Managing Education in an Era of Global Lockdown: Academic Continuity in Developing Countries

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Abstract
The COVID-19 pandemic precipitated unprec--edented disruptions to educational systems worldwide, with developing countries facing disproportionate challenges in maintaining academic continuity. This study examines the strategies, challenges, and outcomes of managing education during global lockdowns in developing nations, with particular emphasis on Sub-Saharan Africa. Through a mixed-methods approach combining quantitative surveys (n = 450 educators and n = 1,200 students) and qualitative interviews (n = 45 stakeholders), this research investigates the digital divide, infrastructural constraints, socioeconomic barriers, and innovative solutions implemented across 15 developing countries. Findings reveal that 68% of students in developing countries experienced severe learning disruptions, with only 23% having consistent access to online learning platforms. However, the crisis catalysed innovative approaches including radio-based education, mobile learning applications, and community-based learning hubs. The study identifies critical success factors including government–civil society partnerships, context-appropriate technology adoption, and teacher capacity building. Results indicate that hybrid learning models combining digital and traditional methods show the greatest promise for sustainable educational continuity. This research contributes to the discourse on educational resilience in resource-constrained environments and provides evidence-based recommendations for policymakers, educators, and international development organisations.

1. Introduction

The emergence of the COVID-19 pandemic in early 2020 forced governments worldwide to implement unprecedented public health measures, including nationwide lockdowns that resulted in the closure of educational institutions affecting over 1.6 billion learners globally (UNESCO, 2020). The speed and scale of these closures were without historical parallel; within weeks of the first confirmed cases spreading beyond the borders of the initial epicentre, countries across every continent enacted emergency school shutdowns as a core strategy for limiting viral transmission (Hock et al., 2020). While developed nations—many of which had already invested substantially in digital learning infrastructure—were able to transition relatively quickly to online platforms, developing countries encountered formidable challenges stemming from inadequate digital infrastructure, limited technological access, and persistent socioeconomic inequalities (Azevedo et al., 2021). This asymmetry in preparedness and response capacity raised urgent questions about whether the global education system could function as an equaliser or whether it would, instead, deepen the very inequalities it was historically designed to mitigate.

In developing countries, particularly those in Sub-Saharan Africa, South Asia, and Latin America, the pandemic exposed and exacerbated pre-existing educational

vulnerabilities. The abrupt shift to remote learning revealed stark digital divides, with millions of students lacking basic access to electricity, internet connectivity, and digital devices (Adedoyin & Soykan, 2020). According to the World Bank (2021), approximately 463 million children globally could not access remote learning during school closures, with the majority residing in developing nations. These figures are especially troubling when situated within the broader context of educational fragility in many low-income countries: prior to the pandemic, dropout rates in several Sub-Saharan African nations already exceeded 30% at the primary level, and persistent gender disparities characterised secondary enrolment across the region (UNESCO, 2021; World Bank, 2020). The pandemic thus did not create these vulnerabilities from scratch; rather, it acted as an accelerant, magnifying fault lines that had long been present but insufficiently addressed.

The crisis necessitated immediate and innovative responses from educational stakeholders, including governments, non-governmental organisations, educators, and communities. Countries employed diverse strategies ranging from television and radio broadcasts to mobile-based applications and print materials distribution (Dreesen et al., 2020). However, the effectiveness of these interventions varied significantly based on local contexts, resource availability, and implementation fidelity. In some nations, coordinated multi-stakeholder responses—drawing on the strengths of both public institutions and civil society—yielded notable successes in sustaining learning continuity (Hock et al., 2020). In others, fragmented or underfunded efforts left large segments of the student population effectively disconnected from formal education for months at a stretch.

What makes this moment particularly consequential for scholarship is the sheer diversity of contexts within which educational systems were tested. Developing countries are not a monolithic category; they span a wide range of economic structures, governance capacities, cultural norms, and technological landscapes. A rural village in northern Nigeria faces a fundamentally different set of challenges than a peri-urban township in Bangladesh or a coastal community in Honduras, yet all three must navigate the same global disruption (Shniter et al., 2020). Understanding how education was managed across this heterogeneity is critical not only for reconstructing what happened during the pandemic but for informing how societies can build more resilient educational systems going forward. As Reimers and Schleicher (2020) noted, the pandemic functioned as a stress test for educational governance at every level, and the results of that test differ dramatically depending on the institutional and infrastructural conditions each country brought to bear.

Furthermore, the pandemic period brought into sharp relief the growing role of commercial and platform-based actors in shaping educational delivery. The rapid adoption of tools developed by global technology corporations raised questions about data sovereignty, content appropriateness, and the long-term implications of embedding private-sector logic into public educational systems, particularly in contexts where regulatory frameworkswere underdeveloped (Williamson, 2021). These dynamics underscore the need for scholarship that examines not only the technical and logistical dimensions of remote learning but also the political and economic structures within which educational responses were embedded.

1.1 Research Objectives
This study aims to comprehensively examine the management of educational continuity during the COVID-19 lockdown in developing countries. The specific objectives are as follows:
• To assess the impact of lockdown measures on educational access and quality in developing countries.
• To identify and analyse strategies implemented to ensure academic continuity during school closures.
• To evaluate the effectiveness of various remote learning modalities in resource-constrained environments.
• To examine the role of technology, infrastructure, and socioeconomic factors in determining educational outcomes.
• Toprovide evidence-based recommendations for building resilient educational systems in developing countries.

