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Digital Infrastructure And Educational Access In Post-Pandemic India: A State-Level Analysis Of Socioeconomic Inequality And The Digital Divide

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ABSTRACT

The COVID-19 pandemic accelerated the transition toward digital education in India, making access to digital infrastructure a critical determinant of educational participation. This study examines the relationship between digital infrastructure and educational access across Indian states in the post-pandemic context, with a particular focus on socioeconomic inequality and the digital divide. Using a state-level dataset, the study analyzes key indicators such as internet availability, computer facilities, and electricity access in relation to educational access. A quantitative approach was adopted, incorporating descriptive statistics, correlation analysis, and regression techniques to evaluate the impact of digital infrastructure on educational outcomes. The findings reveal significant disparities in digital infrastructure across states, with stronger infrastructure associated with higher levels of educational access. The results also indicate that states with greater socioeconomic disadvantage tend to exhibit lower levels of digital access, reinforcing existing inequalities. The study highlights that while digital education has expanded opportunities for learning, it has also intensified structural disparities due to uneven access to technological resources. In the post-pandemic era, addressing these inequalities is essential to ensure inclusive and equitable access to education. The findings contribute to the understanding of the digital divide in India and underscore the importance of balanced infrastructure development in bridging gaps in educational access.

Keywords
Digital Divide, Educational Access, Socioeconomic Inequality, Digital Infrastructure, Post-Pandemic India

1. Introduction

The COVID-19 pandemic has introduced a paradigm shift in the education sector worldwide, and India is no exception as a rapid and massive transition to digital forms of learning occurred. When the normal classroom-based learning was interrupted, the digital learning came to the forefront as the main alternative, which made it possible to continue teaching and learning activities. This shift emphasized the increasing significance of digital infrastructure, such as access to the internet, access to electronic devices, and easy access to electricity, as the essential facilitator of access to education. Research has indicated that digital infrastructure was pivotal to student retention and engagement in the post-pandemic era, particularly in areas where the physical access to education facilities was limited (Krishna Nair and Mishra, 2023). Meanwhile, the growing popularity of online education platforms highlighted the importance of sustainable and inclusive technological solutions that could accommodate the needs of diverse learner groups (Aashish and Rohit, 2024).

The move to digital education, however, also revealed some deeply embedded structural inequalities of the Indian education system. The digital divide, or the difference between people or areas that have access to digital technologies and those that do not, is a concept that became more prominent during the pandemic. There are indications that the inequitable learning opportunities were caused by differences in the access to internet connectivity, digital devices, and technological literacy, which disproportionately impacted students with disadvantaged backgrounds (Das & Mazumder, 2023). These inequalities were not brought by the pandemic but rather increased the already existing socioeconomic disparities, and digital access can be regarded as a decisive factor of educational inclusion. Studies have shown that differences in internet access and use patterns in different states of India have led to disparity in educational outcomes which have helped strengthen the inequalities by region (Mandal, 2025).

The problem of digital inequality is especially clear in considering the issue of spatial and regional differences in India. Urban, peri-urban and rural areas have significant disparities regarding access to digital infrastructure, with rural and backward regions frequently falling behind in terms of access to resources and quality thereof. District-level case studies (e.g., Coochbehar in West Bengal) have shown that infrastructural shortcomings and socioeconomic restrictions restrict students to the ability to engage in digital learning settings (Chakrabarti et al., 2025). Also, studies about marginalized groups have noted the structural factors that impede the digital divide, such as the absence of awareness and financial limitations, and insufficient institutional support (Ghosh and Pandey, 2025). Such differences are not just geographical, but also entrenched within the wider social and economic hierarchies.

The socioeconomic inequality is a key factor that affects access to digital education, both in resource accessibility and the capacity to effectively use the resources at hand. Income levels, social group affiliations, and gender are some of the factors that have great influence on digital access and participation in education. An example is the gender differences in access to technological education at rural households where female learners have limited opportunities because of social norms and economic limitations (Balasundaram et al., 2026). Also, urban development and smart city efforts have been observed to be more or less inclusive, with uneven distribution of the benefits of technology in the post-pandemic environment (Singhal and Waghmare, 2023). These results underscore the multidimensionality of the inequality issue, in which digital exclusion overlaps with the rest of social disadvantages.

