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Editorial

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Editorial

Special Issue 2020: "Impact of COVID-19 on Societies Around the Globe"

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Our world has never been the same following the devastating effect of the novel coronavirus disease 2019 (COVID-19) since December 2019 in Wuhan, China. Now as a global pandemic, the COVID-19 disease has challenged and altered social, economic, educational, political, and health systems worldwide (World Health Organization, 2020). As of the end of July 2020, there were over 17 million confirmed cases and over 685,000 confirmed deaths globally (Worldometers, 2020). The focus of this special issue is to address the impression COVID-19 disease has on societies worldwide. The four papers included in this special issue present diverse perspectives of the pandemic. The papers are structured as follows:

In the first contribution, the author analysed public attitudes in São Paulo, Brazil's hardest-hit city, using Twitter as the preferred platform for text mining. With more people staying at home since the COVID-19 outbreak, there has been a rising number of digitally active users vocal about government responses to the pandemic, especially regarding lockdown measures. User-generated content on social networking sites (SNS) has served as a valuable source of information for exploring public attitudes toward the pandemic, as SNS users often reveal their perceptions of government actions through these platforms. SNS have allowed for large-scale data collection from citizens within a specific timeframe and location, making information readily available in real-time.

In the second paper, the authors analysed the Kenyan situation in implementing and adhering to the United Nations Educational, Scientific and Cultural Organization (UNESCO) recommendations to enhance learning in all levels of education. They also evaluated the challenges and possible remedies for future actions. The paper was largely based on library research and secondary sources to draw practical inferences for both education research and policy.

The third contribution briefly examined the initial, existing, and possible future effects of the COVID-19 pandemic. Though researchers and experts are working hard to estimate the impact of this pandemic on the global economy, it is noted by the author to perfectly project its long term effect. Also, the paper cautions against the over-dependence of retrospective estimations of other serious global health disasters like the Severe Acute Respiratory Syndrome (SARS), the Middle East Respiratory Syndrome (MERS), and Ebola Virus Disease (EVD) to draw COVID-19's long term effects on the global economy as it could lead to an underestimation of the damaging effects of the COVID-19 pandemic.

Finally, the fourth paper examined the scope of misinformation in the COVID-19 era as disseminated by peer-reviewed journals and the nature of poor publishing ethics during the pandemic. The paper cites the case of retraction of a pseudo-scientific paper on 5G that asserts that

5G induces COVID-19 in skin cells. The author suggests that COVID-19-related misinformation might similarly arise from poorly vetted literature with the continued failure of implementing an open data (OD) policy being one of the major reasons behind this misconduct. The author further provides some key recommendations to reduce the misinformation in the COVID-19 infodemic.

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Articles

Analyzing Public Attitudes Toward COVID-19 Lockdown Measures Through Text Mining Twitter: São Paulo as a Case Study

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Abstract

With more people staying at home since the COVID-19 outbreak, there has been a growing number of digitally active users vocal about government responses to the pandemic, especially regarding lockdown measures. User-generated content on social networking sites (SNS) has served as a valuable source of information for exploring public attitudes toward the pandemic, as SNS users often reveal their perceptions of government actions through these platforms. SNS have allowed for large-scale data collection from citizens within a specific timeframe and location, making information readily available in real-time. Brazil presents a particularly interesting case, as it suffers from one of the highest mortality rates in Latin America despite having the highest Global Health Security Index (GHSI) in the region. This paper examines public attitudes in São Paulo, Brazil's hardest-hit city, using Twitter as the preferred platform for text mining. Because information on public sentiment toward government lockdown responses may help weigh in on future policy decisions under similar developments, sentiment analysis is then conducted on the data using the VADER model (Valence Aware Dictionary and sEntiment Reasoner) as a way to conceptualize the results.

Keywords: coronavirus, Covid-19, lockdown responses, natural language processing, sentiment analysis.

Introduction

In December 2019, a novel case of coronavirus pneumonia was discovered in Wuhan, China, where several patients reported flu-like symptoms and other respiratory difficulties. Some of these patients had previously been exposed to the Huanan Seafood Wholesale Market, where the outbreak presumably started. As the spread of the virus began to evolve rapidly into a global challenge, the pandemic called for several contingency plans, some of which took on increasingly restrictive policies. These included lockdown measures that limited not only human mobility between regional and international borders, but also social interactions, promoting closures of public spaces, such as schools and restaurants that would have otherwise resulted in large gatherings. Although the World Health Organization (WHO) initially denied evidence of human-to-human transmission during the earlier phase of the pandemic, the organization later recognized quarantine as an effective tool against the spread of the virus (WHO, 2020).

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With more countries resorting to lockdown as part of their integral response to the pandemic, several countries observed notable improvements in preventing additional deaths, as evidenced by cases in China, Italy, and Spain. Italy, one of Europe's hardest-hit regions during the pandemic, seemed to have averted nearly 200,000 hospitalizations by opting for a nation-wide quarantine (Gatto et al., 2020). Brazil pursued similar lockdown strategies when Sao Paulo declared a partial statewide quarantine in late March, closing all non-essential businesses, restaurants, schools, universities, and entertainment centers (Legislative Assembly of the State of São Paulo, 2020a). Much of this, however, was implemented at a provincial level as a result of local authorities responding differently to the federal government's lack of plans for a lockdown (Giraudy et al., 2020).

Brazil's less territorially uniform approach to national quarantine was due to many reasons, one of which accounted for President Jair Bolsonaro's pro-economic policies. A nationwide lockdown would have meant that many businesses would not farewell. While this may have proven favorable for proponents of anti-quarantine measures, who usually tend to be from the lower-income group, Brazil's growing coronavirus-related fatalities have also equally provoked protests against the administration's inaction toward a more comprehensive lockdown (Londoño et al., 2020). Citizens' responses as a result have varied in polarizing ways. With an intended goal of finding the most dominant public sentiment on quarantine, this research focuses on identifying and analyzing various citizens' reactions, taking the city of São Paulo as a case study.