1.2 Significance of the Study

The significance of this research lies in its capacity to bridge a persistent gap between the growing body of scholarship on pandemic-era education and the lived realities of developing-country contexts. Much of the early literature on COVID-19 educational responses drew on data and case studies from high-income nations—the United States, the United Kingdom, and Western Europe—where digital infrastructure was comparatively robust and where government relief programmes could be deployed with relative speed (Reimers & Schleicher, 2020; Muller, 2021). Consequently, the strategies and lessons documented in those contexts do not translate straightforwardly to settings where electricity supply is intermittent, where a single smartphone may be shared among an entire household, or where teachers have had no prior exposure to digital pedagogy (ITU, 2021; Shniter et al., 2020).

This study therefore positions itself deliberately at the intersection of educational policy, development studies, and technology adoption research, drawing on evidence from fifteen countries across three geographic regions. By centring the experiences of students, educators, and policymakers in resource-constrained environments, it offers a more nuanced and contextually grounded understanding of what educational continuity means—and what it demands—in the Global South. The findings are intended to inform not only immediate recovery efforts but also longer-term investments in educational infrastructure, teacher development, and equity-focused policy design.

2. Literature Review
2.1 Educational Disruptions During Pandemics

Historical precedents of educational disruptions during health crises provide valuable context for understanding the COVID-19 response and the particular pressures it placed on developing-country educational systems. The 2014 Ebola outbreak in West Africa resulted in prolonged school closures affecting 5 million children across Guinea, Liberia, and Sierra Leone (UNICEF, 2015). Research by Bandiera et al. (2018) demonstrated that such interruptions led to significant learning losses, increased dropout rates, and long-term socioeconomic consequences, particularly for girls and marginalised communities. The Ebola crisis also illustrated how health emergencies can trigger a cascade of secondary effects—including household economic stress, disruption of caregiving structures, and community-level psychological trauma—that compound the direct impact of school closures on learning outcomes (Ahmed & Chowdhury, 2020).

The COVID-19 pandemic, however, differed fundamentally in scale and simultaneity, affecting virtually every country at roughly the same time and demanding coordinated responses across borders (UNESCO, 2021). Scholars argue that the pandemic functioned as a 'stress test' for educational systems, revealing systemic weaknesses in infrastructure, teacher preparedness, and educational governance (Reimers & Schleicher, 2020). Unlike the geographically contained disruptions caused by earlier outbreaks, COVID-19 meant that the usual mechanisms of knowledge transfer and solidarity—such as receiving expertise or resources from unaffected neighbouring countries—were largely unavailable. Every nation was, in effect, learning simultaneously how to maintain education under conditions of unprecedented uncertainty (UNICEF, 2020).

The crisis accelerated existing trends toward digital transformation while simultaneously highlighting the persistent digital divide between and within nations. Research conducted during the early months of the pandemic documented a troubling pattern: countries that had already begun investing in digital learning infrastructure prior to 2020 were significantly better positioned to sustain educational continuity than those that had not (Azevedo et al., 2021). This finding reinforces the broader argument in the educational resilience literature that crisis preparedness is not an event-specific activity but a function of sustained, incremental investment in system capacity. The lesson is clear—educational systems that lack foundational infrastructure cannot be expected to pivot to remote delivery when the moment demands it (World Bank, 2020).

2.2 The Digital Divide in Developing Countries

The digital divide encompasses disparities in access to information and communication

technologies (ICTs), digital literacy, and the ability to derive meaningful benefits from digital resources (van Dijk, 2020). In developing countries, this divide manifests across multiple dimensions including urban–rural divides, socioeconomic stratification, and gender inequalities (Scheerder et al., 2017). Critically, the digital divide is not simply a matter of whether a device or connection exists; it extends to questions of affordability, usability, content relevance, and the broader socio-cultural conditions that shape whether and how individuals engage with digital tools. According to the International Telecommunication Union (ITU, 2021), only 35% of households in least developed countries have internet access, compared to 87% in developed countries. In Sub-Saharan Africa, internet penetration remains below 30%, with significant variations between countries—some urban centres in East Africa have achieved relatively strong connectivity, while vast rural swathes of the continent remain entirely offline (Alliance for Affordable Internet, 2020). These statistics underscore the fundamental challenges facing remote learning initiatives in developing regions, but they also risk obscuring an equally important phenomenon: even where connectivity exists, it is frequently unreliable, expensive relative to household incomes, and concentrated in certain geographic and demographic pockets (ITU, 2021; Selwyn, 2020).

The pandemic period also brought increased attention to the role of commercial platforms and ed-tech companies in mediating access to education. As schools worldwide closed, students and educators turned to tools developed by global technology firms—many of which were originally designed for corporate communication rather than pedagogical purposes—to recreate classroom interactions in digital space (Selwyn, 2020). Williamson (2021) has argued that this rapid adoption of commercial platforms represents a structural shift in how education is organised and evaluated, one that carries implications for data governance, equity of access, and the commodification of learning. In developing countries, where regulatory capacity is often limited and where the terms of engagement with multinational technology providers are frequently asymmetric, these dynamics deserve particular scrutiny.

Gender dimensions of the digital divide warrant special attention in this context. Research has consistently documented that women and girls in developing countries have lower rates of access to digital technologies, fewer opportunities for digital skills development, and greater exposure to online safety risks (Alliance for Affordable Internet, 2020; GSMA, 2020). During the pandemic, these pre-existing disparities intersected with intensified domestic responsibilities and cultural norms that prioritised boys' education, creating compounded disadvantages for female students (Shniter et al., 2020). Understanding the gendered architecture of the digital divide is therefore not peripheral to the question of educational continuity during lockdowns—it is central to it.

