

Education and COVID-19: Facts, insights and vital lessons

David Gitumu Mugo (PhD)

Karatina University, P.O.Box 1957-10101, Karatina, Kenya

Abstract: COVID-19, a severe and fatal human respiratory ailment caused by Severe Acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first reported in Wuhan, China in December 2019. The purpose of the paper was to explore the scientific findings regarding SARS-CoV-2, its epidemiology and impact to the education system. The study was a documentary analysis of virtual documents stored electronically for access through the internet, text books, archival repositories as well as encyclopedia. The key findings indicated that genomic features of the virus demonstrated close phylogenetic relationships with other viruses important to human illnesses. This disapproved a public argument that the virus was a laboratory construct. Further the study demonstrated that the transmission of the virus was chiefly exponential resulting to rapid outbreak of the ailment throughout China and other parts of the habitable world. The containment measure adopted by governments and states was largely lockdown of operations in many sectors of the economy, including education. By highlighting facts and insights on interventions adopted globally, the paper was able to provide a deeper understanding of COVID-19 within an educational context. The lessons gathered from the period of the epidemic are highlighted and can be useful to educationists when handling an epidemic in the future.

Keywords: COVID-19, ELearning, Learner, Technology

I. BACKGROUND

The 21st century has been marked by major technological breakthrough in the area of public health. Expanded programs on vaccination and immunization have resulted to containment of otherwise communicable and infectious diseases such as whooping cough, measles, tuberculosis and yellow fever. On the other hand modern times have been exposed to the re-emergence of old diseases such as cholera, plague and yellow fever. Similarly and disturbing, new epidemics such as Ebola virus disease, Lassa fever, Crimean-Congo hemorrhagic fever, Zika, Chikungunya, Avian and other zoonotic influenza, Middle-East Respiratory Syndrome (MERS), Monkey Pox and Pandemic Influenza have emerged posing quite major threats to global public health (WHO 2018). Each of the indicated pandemic have had their role in disrupting the supply of education and public administration

COVID-19 - Early findings

In December 2019, medical practitioners observed a series of pneumonia cases of an unknown cause in Wuhan City, Hubei Province in the Peoples' Republic of China (WHO 2019, World Bank 2020). Samples obtained from lower respiratory tract of the pneumonia patients were quickly analyzed by the

National Health Commission of the Peoples' Republic of China and the World Health Organization (WHO). Laboratory tests confirmed that the ailment was due to a new virus that belonged to the Corona Virus family (coronidae), which had not been previously identified in human. The International Committee of Taxonomy of Viruses named the virus SARS-CoV-2. The WHO, named the disease caused by SARS-CoV-2 as "COVID-19 (WHO, 2020-3). Though the virus was a new micro-organism, it did show phylogenetic relationships with other viruses known to cause important human illness such as common cold as well as more severe diseases such as Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). Further, the corona family of viruses is responsible for important veterinary ailments such as Murine Coronavirus Mouse Hepatitis (MHV) Disease, Avian Infectious bronchitis (AIB), Feline Infectious Peritonitis Virus Disease (FIPVD) and Bovine Coronavirus Disease (BCoVD) The virus, when observed under the electron microscope had a crown-like morphology due to glycoprotein spikes on its envelope, and therefore fit into the "corona" nomenclature as guided by the International Committee on the Taxonomy of Virus resolutions of 1968 (Weiss and Martin(2005)., Di Gennaro, Pizzol Marotta, Antunes, Racialbuto, Veronese and Smith (2020).

SARS-CoV-2 was disputed to have had a zoonotic origin and caused severe and fatal clinical indications (Di Gennaro, Pizzol Marotta, Antunes, Racialbuto, Veronese and Smith, 2020). Public discourse has claimed that the Virus was a laboratory construct. However, by careful analysis of the genomic features of SARS-CoV-2, scientists and researchers have obtained known and documented genomic sequences from the virus, which strongly disapproves this argument (WHO, 2020)

Epidemiology

The COVID-19 epidemic expanded in early December Of 2019 from Wuhan city of Hubei province, and spread quickly throughout China and elsewhere in the world. Rapid human to human infection was reported and cases were restricted to close family members, medical staff, transport and hotel attendants. The exponential rise of infection was because the outbreak coincided with mass movement of people ahead of the Chinese lunar New Year ((Hasnain, Shah, Ayyaz, Shahzar, Hazrat, Rabia and Sajjad, 2020). According to Di Gennaro et al (2020), the first confirmed case of COVID-19 outside China was diagnosed on 13th January 2020 in

Bangkok, Thailand. Holshue et al (2020) reported that The first confirmed case of the infection in the United States was reported on January 20, 2020, in Washington state, on a 35-year-old man who had returned to Washington USA after a visit of a family in Wuhan, China. By 21st January 2020, 47 cases had been reported across the European Nations of the Belgium, Finland, France Germany, Italy Russia, Spain, Sweden and the United Kingdom (Gianfranco et al, 2020). On 30th January 2020, the WHO declared COVID-19 a Public Health Emergency of international concern (Hasnain et al 2020). Egypt was the first country in Africa to report a case on February 14, followed by Algeria on February 25th, then Nigeria on February 27th. By the 2nd of March 2020, 67 territories outside mainland China had reported confirmed cases of COVID-19. This was an indication that the transmission of the virus was quickly spreading into almost all regions of the globe at a speed never imagined. By this date, public health officials of countries in Africa, Asia, Australia, Europe, South America and North America had publicly declared confirmed clinical cases. By 14th May 2020, global statistics on infection as released by the John Hopkins hospital had reached the 5 million mark