With a population of about 12 million, São Paulo is not only Brazil's largest metropolitan area but also the most affected region. A successful lockdown would have meant that Brazil would be better able to contain the overall impact of the pandemic at a national level and, thus, flatten the curve sooner. São Paulo, as a result, became a national focus for counteracting the virus.

Related Work

Similar studies have been conducted using Natural Language Processing (NLP) as a way to examine the impacts of government policies on societies during an outbreak of an infectious disease or other public-health related issues. One particular study by Lazard et al. (2015) used live Twitter chat held at the Centers for Disease Control and Prevention to uncover major themes of public concerns about the presence of the Ebola virus in the U.S. during the 2014 outbreak in West Africa. A related work by Öztürk and Ayvaz (2018) looked into the Syrian refugee crisis by collecting relevant tweets written in Turkish and English as a way to determine public opinions about the crisis. Twitter has also helped predict outcomes of elections, as demonstrated by Wang et al. (2012), which employed a real-time sentiment analysis on the collected tweets regarding the 2012 U.S. presidential elections. The resulting analysis achieved 59% accuracy in predicting public sentiment toward the race.

Methodology

Twitter is a microblogging website that has become a major source of political commentaries and conversations. Although tweets were formerly limited to 140 characters, they are now permitted up to 280 characters, allowing for longer posts and content (Rosen, Ihara, 2017). With over 18 million users, Brazil has one of the largest Twitter accounts in the world (Export Entreprises, 2020). Presidents in the past have used Twitter not only also as a tool for political campaigns, but also as a way to reach larger audiences. Naturally serving as a platform to gauge public opinion on upcoming elections and other related issues, Twitter, for example, was a hotbed for political conversations during the impeachment of Dilma Rousseff in 2016 (Olivetti de França et al., 2018).

Text Mining and Acquisition

A large number of tweets were collected using a Python library in which the parameters were set as follows: taking São Paulo as a geographical point of reference, tweets written in Portuguese containing the keywords, were collected from anywhere within a radius of 24 km from the city's center, Diadema.

Table 1. Parameter details on text mining

Parameters	Details
Search terms	confinamento, distanciamento social, lockdown, quarentena, restrições
Geolocation	Diadema, São Paulo, Brazil
Radius	24 km
Language	Portuguese

The specified radius range was large enough to cover most areas of the state capital. Because João Doria, the Governor of São Paulo, declared a partial state lockdown on March 24, 2020, a week after the country's first coronavirus-related death, the tweets were gathered from the day when the mandate went into full effect until May 11, 2020, when the lockdown was set to end. See Table 1 and Figure 1 for details.

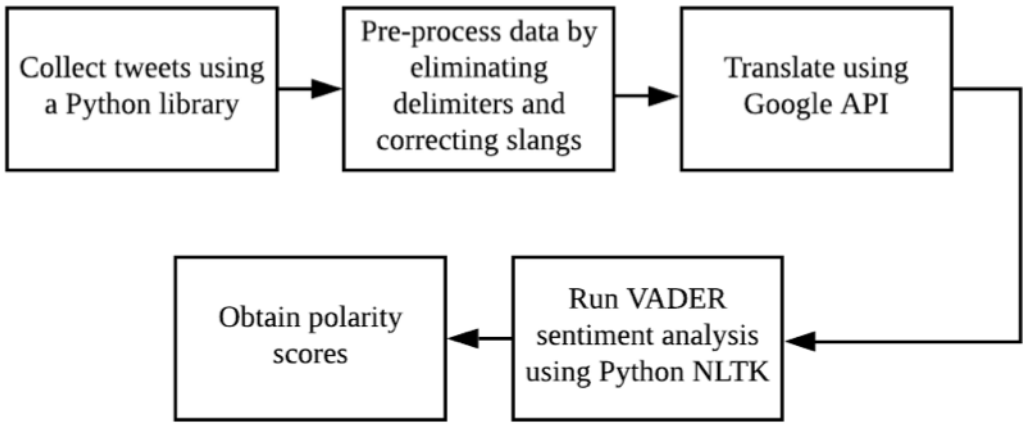

Fig. 1. Flowchart of the step-by-step process

Data Processing

Before the tweets were used for sentiment analysis, they were cleared of multiple delimiters, such as “, ”, and double line breaks. Some of the most popular slangs and abbreviations were also corrected for later translation work, which was done using the Google Translate API (Plotkin, 2015). A total of 55,418 tweets were processed and used for sentiment analysis.

Table 2. Corrected slangs and abbreviations

Slang	Correct Term	Slang	Correct Term	Slang	Correct Term
aq/aki	aqui	FDP	filho da puta	pf/pfvr	por favor
bj/bjo	beijo	gnt	gente	qdo/qnd/qndo	quando
cê/vc	você	ki	o quê	tmb/tb	também
ctg	contigo	n/ñ/naum	não	vcs	vocês

d+	demais	nd	nada	vlw	valeu
dps	depois	neh	né	pqp	puta que pariu
eh	é	ngm	ninguém	pf	por favor

Sentiment Analysis

With over 9000 lexical features, VADER is a Natural Language Toolkit (NLTK) from an open-source Python library that analyzes sentiments specifically extracted from social media sources, including product reviews and news editorials. It returns a series of polarity scores based on the text's positive and negative aspects. Neutral sentiments typically have zero polarity if the texts have no identifiable sentiment; positive and negative sentiments will have polarity scores that are greater and less than zero, respectively (Sarkar et al., 2018). VADER is also based on a human-curated, gold-standard sentiment lexicon, and further provides popular dictionary terms such as slangs and acronyms (Ao et al., 2020).