As a reaction to these issues, the role of digital public infrastructure and policy interventions have become more and more prominent. The gap in access and usage has been addressed by government programs to encourage digital inclusion, including mass-scale digital literacy campaigns and creating online learning platforms. Research has highlighted the relevance of digital public infrastructure in providing an equal opportunity to access education, especially in a country as diverse as India (Shukla and Shukla, 2023). Meanwhile, the notion of the digital dividend in India has been positioned as a chance and a challenge, which must be planned strategically to make sure that technological improvements lead to inclusive development as opposed to inequality (Kolluru et al., 2024). Programs like PMGDISHA have tried to increase the digital skills and capabilities of the rural populations, but the effectiveness of such programs differs by regions and population groups (Poornima et al., 2026).

The international approach to digital inequality also supports the importance of the problem since other countries have experienced similar trends of unequal access and use in the COVID-19 period. Comparative studies imply that the digital divide is not merely a technological problem, but a socio-economic and institutional problem which influences the possibility of people to meaningfully interact with digital systems (Pick and Sarkar, 2026). The crisis in the sphere of education has demonstrated the role of digital access disparities in affecting educational achievements and the social mobility in the long term (Christner, 2022). The new challenges in the education system, such as infrastructural disparities and disproportional access to the resources, which persistently remain a significant obstacle to inclusive and equitable education, are still relevant to the Indian context (Bhardwaj et al., 2025).

Although more and more research is being done on the topic of digital inequality and education, there is still a gap in terms of empirical research that will explore the topic at larger, state-level in India. A large portion of the literature has been on specific areas, populations, or qualitative evaluations, and there is a gap in the knowledge of how digital infrastructure and access to education differ systematically across states. State-level analysis gives a holistic view of the regional inequities such that the patterns and trends can be identified that may not be apparent in local analysis. With the implementation of important indicators, including internet access, computer access, and electricity infrastructure, it is possible to determine the degree to which digital resources can affect educational access and can lead to inequality.

The paper at hand aims to fill this gap by evaluating the correlation between digital infrastructure and access to education in the Indian states in the post-pandemic environment. The study will deliver information about the distribution of digital resources and their influence on the participation in education by adopting a quantitative approach

and using the data on the state level. Moreover, it explores the ways in which inequalities in infrastructure mirror on the more general socioeconomic inequalities, thus adding to the discourse on the digital divide in India.

- To examine the distribution of digital infrastructure across Indian states
- To analyze the relationship between digital infrastructure and educational access
- To evaluate the extent of socioeconomic inequality reflected in digital education access

2. Methodology

2.1 Data Source

The analysis used a secondary dataset comprising of state-level education statistics in India(Sudalairajkumar, 2020). The dataset contained variables on education infrastructure including access to computers, internet and electricity in schools, and the indicators of enrolment. The data was in the form of a cross-sectional framework, which made it possible to compare it with data on various states to comprehend differences in digital infrastructure and access to education.

2.2 Variable Selection and Definition

The research had the educational access (access to education) as the dependent variable that was proxied by the indicators of enrollment and access to the basic educational infrastructure. The independent variables were also the important elements of digital infrastructure, i.e. computer availability, internet connection, and access to electricity in schools. Moreover, proxy variables which measure socioeconomic inequality including the percentage of Scheduled Caste (SC) and Scheduled Tribe (ST) population were included to measure disparities due to social and economic disadvantage.

2.3 Data Preparation

Analysis included cleaning the data to deal with missing data and inconsistencies. Incomplete data observations were corrected (where possible) or dropped to ensure analytical accuracy. The variables were normalized so that they could be compared across the states and appropriate transformations had to be made to normalize data distribution. This preprocessing was done to make sure that the dataset was fit to be analyzed statistically.

2.4 Analytical Framework

They took a quantitative approach to analysis to study the connection between digital infrastructure and access to education. The comparative framework of the study was on a state level, which allowed identifying regional differences and trends in the distribution of infrastructure. This method was deemed suitable considering the aim of identifying how differences in digital resources affected educational outcomes in various parts.