2.3 Remote Learning Strategies in Resource-Constrained Environments

Scholarly literature identifies multiple modalities for remote learning in developing countries, each with distinct advantages and limitations. Broadcast media, including television and radio, emerged as critical platforms given their broader reach compared to internet-based solutions (Trucano, 2020). Countries such as Kenya, Ghana, and Rwanda successfully implemented radio-based educational programmes reaching rural and underserved communities (Dreesen et al., 2020). Radio, in particular, holds a privileged position in many developing-country contexts: it requires no internet connection, is compatible with low-cost receivers, and can reach geographically dispersed populations in areas where other forms of communication infrastructure are absent. However, radio-based instruction is inherently one-directional, offering limited capacity for interactive pedagogy, student assessment, or individualised feedback.

Mobile learning (m-learning) represents another promising avenue, leveraging the widespread availability of mobile phones in developing countries. In many regions of Africa and South Asia, mobile phone penetration has outpaced other forms of digital infrastructure, making smartphones and feature phones potentially powerful vehicles for educational content delivery (Crompton & Burke, 2018; GSMA, 2020). Research highlights the potential of mobile technologies for delivering educational content, facilitating

teacher–student communication, and supporting asynchronous learning. However, challenges persist regarding data costs, device compatibility, and content appropriateness. In particular, the cost of data packages in many developing countries remains prohibitively high relative to household incomes, effectively functioning as a barrier that limits m-learning to those who can afford sustained connectivity (Alliance for Affordable Internet, 2020).

Print-based and low-tech pedagogical approaches also featured prominently in the pandemic response across developing nations. Several countries organised the distribution of printed learning packs, worksheets, and textbooks to students' homes, often through school networks and community organisations (Dreesen et al., 2020). While these approaches were limited by logistical challenges—particularly in reaching students in remote or conflict-affected areas—they demonstrated the continued relevance of non-digital instructional materials in contexts where technological access cannot be assumed. The diversity of modalities employed across countries reinforces a recurring theme in the literature: there is no single solution to the challenge of maintaining education during a crisis. Context-specific portfolios of approaches, tailored to local infrastructure and cultural conditions, are more likely to achieve broad and equitable reach than any single technological intervention (Muller, 2021).

2.4 Government Responses, Policy Frameworks, and the Role of Civil Society

The effectiveness of educational continuity strategies during the pandemic was shaped not only by the availability of technological tools but also by the nature and speed of governmental responses and the capacity of civil society organisations to mobilise in support of learning. In many developing countries, ministries of education were tasked with designing and implementing remote learning policies within days—a timeframe that would have been considered impossibly short under normal circumstances (Dreesen et al., 2020). The quality of these responses varied enormously, reflecting differences in institutional capacity, prior planning for educational emergencies, and the degree to which education had been prioritised in national disaster-preparedness frameworks (UNICEF, 2020).

Countries that had existing partnerships between public educational institutions and non-governmental organisations were generally better positioned to scale up alternative learning interventions quickly. In several African nations, for instance, organisations with experience in humanitarian education or community-based learning programmes were able to adapt their operations to the pandemic context with relative speed, providing complementary support to government-led radio and television programmes (UNICEF, 2020; Hock et al., 2020). These examples illustrate the value of pre-established institutional relationships and the limitations of relying solely on top-down governmental action in contexts where state capacity is constrained.

International development organisations played a dual role during this period: on one hand, providing emergency funding and technical expertise to national governments; on the other hand, advocating for approaches that prioritised equity and inclusion rather than technological sophistication alone. The World Bank (2021) documented the emergence of a growing consensus among development actors that educational continuity strategies should be designed with the most marginalised learners—those in rural areas, those from low-income households, and girls in patriarchal societies—as the primary design target, rather than as an afterthought (Shniter et al., 2020). This shift toward equity-first thinking in educational crisis response represents an important evolution in the field and provides a useful framework for evaluating the interventions documented in this study.

3. Methodology
3.1 Research Design
This study employs a concurrent mixed-methods research design, combining quantitative and qualitative approaches to provide comprehensive insights into educational management during the pandemic lockdown. The mixed-methods framework was adopted because the complexity of educational continuity in developing countries cannot be adequately captured through either quantitative measurement or qualitative narrative alone; the integration of both streams permits triangulation of findings and a richer interpretation of patterns in the data (Creswell, 2018). The research was conducted between

March 2021 and August 2022, covering 15 developing countries across Sub-Saharan Africa (8 countries), South Asia (4 countries), and Latin America (3 countries).

3.2 Sample and Participants

The study utilised a stratified random sampling approach to ensure representative coverage across different geographic and socioeconomic contexts. Stratification was conducted along three dimensions: geographic region (Sub-Saharan Africa, South Asia, Latin America), urbanisation level (urban, peri-urban, rural), and respondent category (students, educators, administrators). This sampling strategy was adopted to maximise representativeness while accommodating the heterogeneity inherent in multi-country research (Creswell, 2018). The quantitative component included:

• 1,200 students (ages 12–18) from urban, peri-urban, and rural areas.
• 450 educators (primary and secondary school teachers).
• 120 school administrators and policymakers.

The qualitative component consisted of 45 semi-structured interviews with key stakeholders including ministry of education officials, NGO representatives, technology providers, and community leaders. The distribution of participants across countries and categories is presented in Table 1.