Before settling on VADER, two other Python NLTK modules, such as the Naive Bayes classifier and TextBlob, were tested on a series of sample texts to identify the model that best represented the overall sentiment. A study by Hutto and Gilbert (2014) revealed that the VADER analysis performed highly, if not better, when compared to seven other well-established models, such as, but not limited to, Affective Norms for English Words (ANEW), General Inquirer (GI), Linguistic Inquiry Word Count (LIWC), and SentiWordNet (SWN).

Table 3. Sample tweets from São Paulo (originally in Portuguese) with polarity scores

Date	Replies	Retweets	Favorites	Tweets	Polarity
25/3/2020	1	0	7	leaving one confinement to another	0
18/4/2020	0	2	2	We have nothing left, being in quarantine, so let's laugh!	0.6334
10/5/2020	0	0	1	this quarantine sucks	-0.3612

Results and Discussion

The collected data was visualized according to its volume size and further categorized into positive, negative, and neutral polarities. When the lockdown went into effect in São Paulo, a large number of tweets relating to the mandate were shared online, suggesting popular interest in the subject. However, with time, the number of tweets relating to the lockdown went down, though there was another spike in counts just days leading up to the state's hopeful easing in May (see Figure 2).

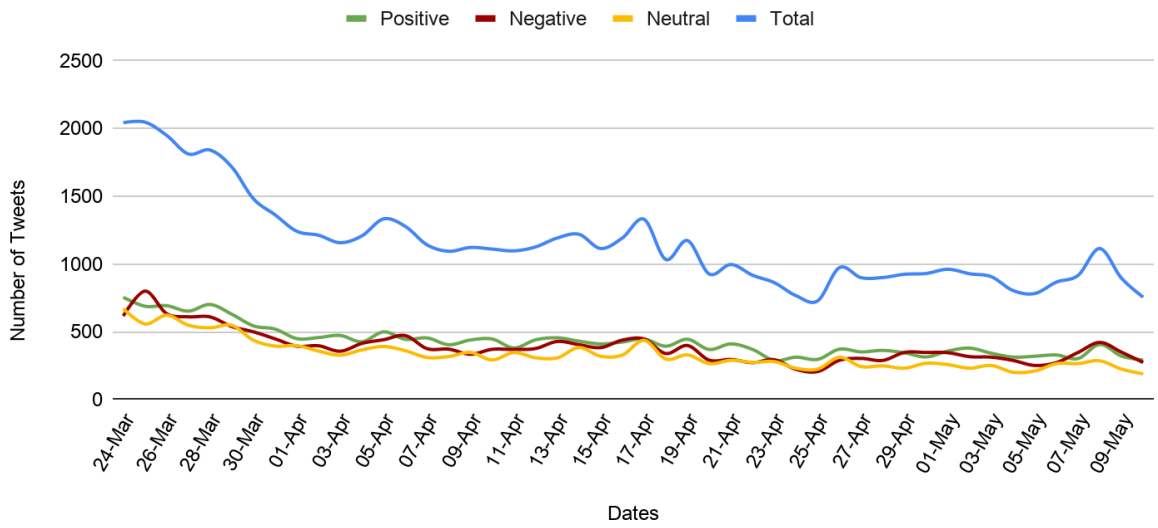

Fig. 2. Volume of tweets relating to the lockdown in São Paulo

The initial large volume of tweets that were observed during the earlier phase of the quarantine occurred just a day after the lockdown began and had a dominant presence of negative sentiments when compared to those with neutral and positive polarities. Similar trends were observed on April 29 and May 8, which coincided with the state's formal announcements of making masks mandatory on public transports and extending the quarantine until the end of the month, respectively as depicted in Figure 3 (Legislative Assembly of the State of São Paulo, 2020b).

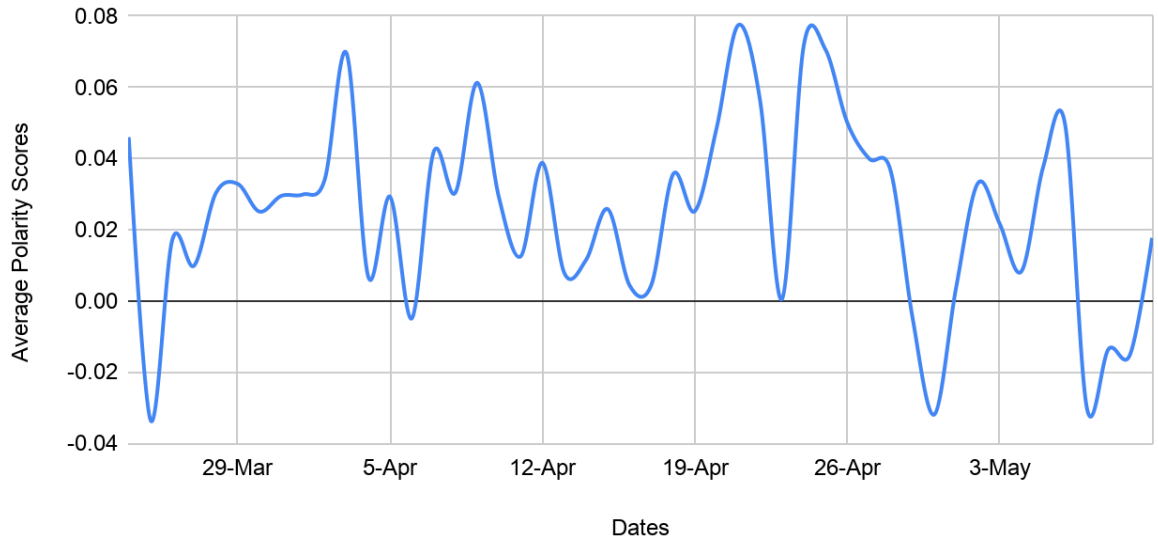

Fig. 3. The average polarity scores of daily tweets

The overall polarity scores revealed that a lot of tweets were positive, representing 37.3 % of all posts. As shown in Figure 4, however, these positive polarities were much closer to zero than to 1, suggesting that they were more neutral-positive.