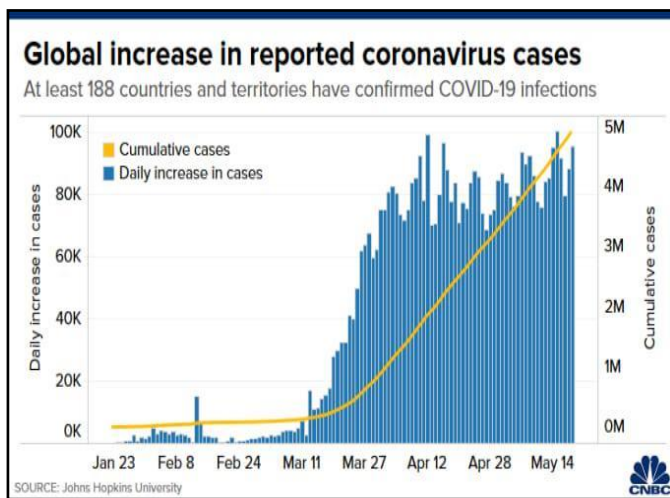


Figure 1. Global reported case of corona Virus, May 2020. Adopted from Meredith, Choudhury and Lee (2020)

II. SYMPTOMS AND TRANSMISSION OF CORONA VIRUS DISEASE

a) Symptoms

Hamidreza et al (2020) observes that the novel COVID-19 is a disease of the respiratory system. The main symptoms as provided by the Centers for Disease Control and Prevention (CDC), appear from 2nd to the 14th day after exposure and may vary from mild flu-like symptoms such as fever, dry cough and tiredness. Other symptoms which are less common amongst patients include body aches and pains, sore throat, diarrhea, conjunctivitis, headache, loss of taste or smell, a rash on skin, or discoloration of fingers or toes. 20% of patients showing mild symptoms may progress to more severe symptoms such as difficulty breathing or shortness of

breath, chest pain or pressure, loss of speech or movement, pneumonia, respiratory failure, and, in some cases, death. Literature provides cases of infected persons who show mild and moderate symptoms but progress to recovery without hospitalization.

The COVID-19 illness does not normally induce a runny nose, sneezing or sore throat, but few patients develop muscle pain or hemoptysis. Older people with comorbidity and serious alveolar injury are more likely to experience respiratory failure. In such patients, the onset of disease will demonstrate rapid progression to organ dysfunction resulting to acute kidney injury, shock, acute cardiac injury, acute respiratory distress syndrome (ARDS) and death (Hasnain et al 2020)

b) Transmission

Initial reports indicated that COVID-19 had a zoonotic origin. According to McIntosh (2020) a full-genome sequencing and phylogenic analysis demonstrated that the virus causing COVID-19 belong to same subgenus as the virus that cause Severe Acute Respiratory Syndrome (SARS) and the virus causing several bat coronaviruses diseases. The closest RNA sequence that are mostly similar to the COVID-19 are two bat coronaviruses. Consequently, it appears likely that bats were the primary source of the COVID-19, but the mechanism in which the virus was transmitted from bats to human has not been documented. However, transmission from bats to human through an intermediate host and transmission from the primary host to human host through food consumption has been augmented. The virus then begun its human to human transmission, mainly via respiratory droplets produced when a healthy person, within 2 meters from an infected person coughs, sneezes, or talks.

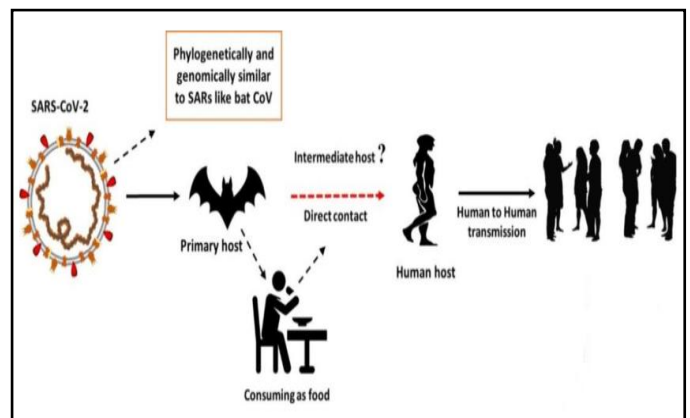


Figure 2: Origin and transmission of COVID-19. Adopted from Sheikhi, Shirzadfar, Hamidreza & Sheikhi and Milad. (2020).

Further, WHO (2020) has obtained data from published epidemiology and virological studies to support the argument that COVID-19 can also be transmitted by direct contact with infected persons, or by contact with contaminated objects and surfaces (UNICEF 2020., WHO 2020., IFCR 2020), provided the person making interaction with the contaminated objects

or surfaces make contact with the mucous membranes of the nose, eyes and mouth

There are three main levels of transmissions of the COVID-19 ailment.