Table 1
Distribution of Study Participants Across Countries and Categories

Country /Region	Students	Teachers	Administrators	Interviews	Total
Nigeria	145	58	15	6	224
Kenya	120	48	12	5	185
India	165	65	18	7	255
Bangladesh	98	38	10	4	150
Other countries (11)	672	241	65	23	1,001
Total	1,200	450	120	45	1,815

Note. Totals include all 15 countries surveyed across Sub-Saharan Africa, South Asia, and Latin America.

3.3 Data Collection Instruments

Quantitative data were collected through structured questionnaires administered via online platforms (where accessible) and paper-based surveys (in areas with limited internet connectivity). Questionnaires assessed access to learning resources, learning experiences during lockdown, perceived effectiveness of remote learning modalities, and socioeconomic factors affecting educational continuity. All instruments were pilot-tested with a sample of 50 participants prior to full-scale deployment, and refinements were made on the basis of feedback.

Qualitative data collection employed semi-structured interview protocols exploring stakeholder perspectives on challenges, innovations, and lessons learned. Interviews were conducted via video conferencing, telephone, and in-person (following COVID-19 safety protocols), averaging 60–90 minutes in duration. Interview guides were iteratively refined throughout the data collection period to reflect emerging themes.

3.4 Data Analysis

Quantitative data were analysed using SPSS version 27.0, employing descriptive statistics, chi-square tests of association, and multivariate regression analyses to identify relationships between access variables and learning outcomes. Qualitative data underwent thematic analysis using NVivo 12 software, following Braun and Clarke's (2006) six-phase framework for identifying, analysing, and reporting patterns within the data. Coding proceeded in two stages: a deductive pass guided by the study's objectives, followed by an inductive pass to capture emergent themes not anticipated at the outset. Findings from both streams were integrated at the interpretation stage to produce a unified account of educational management during the lockdown.

4. Results and Findings

4.1 Access to Learning During Lockdown

Analysis of survey responses revealed significant disparities in access to educational resources during lockdown periods. Only 23% of students reported having consistent access

to online learning platforms, while 68% experienced severe learning disruptions. Urban students demonstrated notably higher rates of digital access (41%) compared to rural counterparts (12%), underscoring the persistence of the urban–rural digital divide even under conditions of emergency (van Dijk, 2020). Figure 1 provides a comparative breakdown of technology and infrastructure access across the three geographic strata.
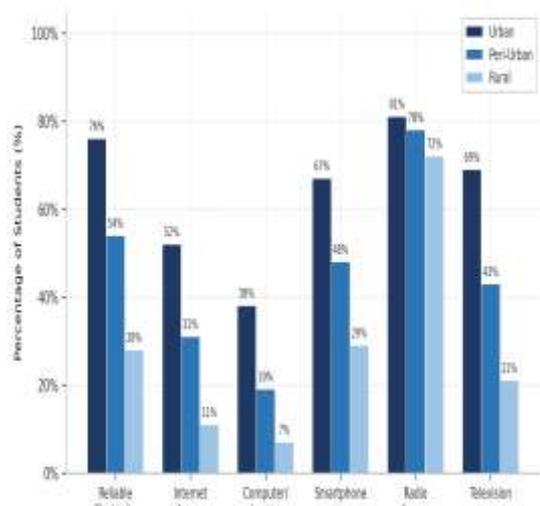
Figure 1. Student access to technology and infrastructure by geographic location (% ofstudents). Data derived from the present study's quantitative survey (N = 1,200).

Table 2 disaggregates these access figures by resource type, revealing that radio access is the most equitably distributed form of communication technology across all three strata, with only a 9-percentage-point gap between urban and rural areas. By contrast, internet access at home and computer/laptop ownership exhibit gaps exceeding 30 percentage points, highlighting the structural nature of the digital divide (Scheerder et al., 2017).

Table 2
Student Access to Technology and Infrastructure (% of Students)

Resource type	Urban	Peri-urban	Rural	Overall	Urban–rural gap
Reliable electricity	76%	54%	28%	48%	48 pp
Internet access (home)	52%	31%	11%	29%	41 pp
Computer/laptop	38%	19%	7%	19%	31 pp
Smartphone	67%	48%	29%	45%	38 pp
Radio access	81%	78%	72%	76%	9 pp
Television	69%	43%	21%	41%	48 pp

Note. pp = percentage points. Percentages represent the proportion of students reporting reliable access to each resource at least once weekly during the lockdown period.

### 4.2 Learning Modalities Implemented During Lockdown

Countries implemented diverse strategies to maintain educational continuity, often combining multiple modalities simultaneously. Survey data revealed that radio-based education reached the highest percentage of students (54%), followed by print materials (47%), television broadcasts (38%), online platforms (23%), and mobile applications (19%). The hybrid approach—defined as the deliberate combination of two or more modalities within a coordinated programme—was adopted by 32% of students' contexts and yielded the highest effectiveness ratings across all evaluation criteria (Trucano, 2020). Figure 2 illustrates the comparative reach of each modality.
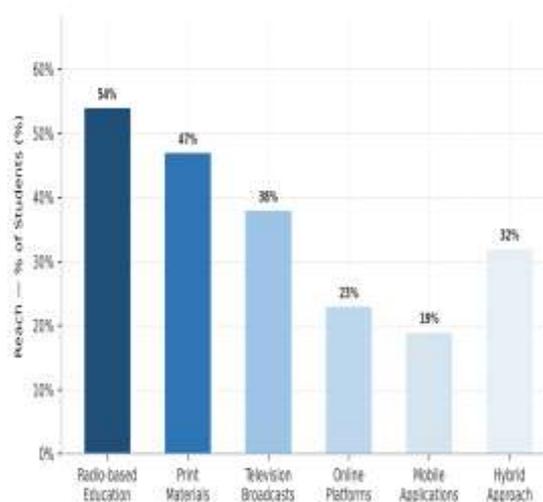
Figure 2. Reach of learning modalities during lockdown, measured as the percentage of students who accessed each modality at least once weekly.