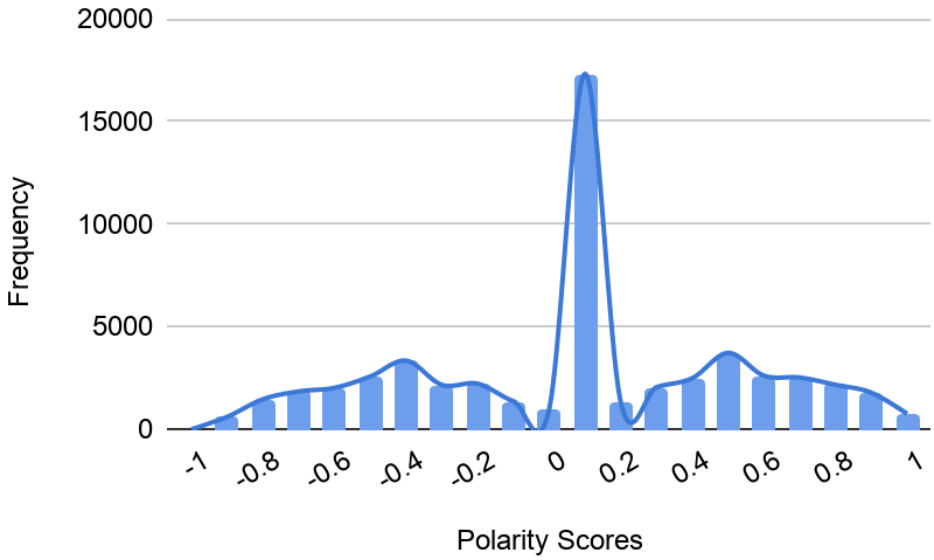

Fig. 4. A histogram showing the distribution of polarity scores

A couple of factors might have accounted for this result. Lockdown in São Paulo was mainly unsuccessful and had little significance to those employed in the informal sector, which absorbed 36.3 % of Brazil's workforce in 2019 (Saraiva, Renaux, 2019). A large number of these workers were also concentrated in the state capital, which consistently demonstrated isolation rates that were below the state's required minimum of 55 %.

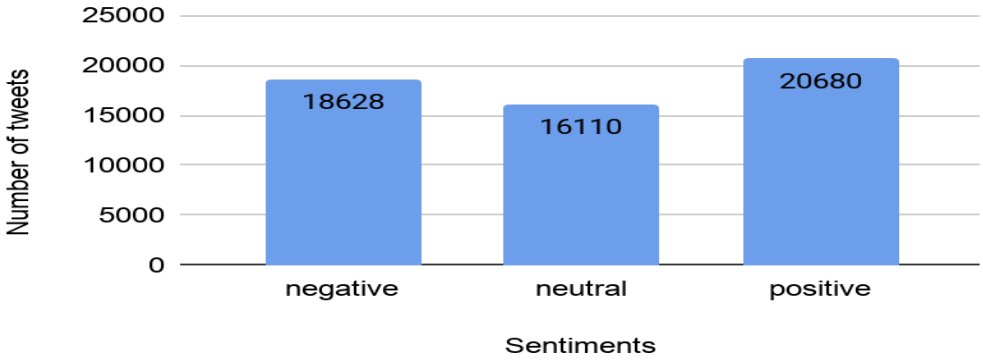

Fig. 5. A bar graph of tweets, classified by their degree of sentiments

Prominent political leaders in Brazil have moreover reacted varyingly to the pandemic, adding to the confusion and, thus, setting up for an unsuccessful lockdown endeavor. When Governor Doria actively worked toward promoting social isolation, President Bolsonaro downplayed the pandemic, encouraging people to return to work. With no coherent government's message toward the crisis, a statewide quarantine in São Paulo was perceived by the public as having low legitimacy.

Limitations and Conclusion

Using the state capital, São Paulo, as a case study, this research looked into Brazil's public attitude toward a statewide lockdown that took place between March 24 and May 11, 2020. Based on the sentiment analysis that was conducted, there were more positive tweets, followed by negative and neutral sentiments, respectively. These positive scores, however, were much closer to zero, a neutral polarity, than they were to 1.

Serving as a potential limitation, the tweets used for this study were translated from Portuguese to English, as the VADER analysis processed only English lexicons. The VADER model

also did not distinguish genuine positive texts from those with sarcastic undertones, which were a common feature of political commentaries.

Future works can include methods specifying tweets' emotions as a way of identifying more detailed patterns of public responses to the lockdown. The scope of the study could also extend to other parts of Brazil outside the state and analyze how they perceive the partial lockdown. The growing severity of the pandemic in São Paulo has opened up future possibilities for multiple revisions to former quarantine orders, creating opportunities for further studies on this subject around changing public attitudes. The implications of these new findings may perhaps reveal meaningful insights into whether or not Brazil as a country could successfully achieve a large-scale quarantine with desired effects.

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Conflict of Interest Statement

The author states that the study was conducted without any commercial or financial connections that could be interpreted as a possible conflict of interest.