Pre-symptomatic transmission

Pre-symptomatic Transmission is the transmission that occurs during the pre-symptomatic period. On the other hand, pre-symptomatic period is the period between the time of pathogen exposure and the time when symptoms appear. This period extend to 14 days, with a median time of 4-5 days (DCD, 2020). Cases of pre-symptomatic patients are hard to obtain from the general population. However screening of individuals who made close contacts with symptomatic cases and random testing regimes provide pre-symptomatic data. He (2020) in MacIntosh (2020) observed that viral load was highest in throat swabs at the time of symptom onset, and inferred that infectiousness peaked on or before onset of symptoms. This observation was collaborated by WHO (2020) whose consolidated data provide indications that the shedding of the virus is highest in nasopharyngeal and oropharyngeal region of patients (popularly known as the upper respiratory tract) normally day one (1) to day three (3) after viral exposure. It is at this period that the infected persons are most contagious than at any other period of the infection. WU and McGroogan (2020) says that the pre-symptomatic stage is the almost the certain driver of local outbreaks, and contribute significantly to the local, regional, national and global spread of the pandemic

Symptomatic transmission

This is the second level of transmission. It refers to the passing of infection from a person who has observable clinical manifestation of the infection. The Centers for Disease Control and Prevention (CDC) observes that COVID-19 is mainly transmitted when symptomatic people, who are within a two meter distance, sneeze or cough to release respiratory droplets laden with the virus. When the infected secretions make direct contact with the mucous membrane of the healthy person, then infection occurs. Likewise, infection can occur if a healthy person touches a surface laden with infected respiratory secretions, and then touches the mucous membranes of the eye, nose and mouth (McIntosh, 2020)

Literature does not seem to support that other routes can cause transmission of COVID-19 under natural conditions. Though the viral RNA has been identified in feces, blood, serum, saliva, tears and urine of symptomatic patients, infections resulting from these body secretions have not been documented (ECDC, 2020). Similarly **Laguipo, (2020)** observes that the experiments done from semen samples obtained from COVID-19 young men patients from USA did not provide conclusive indications that the virus can be sexually transmitted. Parallel studies conducted at the University of Utah and Huazhong University of Science and Technology in China, gave similar results. A joint clinical

report between WHO and China on whether COVID-19 could be transmitted through non respiratory body specimen, was conclusively indicative that such specimen were not statistically significant in the spread of infection. This is based on the premise that respiratory viruses are generally not transmitted through a non-respiratory route. No evidence has provided indications that COVID-19 can be transmitted through contact with non-mucous membrane sites (McIntosh 2020). Transmission of respiratory viruses (such as COVID-19) by blood transfusion or by organ transplantation has not been reported (Center for Disease Control and Prevention 2020). Indeed no other respiratory virus has been reported to have been transmitted through any other route. Likewise, Infections from respiratory droplets can only be within a 2 meter range. Beyond this range, the clinical importance of the infected respiratory droplets to the epidemiology of COVID-19 is lost (McIntosh 2020). However it is universally recommended that precautionary procedures be observed especially when dealing with long range air currents, especially if the currents trajectory is originating from a healthcare facility

Asymptomatic transmission

The WHO defines asymptomatic individuals as people who display no symptoms of a disease, yet confirmatory laboratory tests results allude that the patient is positive. Chisholm et al (2018), in their study of asymptomatic patients posited that the patients remain as infected hosts, are able to spread the disease, but remain symptom free themselves. Consequently these individuals are not readily identified from a normal population, and are normally never an obvious target of disease control efforts. Asymptomatic cases can only be detected through contact tracing or through expanded efforts of random testing from disease surveillance teams (WHO, 2020), and appear to be reservoirs of pathogen loads equivalent to symptomatic cases (Oran and Topol (2020). The epidemiological importance of asymptomatic cases, sometimes referred as carriers, is that the virus can spread silently and deeply without being detected, which by itself challenges the effectiveness of disease control interventions in any population. Different disease display different asymptomatic prevalence across different population clusters, for instance the Influenza Virus shows a mean carriage range of 5-35%, 13% for Severe Acute Respiratory Syndrome (SARS) (Wilder-Smith, Telesman, Heng, Earnest, Ling and Leo, 2005). The prevalence of asymptomatic prevalence of COVID-19 has remain uncertain but Oran and Topol (2020) investigations of asymptomatic prevalence amongst sixteen (16) COVID-19 study cohorts obtained from a non-random mosaic sample, posted an asymptomatic prevalence range of 40-45%. Nishiura et al. (2020) in Daihai et al (2020) estimated the asymptomatic ratio of COVID-19 to be 41.6%.