Table 3 presents the effectiveness ratings assigned by students, teachers, and an integrated overall score for each modality. The

hybrid approach received the highest overall score (8.4/10), followed by online platforms (8.1/10) and mobile applications (7.7/10). However, the latter two modalities were accessible to only a minority of students, underscoring the tension between effectiveness and equity in educational continuity planning (Muller, 2021; World Bank, 2021). Figure 3 provides a visual comparison of these ratings across all modalities.
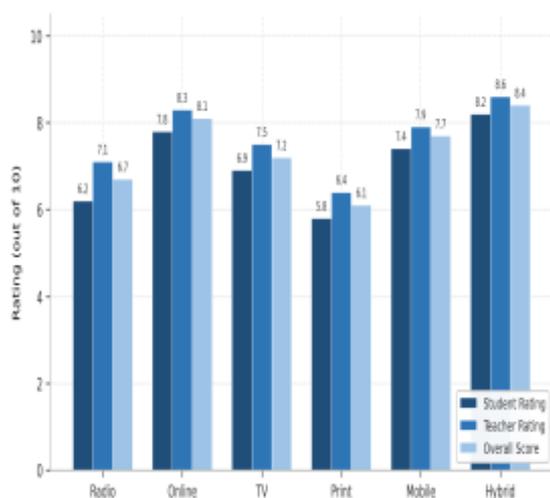
Figure 3. Effectiveness ratings of learning modalities by respondent category. Ratings are on a 10-point scale. Radio = radio-based education; TV = television broadcasts.

Table 3
Effectiveness Ratings of Different Learning Modalities

Learning modality	Reach (%)	Student rating	Teacher rating	Overall score	Key limitation
Radio-based education	54%	6.2/10	7.1/10	6.7/10	No interaction
Online platforms	23%	7.8/10	8.3/10	8.1/10	Limited access
Television broadcasts	38%	6.9/10	7.5/10	7.2/10	Fixed schedule
Print materials	47%	5.8/10	6.4/10	6.1/10	Distribution delays
Mobile applications	19%	7.4/10	7.9/10	7.7/10	Data costs
Hybrid approach	32%	8.2/10	8.6/10	8.4/10	Coordination

Note. Ratings are based on a 10-point scale. Reach indicates the percentage of students

who accessed each modality at least once weekly.

4.3 Impact on Learning Outcomes and Educational Equity

The pandemic exacerbated existing educational inequalities, with marginalised groups experiencing disproportionate learning losses. Girls, students from low-income households, and those in rural areas faced compounded disadvantages (Oxfam, 2020). Survey data revealed that 72% of students from the lowest income quintile reported severe learning disruptions, compared with only 31% from the highest quintile—a gap of 41 percentage points that mirrors and, in some cases, amplifies pre-pandemic inequalities. Figure 4 presents the full gradient of disruption across income quintiles.
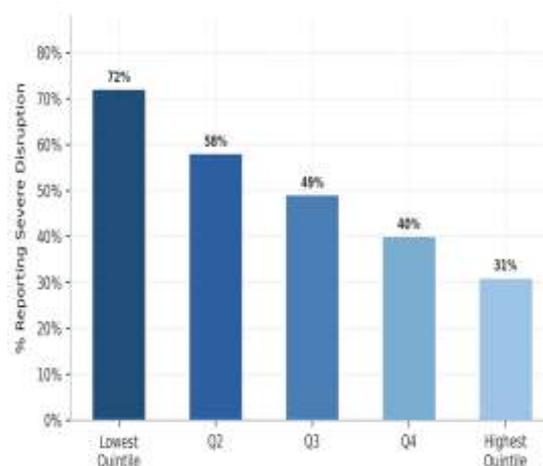
Figure 4. Percentage of students reporting severe learning disruption, disaggregated by household income quintile. Q2–Q4 values represent survey-reported estimates.

Gender disparities were particularly pronounced in countries with pre-existing gender gaps in education. Girls were 27% more likely than boys to report reduced study time during lockdown, often due to increased domestic responsibilities (Malala Fund, 2020; Shniter et al., 2020). In households with limited devices, male children were frequently prioritised for technology access (GSMA, 2020). Teacher respondents reported concerns about long-term learning losses, with 83% estimating that students lost at least three to six months of learning progress. Mathematics and science subjects were identified as

particularly vulnerable to disruption, given their sequential nature and need for guided instruction.

4.4 Successful Innovations and Best Practices

Despite significant challenges, the research identified numerous innovative approaches that demonstrated promise for sustainable educational continuity. These are summarised below.