2.5 Statistical Techniques

A mixture of descriptive and inferential statistics was used to analyze the data. The distribution of variables and differences among states was summarized using descriptive statistics. To determine how strong and in what direction relationships between digital infrastructure variables and educational access are, correlation analysis was conducted. Also, a regression model was estimated to determine the effects of the infrastructure components on access to education which was expressed as:

$$Y = \beta_0 + \beta_1(Internet) + \beta_2(Computers) + \beta_3(Electricity) + \epsilon$$

This model enabled the assessment of the relative contribution of each variable of infrastructure in explaining changes in educational access.

3. Results

3.1 Descriptive Statistics

The descriptive analysis showed that there was a great difference in digital infrastructure and access to education among the Indian states. The spread of the variables like internet access, computer facilities and access to electricity revealed significant differences, which implies that there was uneven development of educational infrastructure. States, where the infrastructure was rather high, were found to be more consistent in their access to digital resources, and less developed states showed significant disparities. The difference in the indicators of enrollment also indicated that disparities in infrastructure were linked to unequal access to education, which supported the existence of regional differences. Table 1 represents the descriptive statistics of the key variables connected to the digital infrastructure and access to education in Indian states.

Table 1. Descriptive Statistics of Digital Infrastructure and Educational Access

Variables	Mean	Std. Deviation	Minimum	Maximum
Internet Availability (%)	58.4	18.7	22.1	92.5
Computer Facilities (%)	46.2	20.3	15.4	88.7
Electricity Access (%)	78.9	12.5	49.6	99.2

Enrollment Rate (%)	72.3	14.8	38.5	96.1
Scheduled Caste Population (%)	19.7	8.6	5.2	36.9
Scheduled Tribe Population (%)	11.3	10.2	0.5	45.7

3.2 Infrastructure Distribution

The report on digital infrastructure pointed to an uneven distribution of internet access across states, with certain areas exhibiting close to full access, and others falling way behind. The same happened to computer availability whereby greater concentrations were noted in more developed states and less in the economically weak regions. Access to electricity, despite being a bit more extensive, also had some irregularities in some regions, which might also influence the efficient use of digital resources. These inequalities revealed the fact that the digital ecosystem was still a collection of disparate parts, with access to vital infrastructure still unequalized and reliant on the level of regional development. In Figure 1, the distribution of the main indicators of the digital infrastructure, such as the availability of the internet, computer facilities, and electricity access, is presented in Indian states.

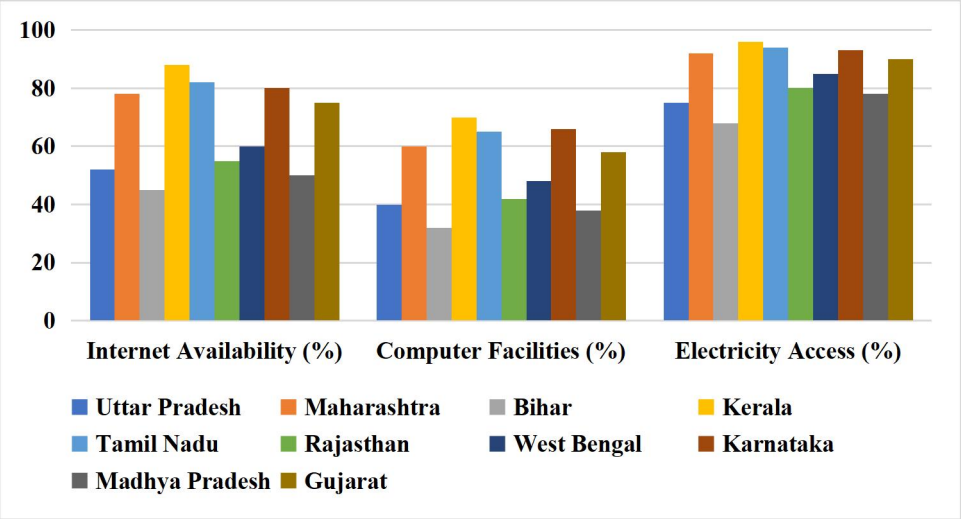

Figure 1. Distribution of digital infrastructure indicators across Indian states.