Infections from asymptomatic cases are as contagious as those from symptomatic individuals, who for a longer period continue to expose the population to the risks associated with COVID-19 (Ait, Abdelhafid, Mohamed and Mohamed, 2020

and Oran & Topo 2020). To isolate the asymptomatic cases, governments have to adopt innovative tactics for public health disease surveillance and expensive sourcing of data through random crowd testing, even amongst individuals who do not possess symptoms of COVID-19. WHO-4 (2020) reports that contact tracing has been the superlative way of isolating asymptomatic cases

COVID-19 in Children

UNICEF (2020) posits that COVID -19 cases in children are not well understood. This observation is collaborated by Hong, Wang, Hung-Tao and Chih-Jung (2020) who admitted that studies amongst COVID-19 pediatric patients are scanty. However, available data alludes to the fact that children are quite susceptible to the virus but manifest clinical symptoms which are less mild than those of adults. Similarly, pediatric patients almost recover within 1–2 weeks after onset of symptoms, and the disease is less likely to progress to the lower respiratory tract. Consequently, the severe symptoms associated with COVID-19 such as acute respiratory distress syndrome, septic shock, refractory metabolic acidosis and coagulation dysfunction are rare in children.

This argument was collaborated by statistical results emanating from the Chinese Center for Disease Control and Prevention, where out of 44,672 confirmed cases of COVID-19, only one death was report of a person aged less than 19 years. Studies from the United States of America indicated that among patients with COVID-19, 80% of deaths occurred among adults whose age is more than 65 years. No fatalities were reported among persons aged less than 19 years. Initial studies from Italy did not report any death from children (Safadi, 2020). Studies conducted by Dong, Mo, Hu, Qi, Jiang, Jiang(2020) in Safadi (2020) demonstrated that school going children were less likely to manifest severe symptoms of COVID-19 infection. The children were either asymptomatic or had mild upper respiratory tract symptoms. Those who contracted pneumonia reported mild clinical manifestation of the same.

III. IMPACT AND MITIGATION OF COVID-19 TO THE EDUCATION SYSTEM

When COVID-19 cases were reported governments around the world responded by closing educational institutions. The result was a disruption of learning to 1.5 billion children and youth (UNESCO 2020-6). Data collected by UNO (2020) indicated that by March 25th of 2020, 27 countries effected school closure before cases of the virus had been recorded. In 69 countries and territories around the world, national and regional examinations were either cancelled or postponed. The justification for closing educational institutions was informed by the principle that the spread of an pandemic can be stemmed through non pharmaceutical interventions (Mustafa 2020; UNESCO IESALC 2020). These interventions, notes Mustafa include social distancing and self-isolation. The governments that responded by closing education institutions immediately the COVID-19 cases were

reported posted success in achieving slowed down rates of spread of the infection. Literature is awash with mathematical models obtained from previous world pandemics, which were useful in informing governments and education sector policy makers on how and when to respond COVID-19. Further UNICEF, WHO and IFRC have provided precautionary guidelines necessary for preventing the spread of COVID-19 within an education setting.

a) Higher Learning Institutions

Reporting on the impact of COVID-19 to higher education, UNESCO's International Institute for Higher Education in Latin America and the Caribbean (IESALC) identifies the major and most immediate consequences. The temporarily cessation of face to face teaching was particularly disruptive to undergraduate students, and those high school graduates aspiring to enter higher education (UNESCO-IESALC, 2020). To this category of students online learning could be of little benefit, owing to the fact that the academic calendar was disrupted very close to the end of the 2019-2020 academic year.

University lecturers and professors especially those on contractual terms suffered termination of honorarium and teaching expectations. The social and professional stigma associated with such a scenario cannot be understated. Similarly job losses amongst non-teaching staff, whose salaries are serviced by revenues generated from income streams from regular or sandwich students have been documented. In economies where long duration of the cessation of face-to-face activities were experienced, (UNESCO-ISEALC) extrapolated a decline in the supply of higher education over the short term, and a spike of the same come the subsequent academic year.

The COVID-19 has by virtue trajected university teaching and learning into a new era that heavily requires the incorporation of technologies as the principle drivers. So as higher education institutions strategized on how and when to resume the face to face teaching and learning sessions, UNESCO-ISEALC (2020) urged the institutions to re-think and redesign their teaching and learning models. The models needed to seamless fit within a technological context, occurring more on the cyber space rather than lecture halls, physical laboratories and workshops. Out of these recommendations, governments across the world advocated for online learning in higher education. Consequently, during the lockdown period, a significant surge in the utilization of radio broadcast to schools, as well as online learning tools such as MOODLE, Google classroom, Google Meet, Ding Talk (of the Alibaba Cloud), Think and learn App, Microsoft teams, Zoom and Blackboard in higher education was demonstrated.

Basic and secondary education

The response of governments to basic and secondary education mirror the initiatives observed at higher education learning Institutions. Governments noted that school closure

was a critical pillar to mitigation of the spread of COVID-19 cases amongst children. The United States Center for Disease Control (US-CDC) indicated that the timing of school closure must be early before school going children have had any contact with the pathogen. The World Bank (2020) observes that school closure is an effective tool for increasing social distancing, an important means of reducing person to person infection.

Consequently many countries of the world were quick to close the entire basic and secondary education immediately cases of COVID-19 were reported in their territories. Portugal, Spain and India used regional school closure while countries such as the UK, New Zealand, Mexico and Switzerland delayed immediate closure of schools. Other countries such as Singapore did not close schools at all (World Bank 2020).

The decision to close the whole of the school system, delayed closure or no closure at all had consequences. On one hand, the World Bank (2020) observes that a closed education system would disengage the learner from the normal school calendar. Consequently, the gains made on UNESCO's universal primary and secondary education policies were halted. In areas where closure was prolonged, the World Bank predicted that learner drop out would be observed when schools resumed. Cases of teenage pregnancies and learners getting hired for productive labour engagements have been reported, especially in low income communities of the world.