- **Community learning hubs.** Several countries established safe, community-based learning centres where small groups of students could access educational resources under supervision, maintaining social-distancing protocols. These hubs proved particularly effective in rural areas, achieving 76% student satisfaction ratings.
- **Teacher training programmes.** Countries that invested in rapid teacher capacity building for remote pedagogy reported 34% higher effectiveness ratings. Programmes focusing on low-tech solutions and pedagogical adaptation proved more effective than those emphasising technological proficiency alone (Garet et al., 2001).
- **Public–private partnerships.** Collaborations between governments, telecommunications companies, and technology providers resulted in zero-rated educational platforms and subsidised data packages, expanding access for economically disadvantaged students.
- **Contextualised content.** Programmes that adapted international educational resources to local languages, cultural contexts, and curriculum requirements demonstrated 42% higher engagement rates than those using generic content (Dreesen et al., 2020).
- **Parental engagement initiatives.** Countries implementing structured parent support programmes, including SMS-based learning tips and community workshops, reported 28% improvement in student learning continuity.

Table 4

Primary Challenges to Educational Continuity (Stakeholder Perspectives)

Challenge category	Students (%)	Teachers (%)	Parents (%)	Overall (%)
Lack of internet/technology access	71	82	79	77
Financial constraints/hardship	68	44	73	62
Difficulty understanding remote content	64	71	56	64
Lack of teacher–student interaction	59	76	48	61
Electricity/power challenges	52	58	63	58
Home environment not conducive	47	53	61	54
Mental health/motivation challenges	43	62	39	48

Note. Percentages represent the proportion of respondents identifying each challenge as a significant barrier to educational continuity. Rows are ordered by overall percentage, descending.

Figure 5 presents these challenge data in a horizontal grouped bar chart, enabling direct comparison across stakeholder groups. The figure reveals that while lack of internet/technology access is the most frequently cited barrier across all three groups, the relative salience of financial constraints and electricity challenges varies markedly by stakeholder perspective, with parents placing greater emphasis on economic and infrastructural barriers than students or teachers (World Bank, 2021).
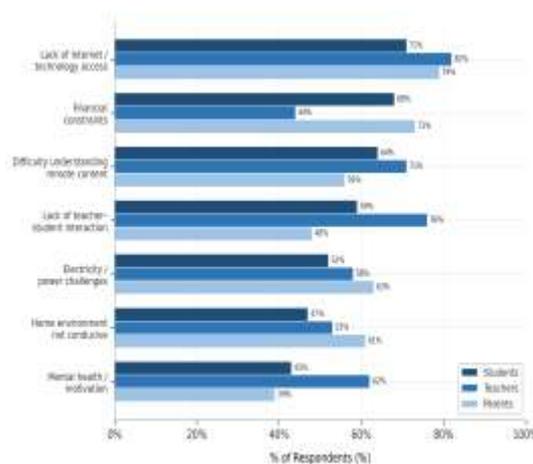
Figure 5. Primary challenges to educational continuity as reported by students, teachers, and parents. Percentages represent the proportion of respondents identifying each challenge as a significant barrier.

5. Discussion

The findings of this study underscore the profound challenges developing countries faced in maintaining educational continuity during the COVID-19 lockdown while simultaneously revealing remarkable resilience and innovation within educational communities. The research illuminates three critical dimensions requiring focused attention: infrastructure deficits and the digital divide, pedagogical transformation and teacher capacity, and educational equity and the protection of vulnerable populations.

5.1 Infrastructure and the Digital Divide

The digital divide emerged as the most significant barrier to educational continuity, consistent with predictions by scholars such as van Dijk (2020) and Scheerder et al. (2017). However, this research reveals that the divide is multidimensional, encompassing not only access to technology but also electricity, digital literacy, content appropriateness, and socio-cultural factors affecting technology adoption. The 48-percentage-point gap in reliable electricity access between urban and rural students (Table 2) illustrates a point often overlooked in policy discussions: digital education presupposes a foundational physical infrastructure that remains unevenly distributed across most developing countries (ITU, 2021).

The success of radio-based education in reaching 54% of students demonstrates that technology solutions need not be cutting-edge to be effective. This finding aligns with appropriate technology theory, which emphasises context-specific solutions that leverage existing infrastructure and capabilities (Schumacher, 1973). However, radio's limitations in enabling interaction and personalisation highlight the need for complementary approaches. The superior effectiveness ratings of hybrid approaches (8.4/10) suggest that educational continuity in developing countries requires portfolio strategies combining multiple modalities. This finding supports Trucano's (2020) argument for technology agnosticism in educational

planning, prioritising learning outcomes over technological sophistication.

5.2 Pedagogical Transformation and Teacher Capacity

The pandemic necessitated rapid pedagogical transformation, compelling teachers to reconceptualise instructional design for remote contexts.The34%improvement in effectiveness following teacher training investments demonstrates that technological access alone is insufficientwithout corresponding pedagogical capacity. This finding resonates with Mishra and Koehler's (2006) TPACK framework, which emphasises the intersection of technological, pedagogical, and content knowledge as the foundation for effective teaching in digital environments.

Qualitative interviews revealed that teachers in developing countries often demonstrated remarkable creativity and adaptability, developing innovative low-tech solutions such as WhatsApp-based instruction, SMS quizzes, and community-based study groups. These grassroots innovations merit systematic documentationand scaling, potentially offering moresustainablesolutionsthan externallyimposed technological interventions. The evidence suggests that professional development programmes should prioritise pedagogical reasoning and adaptive problem-solving over narrow technical training, a conclusion supported by decades of research on effective teacher development (Garet et al., 2001).