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Implementation of UNESCO Recommendations on Enhancing Learning During COVID-19 Pandemic: A Case of Kenya

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Abstract

Most countries worldwide during the COVID-19 pandemic adopted online learning as a means for mitigating the challenges facing face-to-face classroom education. The adoption of remote learning is largely informed by the decisions reached by individual country experts in pursuant to health guidelines of social distancing by the World Health Organization. Further, the United Nations Educational, Scientific and Cultural Organization (UNESCO) suggested recommendations to countries to implement to ensure that learning remains uninterrupted during the COVID-19 period. The paper analyzes critically the Kenyan situation in implementing and adhering to the UNESCO recommendations to enhance learning in all levels of education. Also, it evaluated the challenges faced and possible remedies in form of recommendations for future actions. The paper is largely based on library research to draw practical implications for both education research and policy.

Keywords: COVID-19, implementations, Kenya, learning, online teaching, strategies.

Introduction

The recent COVID-19 pandemic has negatively affected global education. Statistics by the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2020a) estimates that "620 million learners are out of school, 35.4% of the world's student population and 39 countries have been affected by school closures." Although the closure was one of the recommendations of the joint mission on 30th December 2019 in China to curb the spread of the disease, many countries responded differently (UNESCO, 2020; Viner et al., 2020). China was the epicenter of the COVID-19 pandemic, but through emergency measures such as social distancing and lockdown, the country managed to control the spread of the virus (Zhang, 2018). Apart from these interventions, China has lessons to offer to the world in terms of how they managed the education system during the outbreak. The Chinese government launched the "School's Out, But Class's On" campaign. This large-scale online education had an impact on society and education in China (Zhou et al., 2020).

In February 2020, the Ministry of Education (MOE) in China issued a notice on supporting education and teaching using information technology during the pandemic. This was a huge calling considering that China has 270 million students at all levels and nearly 20 million faculty members at all levels. Such a huge population was required to carry out educational activities online for six weeks. This initiative provides lessons that can be useful for countries that are learning to cope

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with the COVID-19 outbreak (Zhou et al., 2020). Apart from providing online content, students were assisted in developing home-based study plans and provided with the necessary guidance. In addition to using the mass media to educate the population, the ministry recommended the adoption of local resources and national platforms. In China, Internet giants such as Tencent, Alibaba, ByteDance, iFlytek, and Dongshi Ideal have long been deeply involved in the education industry (Zhou et al., 2020).

Kenya's case during the COVID-19 pandemic

During the pandemic, Kenya adhered to the World Health Organization's recommended guidelines to curb the spread of the COVID-19. In Kenya, the Ministry of Health COVID-19 Taskforce implemented initial prevention and mitigation measures to control the spread of coronavirus. These measures include the closure of schools and workplaces, suspension of large gatherings, maintaining social distance, implementing curfew, and restricting entry and exit from most affected regions (Aluga, 2020).

Despite the sudden and unprecedented disruption in education, initiatives to enhance learning were embraced by the government and other partners. In response to the pandemic outbreak, the MOE developed the COVID-19 response plan in collaboration with education partners and other stakeholders to ensure continuity in learning for about 3.2 million Pre-primary, 15 million learners in Primary and Secondary schools in Kenya, and close to 150,000 refugees (Republic of Kenya, 2020). The World Bank and the Global Education Coalition worked with the ministries of education worldwide to support remote learning in countries. This initiative was aimed at curbing the impact of school closure - particularly for the vulnerable and marginalized communities (UNESCO, 2020a; World Bank, 2020). Furthermore, UNESCO (2020b) suggested 10 recommendations to ensure that learning remains uninterrupted during this period. This presents the rationale for investigating the implementation of the UNESCO recommendations to boost learning. Furthermore, the paper examines the implementation and adherence of Kenya to the UNESCO recommendations with a view of guiding future research and policy.

UNESCO Recommendations and Kenya's Implementation Programs

1: Examining the readiness and choosing the most relevant tools

"*Decide on the use of high-technology and low-technology solutions based on the reliability of local power supplies, internet connectivity, and digital skills of teachers and students. This could range through integrated digital learning platforms, video lessons, MOOCs, to broadcasting through radios and TVs*" (UNESCO, 2020b).

In Kenya, the closure of schools and institutions from mid-March 2020 to curb the spread of COVID-19 resulted in uncertainty and great concern from all education stakeholders. The Government through the Kenya Institute of Curriculum Development (KICD, 2020) rolled out online learning through Radio, TV, Kenya Education Cloud and You-Tube, ed-tech apps, and mobile phones. The radio and TV learning timetable for both secondary and primary schools including the early years begins at 7.30 am and 8.30 pm daily, apart from Sundays. The Kenya Education Cloud hosts; interactive digital content in pdf, epubs, audio and visual, radio lessons on demand, textbooks for all levels to serve pupils and teachers, and also online courses for teachers on curriculum implementation and use integration of ICT in learning.

Also, an online Safaricom application called Viusasa offers digital audio content in collaboration with KICD that allows learners to engage online by viewing and listening to e-content for each subject for free. Similarly, Eneza Education's Shupavu 291 platform is available on mobile phones and the web for a fee (Baraka, 2020). Besides, to provide wider internet coverage to all students and families, the Kenya Civil Aviation Authority in partnership with Alphabet Inc. and Telkom Kenya has been having Google's Loon Balloons floating over Kenyan airspace to provide internet connectivity to rural and remote communities. This has provided free internet bundles for lecturers to continue engaging their students in online learning activities.