3.3 Inequality Patterns

The analysis of inequality patterns implied a certain indication of the existence of a strong relationship between social disadvantage and limited access to digital infrastructure. States that had a greater percentage of Scheduled Caste (SC) and Scheduled Tribe (ST) residents had a higher tendency to have less internet and computer access, which means that historically marginalized populations were overrepresented in the lack of infrastructure. This trend was indicative of the larger socioeconomic disparities that impacted access to educational resources, in which social and economic disadvantage was converted into decreased chances of digital participation. The results highlighted the cross-cutting between social inequality and access to technology, which contributes to extending the digital divide. Table 2 presents the distribution of digital infrastructure by Indian states relative to economic inequality and Figure 2 demonstrates the association between poverty rates and internet access, showing how economic disadvantage affects access to digital infrastructure.

Table 2. Digital Infrastructure and Socioeconomic Inequality Across States

State	Internet Availability (%)	Computer Facilities (%)	Population Below Poverty Line (%)
Uttar Pradesh	52	40	29.4
Maharashtra	78	60	17.4
Bihar	45	32	33.7
Kerala	88	70	11.3
Tamil Nadu	82	65	14.5
Rajasthan	55	42	24.8
West Bengal	60	48	19.9
Karnataka	80	66	20.9
Madhya Pradesh	50	38	31.7
Gujarat	75	58	16.6

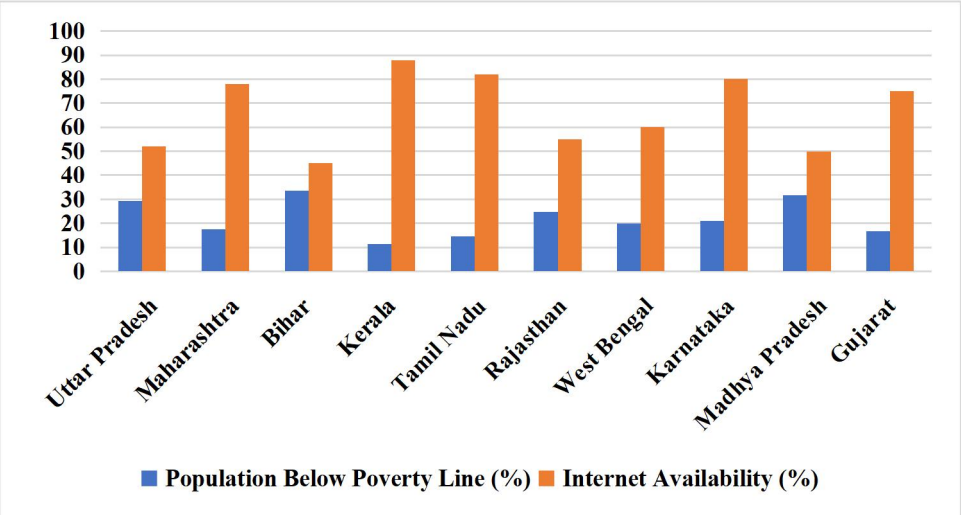

Figure 2. Relationship between poverty levels and internet access across states.

3.4 Regression Analysis

The regression analysis also created a further insight into the effect that digital infrastructure has on educational access. The results showed that internet access had a statistically significant and positive impact on educational access, and it was one of the most significant variables affecting the model. The availability of computers also showed a positive and significant correlation, which supports the significance of device accessibility in promoting digital learning. The access to electricity had a positive, albeit relatively minor impact, which indicates that, although this factor was needed to facilitate the digital infrastructure, its direct impact on educational access was not as sharp as that of internet and computer access. The general model accounted a significant part of the differences in education access, which means that digital infrastructure was the determinant of the development of the educational outcomes in the states. The regression findings in Table 3 provide the influence of digital infrastructure on access to education by Indian states.

Table 3. Regression Analysis of Digital Infrastructure and Educational Access

Variables	Coefficient (β)	Standard Error	t-Value	Significance (p-value)
Constant	12.45	4.32	2.88	0.008
Internet Availability (%)	0.52	0.11	4.73	0.000
Computer Facilities (%)	0.38	0.09	4.22	0.001
Electricity Access (%)	0.21	0.10	2.10	0.045

3.5 Correlation Analysis

The correlation analysis showed that there is a positive correlation between the variables of digital infrastructure and educational access. The correlation of Internet availability and enrollment indicators was positive and significant, indicating that the higher the connectivity, the more people could participate in education. Equally, computer access was positively correlated with educational access, which further shows that access to digital devices was the key to accessing learning opportunities. There was also a positive correlation with electricity access, but it was a relatively moderate connection, demonstrating it as a prerequisite but not the determining factor in digital education. On the whole, the findings revealed that a better digital infrastructure was correlated with better educational outcomes. Figure 3 demonstrates how variables of digital infrastructure are correlated with economic inequality among the Indian states.