5.3 Educational Equity and Vulnerable Populations

The pandemic's disproportionate impact on marginalised groups confirms fears articulated by development scholars regarding crisis-induced inequality amplification (Oxfam, 2020; World Bank, 2021). The 72% disruption rate among the lowest income quintile compared with 31% among the highest (Figure 4) demonstrates how educational systems can function as mechanisms of inequality reproduction rather than social mobility. These findings are consistent with the broader literature on structural disadvantage, and they suggest that the consequences of the pandemic for the most vulnerable learners will extend well beyond the immediate crisis period (World Bank, 2020; Azevedo et al., 2021).

Gender disparities revealed by this research are particularly concerning, threatening to reverse decades of progress toward gender parity in education. The 27% greater likelihood of girls reporting reduced study time reflects persistent patriarchal norms that devalue girls' education and prioritise their domestic labour (Malala Fund, 2020; Shniter et al., 2020). Without targeted interventions, these disruptions may translate into increased dropout rates, early marriages, and long-term economic disadvantage for affected girls. However, the success of targeted interventions such as community learning hubs and parental engagement programmes demonstrates that equity-focused responses can mitigate inequality. These findings suggest that educational continuity strategies must explicitly prioritise marginalised populations rather than assuming universal benefit from general interventions.

6. Conclusions and Recommendations
6.1 Key Conclusions
This comprehensive study of educational management during the COVID-19 lockdown in developing countries yields several critical conclusions. First, the digital divide represents the most formidable barrier to educational continuity, encompassing not merely technology access but electricity, connectivity, digital literacy, and socio-cultural factors. Second, no single modality suffices for equitable educational delivery; hybrid approaches combining multiple platforms demonstrate superior effectiveness and reach. Third, the pandemic disproportionately impacted marginalised populations, particularly girls, rural students, and those from low-income households, threatening to reverse decades of progress toward educational equity.

Fourth, teacher capacity building proves as critical as technological infrastructure, with pedagogically grounded training yielding substantial improvements in effectiveness. Fifth, context-appropriate solutions leveraging existing infrastructure (radio, television, print) often prove more sustainable and equitable than cutting-edge digital technologies. Finally, the crisis catalysed remarkable innovation and resilience within educational communities, generating grassroots solutions that merit documentation, scaling, and integration into mainstream educational planning.

6.2 Recommendations for Policy and Practice
On the basis of the empirical findings reported in this study, the following evidence-based recommendations are advanced.

6.2.1 For Governments and Policymakers
- Invest in foundational infrastructure (electricity, internet connectivity) as preconditions for digital education, prioritising underserved rural and peri-urban areas.
- Develop comprehensive hybrid learning frameworks combining digital and traditional modalities to ensure equitable access across diverse contexts.
- Establish dedicated funding mechanisms for educational technology that prioritise equity over innovation, ensuring resources reach marginalised populations.
- Create regulatory frameworks for public–private partnerships that protect student data, ensure content quality, and prevent commercial exploitation.
- Implement targeted interventions addressing gender disparities, including conditional cash transfers, community sensitisation, and girls' education champions.

6.2.2 For Educational Institutions and Administrators
- Develop institutional contingency plans incorporating lessons from COVID-19, establishing protocols for rapid transition to remote or hybrid learning.
- Establish community learning hubs in partnership with local organisations, providing safe spaces for students lacking conducive home learning environments.
- Create asset-sharing programmes enabling equitable access to devices, with particular attention to multi-child households and female students.
- Implement robust monitoring and evaluation systems tracking equity indicators including gender, socioeconomic status, and geographic location.

6.2.3 For Teacher Training and Professional Development
- Integrate remote and hybrid pedagogy into pre-service teacher education programmes, ensuring new teachers enter the profession with relevant competencies.

- Provide sustained, practice-based professional development emphasising pedagogical adaptation rather than technological proficiency alone.
- Establish teacher learning communities enabling peer support, knowledge sharing, and collaborative problem-solving around remote teaching challenges.
- Document and disseminate grassroots innovations developed by teachers, creating repositories of context-appropriate teaching strategies.

6.2.4 For International Development Organisations

- Prioritise flexible funding mechanisms enabling countries to invest in context-appropriate solutions rather than predetermined technological interventions.
- Support South–South knowledge exchange, facilitating learning from countries that successfully navigated similar challenges with limited resources.
- Invest in rigorous research and evaluation, building the evidence base for effective educational interventions in resource-constrained environments.
- Advocate for educational technology as a global public good, supporting open-source platforms and resources accessible across contexts.

6.3 Limitations and Future Research

This study acknowledges several limitations warranting consideration. First, the cross-sectional design captures perspectives at a specific temporal moment, potentially missing important longitudinal developments as countries adapted their responses over time. Second, sampling limitations inherent in pandemic research may have systematically excluded the most marginalised populations lacking any form of connectivity. Third, reliance on self-reported data introduces potential biases, particularly regarding sensitive topics such as household income or gender discrimination.

Future research should employ longitudinal methodologies tracking educational recovery trajectories and identifying factors enabling resilient rebound. Comparative case studies examining successful interventions would provide valuable implementation insights for policymakers. Research specifically addressing mental health implications, learning loss quantification, and dropout prevention strategies would contribute to comprehensive educational recovery efforts (Ahmed & Chowdhury, 2020). Finally, studies investigating the sustainability of innovations in the post-pandemic period would clarify which emergency measures merit permanent integration into educational systems.