Both both private and public universities turned to online learning to ensure students finish their courses on time, but preparedness varied in each institution (Association for the Development of Education in Africa, ADEA, 2020; Ndede-Amadi, 2020). For instance, the majority of private universities implement e-learning initiatives for students, trained their staff and students, and also entered into the 'Soma na Telkom' bundles partnership with Telkom Kenya to ensure their staff

and students receive cheaper data bundles specifically for e-learning. Specifically, KCA University administered their end-of-semester examinations online to ensure students complete their studies on time. Strathmore University adopted online and produced user manuals to ensure online teaching continues effectively and Mount Kenya University did the same. United States International University–Africa partner with Safaricom through the 'Remote Learning Mobile Data Bundle Subsidy' package to ensure staff and students receive subsidized data bundles to carry on with e-learning (Wachira, Ombati, 2020). Although online learning in private universities has preceded that in public universities, the levels of implementation have varied considerably from one university to another. It is therefore imperative to investigate these divergences in implementation.

Despite rolling online learning for pre-primary, primary, and secondary schools, a study revealed that only a limited number of learners have access to remote learning while the majority in rural and urban poor have no access since most of the homes lack electricity, internet bundles, radio, television, and smartphones (Mhlanga, Moloi, 2020; Ngwacho, 2020). Also, Usawa Agenda revealed that on average 22 out of 100 children are accessing online learning in Kenya, with children in private schools having an advantage over children in public schools (Kihiu, 2020). Similarly, learning mediated through ed-tech remains out of reach for many disadvantaged children in primary and secondary schools due to connectivity, the cost of internet, and privacy challenges (Parsitau, Jepkemei, 2020). Lack of access to technology and reliable internet connectivity was pointed out as a barrier to continued learning, especially for students from disadvantaged families hence creating inequalities in access to education (Republic of Kenya, 2020). Furthermore, the adoption of online learning in the universities mainly focused on postgraduate students and implementation varies due to the ICT challenges still facing both students and lecturers mainly in disadvantaged areas. Issues pointed out as challenges of online teaching in the Kenyan universities include inadequate information technology facilities and equipment in university; lack of skills by lecturers to teach effectively, cost of data bundles for students and lecturer to utilize online materials, students lack technical skills to access and utilize online learning materials and lack of internet in rural areas (Ndede-Amadi, 2020). Further, despite adopting remote learning, the majority of students were not reached out, and learners in public universities being disadvantaged because of the large numbers (ADEA, 2020).

2: Ensuring the inclusion of distance learning programs

"*Implement measures to ensure that students including those with disabilities or from low-income backgrounds have access to distance learning programs if only a limited number of them have access to digital devices. Consider temporarily decentralizing such devices from computer labs to families and support them with internet connectivity*" (UNESCO, 2020b).

The online learning approaches incorporated only sign language for the deaf favoring only one category of disabilities (ADEA, 2020). Inclusion seems to be still challenging across countries including Kenya since online learning approaches are not inclusive and effective enough particularly for the visually impaired (ADEA, 2020). Also, virtual learning had its challenges as radio and TV lessons were not properly designed to include learners with varied needs and abilities per county while the slow learners have not been taken care of in remote learning (Ngwacho, 2020). The decentralized access to connectivity is one of the MOE's proposed interventions that may be useful even after COVID-19 (Republic of Kenya, 2020).

3: Protecting data privacy and data security

"*Assess data security when uploading data or educational resources to web spaces, as well as when sharing them with other organizations or individuals. Ensure that the use of applications and platforms does not violate students' data privacy*" (UNESCO, 2020b).

Remote and distributed learning has exposed an increased number of learners and teachers to online learning with its imminent threats of security breaches and data protection. While developed countries have initiated serious regulatory laws governing data privacy and security, the same cannot be said about developing countries that are still lagging in these matters. Many online learning management systems have conceptual problems with principles of privacy that must be decided. The shift to online learning occasioned by the COVID-19 pandemic has increased access to the components of cyberspace (websites, distributed resources, content, libraries, forums, social media, cloud services, etc.). This requires adequate protection based on the rules of international conventions (Humayun, 2020). European regulation accepts using the so-called

"Privacy Enhancing Technologies" for individual protection of privacy. In Africa, the data protection protocol is still a grey area that is being developed (Makulilo, 2016). This exposes the learning that is taking place online to a lot of potential threats. Recently the Directorate of Criminal Investigation issued an alert and warning regarding the increased cases of cybercrimes in Kenya as a testimony to the increase in potential threats facing young learners. The learning system must protect the sensitive personal data of the learners. While many Learning Management System used in our higher learning institutions have taken these precautions, the proliferation in the use of messaging services such as skype, zoom, adobe connect has exposed the users to issues of privacy violation. Since access codes to such forums are shared on open platforms such as WhatsApp groups, the propensity of unauthorized parties to get access to confidential information has become a greater risk. The Government of Kenya enacted the Data Protection Act 2019 which provides for the protection of personal and sensitive data. The level of awareness of the provisions of this Act is still very low and this exposes the users and providers of online learning forums to cases of violation or misuse of personal data thereby exposing themselves to numerous potential threats. The most frequent types of violations occur when online sessions are recorded without the consent of the users and posted onto open access platforms without regard to the participants' privacy issues. Several loopholes have been raised regarding the Act which can be exploited for selfish interests. Remote learning both in primary and secondary schools faced privacy challenges (Parsitau, Jepkemei, 2020). The Data Protection Act has been criticized for inconclusively addressing issues of individual privacy.

4: Prioritizing solutions to address psychosocial challenges before teaching

"Mobilize available tools to connect schools, parents, teachers, and students with each other. Create communities to ensure regular human interactions, enable social caring measures, and address possible psychosocial challenges that students may face when they are isolated (UNESCO, 2020b).

