction was 63.4%, with a 0.00% accuracy rate for Zoom and a 99.6% accuracy rate for the other platforms.

Table 12. Binary logistic Regression outcomes.

Endogenous	Exogenous variable	B	S.E.	Wald	df	Sig.	Exp(B)
Gender	Factor1	–0.17	0.11	2.53	1.00	0.11	0.85
	Factor 2	–0.08	0.10	0.64	1.00	0.42	0.92
	Factor 3	0.38	0.11	10.72	1.00	0.00	1.46
	Factor 4	0.10	0.10	0.96	1.00	0.33	1.11
	Factor 5	–0.16	0.11	2.40	1.00	0.12	0.85
	Constant	0.02	0.10	0.03	1.00	0.87	1.02
Education	Factor 1	–0.13	0.11	1.42	1.00	0.23	0.88
	Factor 2	–0.07	0.11	0.43	1.00	0.51	0.93
	Factor 3	0.04	0.10	0.12	1.00	0.73	1.04
	Factor 4	0.25	0.11	5.54	1.00	0.02	1.29
	Factor 5	0.22	0.11	4.22	1.00	0.04	1.24
	Constant	0.38	0.11	12.92	1.00	0.00	1.46

Table 12. (*Continued*).

Endogenous	Exogenous variable	B	S.E.	Wald	df	Sig.	Exp(B)
Awareness	Factor 1	–0.38	0.19	4.12	1.00	0.04	0.68
	Factor 2	–0.29	0.20	2.23	1.00	0.13	0.75
	Factor 3	–0.87	0.17	24.55	1.00	0.00	0.42
	Factor 4	0.58	0.26	5.09	1.00	0.02	1.78
	Factor 5	0.19	0.24	0.62	1.00	0.43	1.21
	Constant	–3.24	0.30	115.00	1.00	0.00	0.04
Participation online class	Factor 1	–0.57	0.14	16.93	1.00	0.00	0.57
	Factor 2	–0.01	0.15	0.00	1.00	0.95	0.99
	Factor 3	–0.26	0.14	3.16	1.00	0.08	0.77
	Factor 4	0.24	0.16	2.30	1.00	0.13	1.27
	Factor 5	0.17	0.16	1.14	1.00	0.29	1.19
	Constant	–2.00	0.17	143.82	1.00	0.00	0.14
Application used	Factor 1	–0.10	0.11	0.89	1.00	0.35	0.90
	Factor 2	0.06	0.11	0.37	1.00	0.54	1.07
	Factor 3	0.02	0.11	0.04	1.00	0.85	1.02
	Factor 4	0.15	0.11	1.91	1.00	0.17	1.16
	Factor 5	–0.12	0.11	1.17	1.00	0.28	0.89
	Constant	0.57	0.11	28.22	1.00	0.00	1.76

4. Conclusion

The global onset of the COVID-19 pandemic triggered unprecedented challenges across various sectors, with the educational landscape undergoing a profound paradigm shift. In the Indian context, the repercussions have been particularly significant, prompting a re-evaluation of traditional learning models and necessitating adaptive measures. This study delves into the enduring impact of COVID-19 on education in India, exploring the long-term ramifications that have reshaped the way students, educators, and institutions approach learning is well aligned with earlier studies conducted by Pujari (2020) and Rawal (2021). From the accelerated adoption of digital technologies to the transformation of pedagogical approaches, the educational sector in India has witnessed a dynamic evolution. This study aims to unravel the complexities of this transformative journey, shedding light on the challenges faced, the innovations spurred, and the lasting changes that will continue to shape the future of education in the country.

This research suggests that the unique difficulties posed by the global pandemic have produced a novel and robust educational panorama in line with earlier research conducted by Tilak and Kumar (2022). The literature review has laid solid groundwork, exhibiting the range and depth of research on the revolutionary changes in the educational landscape. By collecting and evaluating data using a structured questionnaire created to cover the impact of a pandemic, this study hopes to give valuable insights into the long-term consequences of education in India as we navigate the undiscovered frontiers of post-pandemic education. Factor analysis and binary logistic regression were used to evaluate the data from 386 respondents. The results

show that, of the five criteria considered, only factor three has a gendered value of 1.46, suggesting that men have a slight edge. It is significant at the 1% level of statistical analysis. Higher education has an advantage of 1.29 over primary education. At the same time, factors four and five are significant at the 5% level in terms of education level (where 1.29 and 1.24 are the odd values of their respective factors). Higher education has a 1.24-to-1 advantage over primary school on elements four and five. At the 5% level of significance, factors 1, 3, and 4 have an odd value of 0.68, 0.42, and 1.78 in favour of individuals who are familiar with the phrase pandemic compared to those who are not. One factor has a statistically significant advantage of 0.57 points over non-participants in online programs. Finally, the logistic regression findings on the application's users must be more conclusive.

Therefore, it aims to inform policy decisions, guide educational practices, and inspire future study by identifying adaptive techniques, problems faced, and lessons learned. The process of adjusting to the new normal is continuing, and the results of this study are meant to be a helpful tool in designing a more robust, egalitarian, and innovative educational system in India and beyond.

5. Policies suggestion

Presented below is a preliminary collection of policies that warrant consideration:

Invest in improving digital infrastructure, including widespread internet access and the availability of digital devices, to bridge the digital divide among students across urban and rural areas.

Collaborate with private stakeholders to provide affordable and accessible technology solutions for remote learning.

Implement extensive training programs for educators to enhance their proficiency in online teaching methods, digital tools, and virtual classroom management.

Develop a flexible curriculum that seamlessly transitions between in-person and online learning modes.

Integrate mental health education into the curriculum and provide resources for students and educators to address the psychological impact of the pandemic.

Introduce financial aid and scholarship programs to assist families facing economic hardships, ensuring that financial constraints do not hinder access to education.

Collaborate with non-governmental organizations and corporate partners to create scholarship opportunities and support systems for vulnerable student populations.

Encourage the development and adoption of innovative learning platforms and educational technologies to enhance the quality of online education.

Foster partnerships between educational institutions and technology companies to create engaging and interactive digital learning resources.

Implement targeted interventions and remedial programs to address learning gaps that may have emerged due to the disruptions caused by the pandemic.

The aforementioned provisional policies are designed to tackle the current obstacles and establish a more robust and equitable educational framework in India.

This framework should be able to effectively navigate uncertainties while placing the utmost importance on all students' welfare and educational requirements.

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