Interventions within the education sector

Pandemics are not a new phenomenon, and in almost all cases have had interruptions to the education process. Against this backdrop therefore, UNESCO declared a framework for action that need to guide countries as they respond to the disruption of learning brought about by COVID-19. The framework suggested that states and governments need to provide alternative modes of learning for children and youth who were not in school during the disruption (UNESCO 2020-5). Consequently, education ministries across the world, in consultation with state and governments responded in almost a similar way, informed by guidelines provided by the UNESCO's Declaration and Framework for Action of Education in Times of Crisis and Emergencies

In China for instance, all face to face teaching and learning were banned in the face of the pandemic. The government, on its part, launched a "Disrupted Classes, Undisrupted Learning" initiative aimed at providing flexible online learning to millions of Chinese children and youth from their homes. The theory of the initiative was guided by the Learner-centered philosophy and was tailored to break barriers that would prevent the learner from attending a learning context. To remove such barriers the initiative was conceived to leverage on technology while offering the learner options of time, place and pace. Consequently a 6 facet agenda for flexible learning was conceived, and has been used by UNESCO as a template for implementing flexible learning

scenarios across the globe. The 6 facet agenda include but not limited to the following:

First, the government mobilized all major telecom providers within china to provide internet infrastructure and increase bandwidth to support learning, especially in the underserved regions. Similarly television firms commenced open broadcasting channels, targeted to learners who could not access learning through the net. University senate was authorized to experiment with tele courses. Secondly, tools for producing education resources were provided. These tools include PowerPoint producing software, screen capture software, video production software, and software for producing multimedia elements. Thirdly, teachers were encouraged to select and utilize learning resources, such as e-books, videos, animations, quizzes and games that met the unique needs of the learner. Fourth the teachers were guided on how to adopt pedagogy within a digital framework. Fifth, technical support services were and continued being provided to teachers to improve their online teaching ability on areas such as cyber-learning software, learning management systems and procedures for conducting online learning activities. On the same note, technical teams were mobilized to give the learner support especially those experimenting with online learning for the first time. Lastly the sixth facet involved ensuring an interminable cooperation between enterprise, government, research institutes, families and schools to build platforms for sharing safety concerns related to learning and COVID-19 (UNESCO 2020-5).

Reopening of education systems

Literature supports that learning for 1.6 billion learners in more than 190 nations of the world was disrupted by Covid-19, the most significant disruption in recorded history (UNICEF 2022). Since the disruption was posing serious consequences to access and supply of education, it was imperative that governments and education partners ensured learning resumed. UNESCO and the World Bank were instrumental in guiding nations and governments on safe protocols for education reopening. Government and education officials in partnership with the public health departments were mandated to inspect educational institutional preparedness for resumption of physical learning. In doing so, they would be guided by the *Framework for reopening schools* as jointly published by UNESCO, UNICEF, World Bank and World Food Program (UNESCO 2020-3). The framework provided protocols for the formation of a COVID-19 taskforce comprising the local administration, health and education officials and school management. The taskforce would closely monitors adherence to prevention protocols putting special attention to care and supporting the whole of the system by implementing policies on correct wearing of mask by all teachers, staff, students, and visitors to institutions regardless of their vaccination status. Other protocols include but not limited to; providing access to handwashing or sanitizer facilities within the institution, providing for adequate ventilation, ensuring frequent sanitizing or cleaning

of shared facilities, staggering meal and break time and by prioritizing COVID-19 vaccination for teachers as frontline workers. Similarly, sharing information amongst stakeholders, particularly health workers, parents, guardians and teaching faculty on the state of health of the learner was enforced (UNICEF 2020-4). Students and teachers, who developed signs of infectious illness, would be isolated in designated areas within the institution, after which they'd be referred to a health care institution, for testing and specialised care.

The protocols served as a starting point for building confidence for re-opening the education system. So, nations began reopening of schools for classroom based learning. Taiwan reopened on February 25th, Denmark on April 15th, Norway and Germany on April 20 (Willey, 2020). In the UK, reopening of schools was staggered from June 1st 2020 for preschools and selected primary schools, then secondary from 15th June 2020 (Aiano et al, 2021). China, Singapore and Viet Nam, and those nations of the Pacific who were able to contain the virus to some degree started re-opening schools beginning May through June and July of 2020. Nevertheless, literature documents that by November of the same year, only 43% learners in the South and West Asia had resumed personalized learning (UNESCO, 2021)