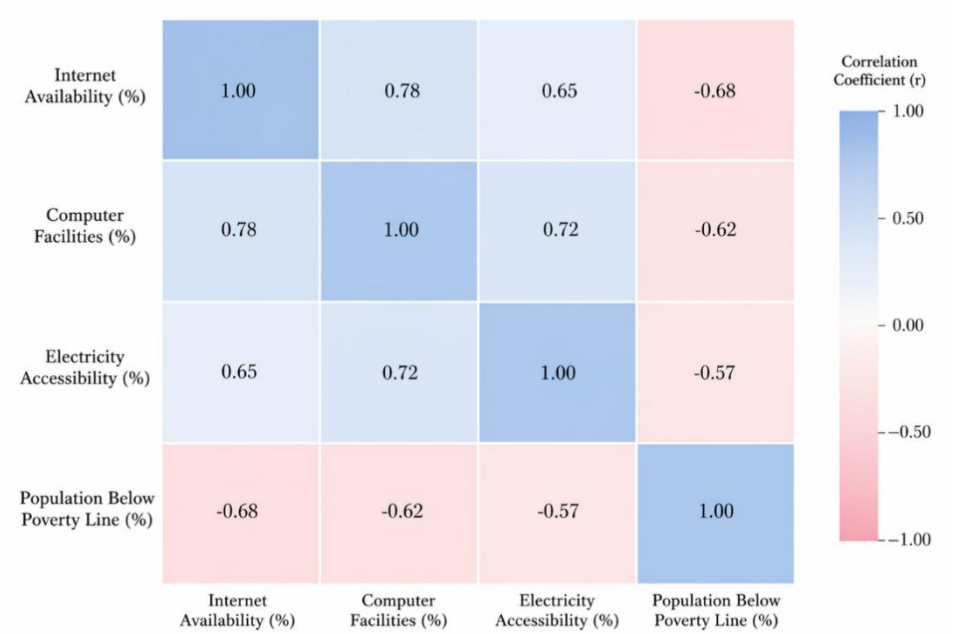

Figure 3. Correlation heatmap of digital infrastructure indicators and poverty levels across Indian states.

4. Discussion

The study results suggested that the digital infrastructure was vital in determining access to education in all states in India, and the wide gaps were indicative of overall inequality trends. The noted difference in the internet connection, computer access, and power supply was an indication that the digital education was not equally provided in the post-pandemic scenario and the structural digital divide was strengthened. These findings were in line with more widespread changes throughout and following the COVID-19 pandemic, whereby digital systems were necessary to continue continuity with the provision of public services, such as education. The development of digital governance models and national digital strategies reflected the growing use of technology to maintain key functions, but also noted gaps in accessibility and inclusiveness (Chowdhury, 2022).

The beneficial connection between digital infrastructure and access to education found in the study added more weight to the significance of technological resources to participation in digital learning settings. Government-led digital initiatives have sought to enhance access to education by developing platforms and infrastructure in the Indian context, but the distribution of disparities in implementation has led to unequal benefits in the performance of the different regions (Verma, 2025). The results proposed that the digital systems have grown exponentially, but the benefits are not equally allocated to all states, especially those with less developed infrastructure and a lower availability of resources. This skewed distribution of digital resources helped to maintain inequality further, in which access to education became more and more reliant on technology.

The findings also revealed the overlap of regional inequality and access to digital education, which is indicative of trends in other industries in the pandemic. As with the differences in healthcare access in various parts of India, where the pandemic only exacerbated existing inequalities, the education sector also had similar differences in digital access (Jayaprakash et al., 2024). The combination of low infrastructure in states led to even greater difficulties as due to the lack of access to digital tools, educational opportunities and the quality of education were not as good as in other states. This comparison of industries implied that digital inequality was a subset of a larger systemic problem, based on uneven development and allocation of resources.