Issues of psychosocial challenges facing learners, teachers, and parents are only noted by MOE in its report and proposed interventions such as building the capacity of teachers in life skills, guidance and counseling to effectively respond to changes in social behavior, providing appropriate psycho-social support to learners, teachers and education officials including caregivers to manage the impact of COVID-19 and deal with future crises. Also, it focused on approaches to sensitize learners, teachers, and education staff on approaches to deal with post-traumatic stress caused by COVID-19 (Republic of Kenya, 2020). The psychosocial challenges occasioned by the COVID-19 pandemic take various forms and assumes different modalities.

The foremost challenge is the feeling of loneliness and disconnectedness associated with learning online. Students and faculty who have previously been used to face to face interactions have suddenly been pushed to online platforms that have little room for interaction. Because of the sudden transition, a lot of faculty were ill-prepared to design inline courses that provide interaction amongst the participants. This has created a sense of isolation and brooding loneliness amongst students and faculty. Online interaction by their design does not provide much room for providing emotional and psychological support for learners who are either directly or indirectly affected by the COVID-19 situation. Many of them have to contend with the minimal interaction that occurs in discussion and chat forums. These forums are created to engage with the academic content and so there is little engagement at the emotional level (Johnson et al., 2020).

Engagement of learners through online interaction enhances their levels of motivation which in turn improves the level of satisfaction (Martin & Bolliger, 2018). When this is absent in online remote teaching, the students' level of satisfaction decrease. This has been the case especially amongst primary school pupils who feel demotivated to engage in online classes. Remote learning does not provide opportunities to address individual learning needs. Parental role in learning has been diminished and in most cases relegated to meeting the cost of internet and equipment such as laptops, smartphones, and ipads for their children. Many parents are working remotely and the time spend working online coincides with the children's online classes. Since the activities are done and posted online, it is difficult to monitor learning and provide the emotional and psychological support that children need. In Kenya, classroom sizes are typically large. By shifting large classes to the online platforms, the levels of engagement have naturally gone down because the interfaces used allows a small picture of the individuals to be seen at a time. This means that unless the facilitator makes deliberate efforts to engage learners in a balanced manner, some of them are left

out. Teachers tend to focus their attention on learners who are active or stand out on the platforms. The others who are left out feel bad about this because they think all the attention is being directed to specifics students and not them. To prevent online students from experiencing potential boredom and isolation, it is necessary to design activities that enhance engagement (Martin, Bolliger, 2018). Unfortunately, the platforms that are currently being used to teach primary school children, in particular, do not allow this kind of interaction.

5: Planning the study schedule of the distance learning programs

"Organize discussions with stakeholders to examine the possible duration of school closures and decide whether the distance learning programme should focus on teaching new knowledge or enhance students' knowledge of prior lessons. Plan the schedule depending on the situation of the affected zones, level of studies, needs of students, and availability of parents. Choose the appropriate learning methodologies based on the status of school closures and home-based quarantines. Avoid learning methodologies that require face-to-face communication" (UNESCO, 2020b).

To curb the spread of the virus in learning institutions, the Government of the Republic of Kenya closed all learning institutions on the dates of 16th March and 20th March. Further, the MOE developed COVID-19 Response Plan in collaboration with education partners and other stakeholders to guide on remote learning (Republic of Kenya, 2020). Further, the COVID-19 Education response committee was established to advise on the possible reopening period that is safe. The team proposed that schools, colleges, and universities be reopened in September 2020. Meanwhile, virtual platforms offer continued learning and revision for learners (UNESCO, 2020b).

6: Providing support to teachers and parents on the use of digital tools.

"Organize brief training or orientation sessions for teachers and parents as well, if monitoring and facilitation are needed. Help teachers to prepare the basic settings such as solutions to the use of internet data if they are required to provide live streaming of lessons" (UNESCO, 2020b).

The education television broadcasts on the Edu Channel TV programs are made available as live streams as well as on-demand content via KICD's Edu TV Kenya YouTube channel (UNESCO, 2020b). The ministry continues to assure the quality of programs on TV, radio, and online through the development of online and offline monitoring tools for headteachers and principals and the development of a mechanism for communication between headteachers and QASOs using bulk SMS, emails, and WhatsApp (Republic of Kenya, 2020).

On contrary, findings by the Directorate of Quality Assurance and Standards in the State Department of Early Learning and Basic Education revealed that parents/guardians for pre-primary, primary, and secondary are not at the forefront of their children learning at home, while teachers' supervision role is extremely low for learners while at home (Mhlanga, Moloi, 2020). Another study revealed that two out of ten parents were not aware that their children were expected to continue learning from home (Kihiu, 2020).

7: Blending appropriate approaches and limit the number of applications and platforms.

"*Blend tools or media that are available for most students, both for synchronous communication and lessons and for asynchronous learning. Avoid overloading students and parents by asking them to download and test too many applications or platforms*" (UNESCO, 2020b).

The MOE through KICD provided virtual platforms that enhanced both synchronous communication and lessons, and asynchronous learning for instance through radio programs broadcasted on all weekdays and education television broadcasts on the Edu Channel TV. The television programs are made available as live streams as well as on-demand content through KICD's Edu TV Kenya and YouTube channel. Similarly, there is a partnership with the Kenya publishers association, where electronic copies of textbooks have been made available for free on the Kenya Education Cloud for all students. Additionally, Safaricom, a private mobile network operator, has partnered with Eneza Education, Longhorn publishers, and Viusasa to support primary and secondary school students with free access to educational e-content (UNESCO, 2020; Republic of Kenya, 2020).

8: Developing distance learning rules and monitoring students' learning process

"*Define the rules with parents and students on distance learning. Design formative questions, tests, or exercises to monitor closely students' learning process. Try to use tools to*

support the submission of students' feedback and avoid overloading parents by requesting them to scan and send students' feedback" (UNESCO, 2020b).