In African countries, the back-to-school strategies were matched with a change of education policy and included a host of incentives or support programs for bringing learners back to school upon reopening. The incentives were necessary because prolonged school closures may have resulted to loss of interest to schooling, unintended pregnancies, forced marriages and trauma from sexual exploitation. Some learners had already been engaged in paid-up child labor, and were getting used to carrying out household chores. The boy learner was particularly tied up into farming, construction, herding and a host of other menial jobs. , some of which could be more attractive than schooling altogether.. Governments in Africa, particularly in Kenya Uganda and Côte d'Ivoire had to provide incentives that shielded parents from hiked fees by school management. In Sierra Leone, Zimbabwe and Senegal, policies that restricted pregnant girls from readmission into the school system were lifted. In Burkina Faso, Côte d'Ivoire, Kenya, Mali, Mauritania, Somalia and Zambia learners from poor households were provided with meals from the school feeding program with a view of encouraging education participation especially by the most vulnerable children (ADEA, AU/CIEFFA, & APHRC, 2021). A similar but improved scenario was observed in the republic of Guatemala and Peru in South America, who introduced take home meals during the period of school closure, but paired pick up of meal package from school with the delivery of education material scenario In Egypt, UNICEF, the Ministry of Education, the UK government and Egyptian Red Crescent distributed hygiene kits for the vulnerable and marginalized children, particularly those schooling in North and South Sinai as well as Ismailia (Hemed, 2021).The approach employed in Egypt was similarly adopted by Côte d'Ivoire, Nicaragua and

Somalia. Tunisia, Sierra Leone, Malawi and Kenyan schools remained closed for the better half of the year 2020, but allowed those students studying for exams to resume classes, giving them variable weeks of remedial learning before administering the examinations (UNESCO 2020-4). A worth to note scenario was the use of government administrators (chiefs, assistant chiefs and community leaders) to enforce a mandatory return to school policy by the Kenyan government. These measures were celebrated as working formulas for reducing the risk of non-return to school after reopening.

IV. LESSONS GATHERED FROM THE PANDEMIC

While complete understanding of the consequences of COVID-19 pandemic to the education sector is still forming, vital lessons can be drawn from the pandemic.

1. That technology is an integral component of learning now and in the future. The pandemic has exposed the unique opportunities available in technology assisted learning, particularly e-learning. According to the World Bank (2021) educators across the globe have been able to reimagine the traditional institutional based learning more than ever before.
2. The COVID period challenged teachers to build up their digital literacy while challenging global telecommunication firms to re-engineer their infrastructure so as to increase capability and connectivity
3. All education stakeholders including regulatory agencies, development partners, administrators and parents (as discussed herein) can be vital catalysts in ensuring seamless learning during and after a pandemic, now and in the future
4. The modus operandi for future learning and assessment is to be founded on the premise of flexibility not only on the school calendar but also on pedagogy and learning places
5. Learners from disadvantaged communities, vulnerable and learner with special needs require special support during a crisis. Special provisions should be made to shield them from alienation from learning opportunities

REFERENCES

- [1] ADEA, AU/CIEFFA, & APHRC (2021). School Reopening in Africa during the COVID-19 Pandemic. Abidjan, Ouagadougou, Nairobi: ADEA, AU/CIEFFA, APHRC. Downloaded on 12th January 2022 from https://www.adeanet.org/sites/default/files/school_reopening_kix_observatory.pdf
- [2] Aiano, F., Mensa, A.A., McOwat, K., Obi, C., Vusirikala, A., Powel, A. (2021): COVID 19 Outbreaks following full reopening of primary and secondary schools in England: cross sectional national surveillance, November 2020. The Lancet Region Health, Europe, downloaded On 12th June 2021 from [https://www.thelancet.com/journals/lanepi/article/PIIS2666-7762\(21\)00097-1](https://www.thelancet.com/journals/lanepi/article/PIIS2666-7762(21)00097-1)
- [3] Ait A, Rachid & Benksim, Abdelhafid & Amine, Mohamed & Cherkaoui, Mohamed. (2020). Asymptomatic COVID-19 infection management: The key to stop COVID-19. The Journal of clinical investigation. 11. 10.5799/jcei/7866.). Downloaded on 8th July