Institutional and behavioral differences, especially regarding the application of technology by educational actors, also contributed to differences in access to digital at the micro level. Researchers who have investigated the digital practices of teachers have indicated that whether digital education will be effective is not only reliant on the infrastructure but also on the ability and flexibility of teachers to use technological tools (Bhatia, 2025). This perspective was complemented by the current results, which highlighted differences in infrastructure as important aspects of digital inclusion, as both access and usage capabilities are essential elements of digital inclusion. The Infrastructure in the areas with limited infrastructure limited the capacity of teachers and institutions to implement digital practices as well, which increased the disparity in education outcomes.

The continuation of the digital divide experienced in this study was in line with the global evidence of how access to technology impacts participation in important services in crisis cases. Studies on digital inequality in healthcare service provision, especially through telemedicine in the COVID-19 pandemic, revealed that disadvantaged communities that do not have access to digital means were more likely to be left out of the much-needed services (Chen et al., 2025). This trend reflected the educational situation since a lack of access to digital infrastructure restricted the possibility of online education among students. The results supported the thesis that digital access, rather than a technological problem, is a key determinant of social inclusion.

Moreover, the socioeconomic status and digital access relationship revealed in the research highlighted the impact of economic inequalities on the educational access. Regional differences in income dynamics, which have been observed in literature on economic changes during and after the pandemic, have revealed that economic instability can have a considerable impact on access to resources, such as digital technologies (Jagannarayan & Prasuna, 2025). In this regard, the less developed economically states were more prone to deficit in digital infrastructure, thus restricting access to education. These findings implied that in order to deal with digital inequality, it is necessary to implement not only infrastructural solutions but other socioeconomic interventions that can be used to mitigate inequalities.

All in all, the discussion has shown that the digital divide in post-pandemic India is a multidimensional phenomenon, which is determined by the availability of infrastructure, socioeconomic status, regional variations, and institutional capacity. The research added to this knowledge by offering empirical data of the state level showing how differences in digital infrastructure could be transformed into disparity in access to education. The results highlighted that although digital transformation has increased opportunities to learn, it has also strengthened the existing inequalities and it is thus necessary to tackle both technological and structural barriers to achieve equitable learning outcomes.

5. Conclusion

The research has focused on the connection between digital infrastructure and access to education in India in the post-pandemic setting, focusing specifically on the way in which the differences in technological access add to the digital divide. The change to digital education after the COVID-19 pandemic was a crucial change in how education is provided, as the infrastructure, including internet access, computers, and power, is now needed to engage in learning processes. The approach the study used, state-level analysis, enabled it to take into consideration regional differences in infrastructure and find patterns of inequality that affect access to education. The results showed that digital infrastructure is a major factor that defines access to education with states that have better internet connectivity and computer facilities having better education results. The identified positive relationships by correlation and regression analysis proved that better access to digital resources increases the capacity of students to learn, especially in a learning environment that is becoming more and more dependent on online and technology-oriented learning systems. Meanwhile, the findings showed that there are substantial differences between states, which means that access to digital infrastructure is not even and is closely associated with the overall trends in the development of the regions. The research also demonstrated that social economic disparity is a key factor in determining the access to digital education. The level of digital infrastructure was observed to be lower in states with higher population concentration of socially and economically disadvantaged groups, indicating that the current disparities are supported by restricting access to technological means. This association highlights how digital and social inequalities are interrelated, in which absence of infrastructure access is not only limiting to educational opportunities, but also helps to perpetuate the impact of developmental disparities more broadly. The digital divide, thus, not only becomes a technological problem, but also a manifestation of structural inequalities incorporated into the socio-economic space of the nation. This fact is even more significant in the post-pandemic context, when digital education remains a key factor in the education system. Digitization of learning has led to opportunities to increase access, but it has also revealed the shortcomings of current infrastructure and the dilemma of providing equitable access to everyone. The results of the research point to the fact that the positive outcomes of digital transformation in education might continue to be concentrated in more privileged areas unless the proper emphasis is placed on the development of infrastructure and reduction of inequality, which will further increase the gap between various layers of the population. Finally, the research confirms that digital infrastructure is a key aspect of access to education in modern India and that the differences in its distribution are a major contributor to the digital divide. The analysis on the state level offers some good information on the unbalanced topography of digital education, and it is essential to focus more on a balanced and inclusive development of infrastructure. It is necessary to address these disparities to make digital education an inclusion tool and not an exclusion tool and to facilitate a more equitable and accessible education system in the changing post-pandemic world.

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