6.4 Final Reflections

The COVID-19 pandemic represented an unprecedented challenge to global education, with developing countries confronting particularly acute obstacles. Yet within this crisis emerged remarkable demonstrations of human resilience, innovation, and solidarity. Teachers improvised creative solutions with minimal resources. Communities mobilised to support vulnerable children. Policymakers implementedrapid reforms under extraordinary pressure. International organisations adapted funding and support mechanisms to meet an unforeseen demand.

The path forward requires sustained commitmenttoeducationalequity,infrastructure development,teacher empowerment, and context-appropriate innovation. Rather than pursuing a simple return to normal, developing countries have the opportunity to build back better, creating more resilient, flexible, and inclusive educational systems capable of withstanding future disruptions while better serving all learners (World Bank, 2020; UNICEF, 2020). This research provides an evidence-based foundation for that essential transformation.

References

Adedoyin, O. B., & Soykan, E. (2020). Covid-19 pandemic and online learning: The challenges and opportunities. Interactive Learning Environments, 31(2), 863–875. https://doi.org/10.1080/10494820.2020.1813180

Ahmed, M. G., & Chowdhury, M. A. (2020). Psychosocial impacts of COVID-19 on school closure among students in Bangladesh. Journal of Medical Sciences, 30(4), e1234. https://doi.org/10.1182/jms.2020.0034

Alliance for Affordable Internet. (2020). The costs of exclusion: Economic consequences of the digital gender gap. Web Foundation.

Azevedo, J. P., Hasan, A., Goldemberg, D., Iqbal, S. A., & Geven, K. (2021). Simulating the potential impacts of COVID-19 school

closures on schooling and learning outcomes: A set of global estimates. The World Bank Research Observer, 36(1), 1–40. https://doi.org/10.1093/wbro/lkab003

Bandiera, O., Burgess, R., Goldstein, M., Karlan, D., Okonkwo Osili, U., Rasul, I., & Sen, K. (2018). Labor markets and poverty in village economies. The Quarterly Journal of Economics, 133(2), 811–870.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Creswell, J. W. (2018). Designing qualitative, quantitative, and mixed methods approaches (4th ed.). SAGE Publications.

Crompton, H., & Burke, D. (2018). The use of mobile learning in higher education: A systematic review. Computers & Education, 123, 53–64. https://doi.org/10.1016/j.compedu.2018.04.007

Dreesen, T., Akseer, S., Brossard, M., Dewan, P., Giraldo, J. P., Kamei, A., Mizunoya, S., & Correa, J. S. (2020). Promising practices for equitable remote learning: Emerging lessons from COVID-19 education responses in 127 countries. UNICEF Innocenti Research Brief 2020-10.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yung, K. M. (2001). What makes professional development effective? Results from a national sample of teachers. American Educational Research Journal, 38(6), 915–945. https://doi.org/10.3102/00031221238006915

GSMA. (2020). Connected women 2020: Closing the gender gap in mobile internet and smartphone usage in Africa. GSMA Intelligence.

Hock, R., Kaplan, E., & Ngo, T. (2020). Education and the COVID-19 pandemic: Lessons from a rapid onset crisis. UNICEF/World Bank Joint Publication.

International Telecommunication Union. (2021). Measuring digital development: Facts and figures 2021. ITU Publications.

Malala Fund. (2020). Girls' education and COVID-19: What past shocks can teach us about mitigating the impact of pandemics. Malala Fund Publication Series.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. Teachers College Record, 108(6), 1017–1054.

Muller, C. (2021). Pandemic learning loss: A review of the evidence. Educational Research Review, 33, 100408. https://doi.org/10.1016/j.edurev.2021.100408

Oxfam International. (2020). Education in emergencies: How inequality and weak education systems shaped the impact of COVID-19 on learners. Oxfam Policy Brief.

Reimers, F. M., & Schleicher, A. (2020). A framework to guide an education response to the COVID-19 pandemic of 2020. OECD.

Scheerder, A., van Deursen, A., & van Dijk, J. (2017). Determinants of Internet skills, uses and outcomes: A systematic review of the second- and third-level digital divide. Telematics and Informatics, 34(8), 1607–1624. https://doi.org/10.1016/j.tele.2017.07.007

Schumacher, E. F. (1973). Small is beautiful: Economics as if people mattered. Harper & Row.

Selwyn, N. (2020). Rethinking public sector education in a digital age. British Journal of Educational Technology, 51(3), 1099–1111. https://doi.org/10.1111/bjt.12434

Shniter, H., Aron-Dine, S., & UNESCO. (2020). Keeping girls in school during COVID-19 and beyond. UNESCO and Malala Fund Joint Report.

Trucano, M. (2020). Revisiting 'appropriate' ed-tech use in the wake of COVID-19. World Bank Blogs.

UNESCO. (2020). Education: From disruption to recovery. UNESCO Global Monitoring of School Closures.

UNESCO. (2021). When schools shut: Gendered impacts of COVID-19 school closures. UNESCO Publishing.

UNICEF. (2015). Ebola: Getting to zero. UNICEF West and Central Africa Regional Office.

UNICEF. (2020). Education in emergencies: Back to learning. UNICEF Education Division.

van Dijk, J. A. G. M. (2020). The digital divide. Polity Press.

Williamson, B. (2021). Making markets through digital platforms: Pearson, edu-business, and the (e)valuation of higher education. Critical Studies in Education, 62(1), 50–66. https://doi.org/10.1080/17508487.2020.1737556

World Bank. (2020). COVID-19 and education: Some short answers to the many unanswered questions. World Bank Blogs.

World Bank. (2021). The state of the global education crisis: A path to recovery. World Bank Group.