- from
https://www.researchgate.net/publication/340314585_Asymptomatic_COVID-19_infection_management_The_key_tostop_COVID-19/citation/download
- [4] Anjorin, A. (2020). The coronavirus disease 2019 (COVID-19) pandemic: A review and an update on cases in Africa. *Asian Pacific Journal of Tropical Medicine*. 13. 1-5. 10.4103/1995-7645.281612.
- [5] Center for Disease Control and Prevention (2020). Interim Clinical Guidance for Management of Patients with Confirmed Coronavirus Disease (COVID-19). Downloaded on 7th July 2020 from <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html>
- [6] Center for Disease Control and Prevention (2022) Guidance for COVID-19 Prevention in K-12 Schools. Downloaded On 6th January 2022 from <https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/k-12-guidance.html>
- [7] Chisholm, Rebecca & Campbell, Patricia & Wu, Yue & Tong, Steven & Mcvernon, Jodie & Geard, Nicholas. (2018). Implications of asymptomatic carriers for infectious disease transmission and control. *Royal Society Open Science*. 5. 172341. 10.1098/rsos.172341
- [8] Daihai Hea, *, Shi Zhaob,c , Qianying Lind , Zian Zhuanga , Peihua Caoe , Maggie H. Wangb,c , Lin Yangf (2020). The relative transmissibility of asymptomatic COVID-19 infections among close contacts. *International Journal of Infectious Diseases*, Elsevier 2020.
- [9] Daniel P. Oran, AM and Eric J. Topol, (MD 2020). Prevalence of Asymptomatic SARS-CoV-2 Infection. *Annals of internal medicine*, A Narrative Review Published online 2020 Jun 3. doi: 10.7326/M20-3012. Downloaded on 8th July 2020 from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7281624/>
- [10] Di Gennaro, F., Pizzol, D., Marotta, C., Antunes, M., Racialbuto, V., Veronese, N., and Smith, L (2020) *International Journal of Environmental Research and Public Health Review Coronavirus Diseases (COVID-19) Current Status and Future Perspectives: A Narrative Review*
- [11] European Centre for Disease Prevention and Control-ECDC (2020) Coronavirus disease 2019 (COVID-19) and supply of substances of human origin in the EU/EEA. Downloaded on 7th July 2020 from <https://www.ecdc.europa.eu/sites/default/files/documents/covid-19-supply-substances-human-origin.pdf>
- [12] Hasnain, J., Shah, F., Ayyaz, K., Shahzar, K., Hazrat, U., Rabia, L., & Sajjad.S. (2020). COVID-19: Review of Epidemiology and Potential Treatments Against 2019 Novel Coronavirus. *Discoveries*. 8. 10.15190/d.2020.5.
- [13] Hemed,K. (2021). Combating COVID-19 in public schools. Downloaded on 13th January 2022 from <https://www.unicef.org/egypt/stories/combating-covid-19-public-schools>
- [14] Hong, Hao & Wang, Yuan & Chung, Hung-Tao & Chen, Chih-Jung. (2020). Clinical characteristics of novel coronavirus disease 2019 (COVID-19) in newborns, infants and children. *Pediatrics & Neonatology*. 61. 10.1016/j.pedneo.2020.03.001.
- [15] Laguipo, A.B.(2020). SARS-CoV-2 found in semen of COVID-19 patients. Downloaded on 7th July 2020 from <https://www.news-medical.net/medical/authors/angela-betsaida-laguipo>
- [16] McIntosh, K. (2020) Coronavirus disease 2019 (COVID-19): Epidemiology, virology, and prevention. Downloaded on 7th July 2020 from https://www.uptodate.com/cont_ent_s/coronavirus-disease-2019-covid-19-epidemiology-virology-and-prevention
- [17] Meller, M. (2020) The asymptomatic and pre-symptomatic spread of COVID-19, Gundersen Health system. Downloaded on 7th July 2020 from <https://www.gundersenhealth.org/covid19/the-asymptomatic-and-pre-symptomatic-spread-of-covid-19/>
- [18] Meredith, S., Choudhury, S.R., Lee, Y.N. (2020) Global Increase in Reported Corona Virus Cases. Downloaded on 15th July from <https://www.cnbc.com/2020/04/02/coronavirus-live-updates.html>
- [19] Michelle L., Holshue, Chas DeBolt, M.P.H., Scott Lindquist, M.D., Kathy H. Lofy, M.D., John Wiesman, Dr.P.H., Hollianne Bruce, M.P.H., Christopher Spitters, M.D., Keith Ericson, P.A.-C., Sara Wilkerson, M.N., Ahmet Tural, M.D., George Diaz, M.D., Amanda Cohn, M.D., First Case of 2019 Novel Coronavirus in the United States Downloaded from 23rd July 2020 from https://www.nejm.org/doi/full/10.1056/NEJM_Moa200119_1#article-letters
- [20] Mustafa, Nasir. (2020). Impact of the 2019–20 coronavirus pandemic on education. 10.13140/RG.2.2.27946.98245. Downloaded on 8th July 2020 from https://www.researchgate.net/publication/340849956_Impact_of_the_2019_20_coronavirus_pandemic_on_education/citation/download
- [21] Safadi, Marco. (2020). The intriguing features of COVID-19 in children and its impact on the pandemic. *Jornal de Pediatria*. 96. 10.1016/j.jped.2020.04.001.
- [22] Sheikhi, Kowsar & Shirzadfar, Hamidreza & Sheikhi, Milad. (2020). A Review on Novel Coronavirus (Covid-19): Symptoms, Transmission and Diagnosis Tests. 10.33702/ridtm.2020.2.1.1. Downloaded from on 6th July 2020 from https://www.researchgate.net/publication/341105491_A_Review_on_Novel_Corona_virus_COvid-19_Symptoms_Transmission_and_Diagnosis_Tests
- [23] Spiteri, Gianfranco & Fielding, James & Diercke, Michaela & Campese, Christine & Enouf, Vincent & Gaynard, Alexandre & Bella, Antonino & Sognamiglio, Paola & Moros, Maria & Riutort, Antonio & Demina, Yulia & Mahieu, Romain & Broas, Markku & Bengnér, Malin & Buda, Silke & Schilling, Julia & Filleul, Laurent & Lepoutre, Agnès & Saura, Christine & Ciancio, Bruno. (2020). First cases of coronavirus disease 2019 (COVID-19) in the WHO European Region, 24 January to 21 February 2020. *Euro surveillance*. 25. 10.2807/1560-7917.ES.2020.25.9.2000178.
- [24] Susan R. Weiss1* and Sonia Navas-Martin2* (2020). Coronavirus Pathogenesis and the Emerging Pathogen Severe Acute Respiratory Syndrome Coronavirus. *MICROBIOLOGY AND MOLECULAR BIOLOGY REVIEWS*, Dec. 2005, p. 635–664 Vol. 69, No. 4, 1092-2172/05/\$08.00_0 doi:10.1128/MMBR.69.4.635–664.2005, Copyright © 2005, American Society for Microbiology.
- [25] UNESCO (2020-1): Education: From Disruption to recovery, UNESCO. Downloaded on 8th July 2020 from <https://en.unesco.org/covid19/educationresponse+>
- [26] UNESCO (2020-2). Handbook on Facilitating Flexible Learning during Educational Disruption. The Chinese experience in maintaining uninterrupted learning in COVID -19 Outbreak. Downloaded on 10th July 2020 from <https://iite.unesco.org/wp-content/uploads/2020/03/Handbook-on-Facilitating-Flexible-Learning-in-COVID-19-Outbreak-SLIBNU-V1.2-20200315.pdf>
- [27] UNESCO (2020-3) COVID-19 Education Response Education Sector issue notes Issue Noten^o7.3–June2020. Downloaded on 12th January 2022 from <https://unesdoc.unesco.org/ark:/48223/pf0000373610/PDF/373610eng.pdf.multi>
- [28] UNESCO (2020-4). Emerging lessons from country experiences in managing the process of reopening schools. Downloaded on 13th January 2022 from <https://www.unicef.org/media/83026/file/Emerging-lessons-from-countries-experiences-of-reopening-schools-2020.pdf>
- [29] UNESCO (2021) School closures and regional policies to mitigate learning loss due to COVID-19: Downloaded on 13th January 2022 a focus on the Asia-Pacific. <https://unesdoc.unesco.org/ark:/48223/pf0000378429>
- [30] UNESCO IESALC. (2019). COVID-19 and higher education: Today and tomorrow April 9, 2020 1 Impact analysis, policy responses and recommendations. Downloaded on 8th July 2020 from <http://www.iesalc.unesco.org/en/wp-content/uploads/2020/04/COVID-19-EN-090420-2.pdf>
- [31] UNICEF (2020). Key Messages and Actions for COVID-19 Prevention and Control in Schools. Unicef, WHO and IFCR. Downloaded on 7th July 2020 from https://www.who.int/docs/default-source/coronaviruse/key-messages-and-actions-for-covid-19-prevention-and-control-in-schools-march-2020.pdf?sfvrsn=baf81d52_4
- [32] UNICEF (2022). UNICEF for every child. Downloaded on 12th January 2022 from <https://www.unicef.org/press-releases/schools-still-closed-nearly-77-million-students-18-months-pandemic-unicef>
- [33] UNO (2020). United Nation Policy bried on the Impact of COVID-19 on Children. Downloaded on 9th July 2020 from <https://www.unicef.org/press-releases/schools-still-closed-nearly-77-million-students-18-months-pandemic-unicef>

- [://unsdg.un.org/sites/default/files/2020-04/160420_Covid_Children_Policy_Brief.pdf](https://unsdg.un.org/sites/default/files/2020-04/160420_Covid_Children_Policy_Brief.pdf)
- [34] Wilder-Smith, A., Teleanu, M. D., Heng, B. H., Earnest, A., Ling, A. E., & Leo, Y. S. (2005). Asymptomatic SARS coronavirus infection among healthcare workers, Singapore. *Emerging infectious diseases*, 11(7), 1142–1145. <https://doi.org/10.3201/eid1107.041165>
- [35] Willey, M (2020). COVID-19: Countries around the world are reopening their schools. Downloaded from on 12th January 2020 from <https://www.weforum.org/agenda/2020/05/coronavirus-countries-schools-education-covid19-reopen-classroom/>
- [36] World Bank (2020) Guidance Note on Education Systems' Response to COVID19 March 25, 2020. Downloaded on 10th July 2020 from <http://pubdocs.worldbank.org/en/450881585235950757/COVID19-Education-Sector-Guidance-Note-March26.pdf>
- [37] World Bank. 2020. The COVID-19 Pandemic : Shocks to Education and Policy Responses. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/33696> License: CC BY 3.0 IGO
- [38] World Bank, (2021). Remote Learning During COVID-19: Lessons from Today, Principles for Tomorrow. <https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-covid-19-pandemic>
- [39] World Health Organization (2018) Managing epidemics, Key facts about major deadly diseases
- [40] World Health Organization (2019) Coronavirus disease (COVID-19) training: Online training. Downloaded on 1st July 2020 from <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/training/online-training>
- [41] World Health Organization (2020) Laboratory testing for coronavirus disease (COVID-19) in suspected human cases Interim guidance for 19 March 2020
- [42] World Health Organization (2020) . Coronavirus disease 2019 (COVID-19) Situation Report – 73. Data as reported by national authorities by 10:00 CET 2 April 2020. Downloaded on 6th July 2020 from <https://www.who.int/docs/default-source/coronavirus/situation-reports/20200402-sitrep-73-Covid-19.pdf>
- [43] Wu, Zunyou and MacGroan . (2020). Asymptomatic and Pre-Symptomatic COVID-19 in China. *Infectious Diseases of Poverty* 9:72 Downloaded on 16th July 2020 from <https://doi.org/10.1186/s40249-020-00679-2>