There is an application that has also been developed for high school learners, topic by topic lesson notes, questions, and answer for revision. These materials are being shared through WhatsApp groups and the internet (UNESCO, 2020b). The learners in private schools and their teachers get online feedback, they also utilize Zoom video conferencing to respond to learners' issues on WhatsApp (ADEA, 2020). However, a study on monitoring and evaluation revealed that since head-teachers received the information regarding the closure of learning institutions, there is no format provided for them for monitoring the learners' assignments particularly in public schools (ADEA, 2020).

9: Defining the duration of distance learning units based on students' self-regulation skills

"*Keep a coherent timing according to the level of the students' self-regulation and metacognitive abilities especially for live-streaming classes. Preferably, the unit for primary school students should not be more than 20 minutes and no longer than 40 minutes for secondary school students*" (UNESCO, 2020b).

Regarding specifying a duration for the remote learning, the MOE rolled out a radio and TV time table for both secondary and primary schools - including the early years. Learning is between 7.30 am and 8.30 pm daily, apart from Sundays (Republic of Kenya, 2020). The entire learning timetable is updated on monthly basis. However, the MOEST report on e-learning found out that some 18 % of the learners do not have access to the online learning timetable. The adequacy of the timetable for learning as per the syllabus was inaccessible to the majority of learners, the time allocated was inadequate, there was an unequal distribution of subjects, and not all lessons are covered in the timetable (Ngwacho, 2020).

10: Creating communities and enhancing connection

"*Create communities of teachers, parents, and school managers to address a sense of loneliness or helplessness, facilitate sharing of experience and discussion on coping strategies when facing learning difficulties*" (UNESCO, 2020b).

Despite the creation of communities and enhancing connection at the infancy stage, the United Nations High Commissioner for Refugees (UNHCR) recognizing that virtual learning requires a different approach has focused on identifying available resources. These also include identifying tools for virtual learning and the collaboration work with partners like EdTech Hub to update the list of available digital resources and tools for students and teachers (UNHCR, 2020). However, the use of online remote learning, while creating a forum for distance learning, can also foster a sense of loneliness and lack of community amongst the learners and the facilitators. Virtual spaces can become lonely for the participants especially if there is infrequent interaction. Learning in a virtual environment can create a lack of connectedness especially when those engaged in the process are loosely related and connected. When learners are not familiar with the online educational delivery system, they may become frustrated and develop a sense of disconnection with the learning process (Bawa, 2016). It is important therefore for online facilitators to ensure the learners are familiar with all the online tools that can promote engagement and a sense of community. Multiple communication options can be used to facilitate online engagement. It is important to use these to promote more interaction between the facilitators and the students and between students themselves. If online engagement is not active, then learning becomes less since the learners are not adequately motivated (Bawa, 2016). The limitations of using online technology to engage are not limited to students alone. Faculty limitations in using technology are another concern. At times there is a disconnect between the facilitators and the students who may be digitally disengaged. The reason for this is the paucity of technical resources and expertise in online course design. Course designers need to use the available tools to engage the participants. The technology used to create effective course designs is rapidly evolving and faculties are struggling to keep pace with these emerging technologies. They lack the confidence, knowledge, and expertise required to practically apply the technologies in a way that engages learners and fosters learning (Bawa, 2016) reports that one of the reasons for the faculty's failure to design good online courses is the limitations in faculty training. Although large amounts of money are spent on acquiring technology, the amount spent on training faculty is not adequate.

Recommendations

The recommendations are based on areas that need to be strengthened in Kenya regarding the implementation and adherence to the UNESCO recommendations to enhance effective online teaching and learning in all the levels of education in the country.

Prioritizing mechanism of protecting data privacy and data security

The beginning of data protection should begin with amendments to the data protection Act to take into cognition the specific rights of children. The government should then develop regulatory policies through the MOE to guide the processing and handling of personal data related to children. Schools and other educational institutions should develop policies that guide online engagement and safeguard personal data and safe online learning spaces. Faculty and staff need to be sensitized to these policies and must comply with them by signing relevant commitment forms. Parents have to be sensitized to the need to safeguard the children while engaged in online/remote learning.

Prioritizing the creation of communities and enhancing the connection

While the government has achieved commendable milestones in expanding access to internet connectivity by laying undersea fiber cables that have increased internet speeds and connectivity especially in Urban areas; the same needs to be done in rural parts of the country. Many rural homes do not have electricity connections and the internet. The government should prioritize making internet access to rural children so that learning can continue during such emergencies. Students from rural communities should be given smart devices per family to enable them to access digital educational content while at home.

Boosting ICT infrastructure

In line with the foregoing discussion, the ICT-related infrastructure needs to be expanded and strengthened to enhance access to the internet and digital educational resources. Schools should be equipped with servers that can accommodate Learning Management Systems. They can also do capacity-built to develop online versions of the physical curriculum that is offered through the face to face classroom interaction. This can be a backup plan to ensure continuity of instruction during emergencies when regular teaching is disrupted or cannot continue.

Enhancing faculty training and support

It is important to train faculty on effective online course design and delivery (Bawa, 2016). The shift from face-to-face learning to the online platform was so abrupt that the faculty did not have enough time to get re-trained on the use of online technologies. Having less time to re-learn how to use these technologies, many of them engaged learners with little know-how. Faculty need adequate time to prepare for online delivery so that they can develop various activities that engage learners effectively. These include discussion forums, quizzes, and chats.

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COVID-19 and Global Economy: A Review

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Abstract

The COVID-19 (coronavirus) pandemic has changed the direction of the global economy since its inception. Though researchers and experts are working hard to estimate its impact on the global economy, it is difficult to project its long term effect. The focus of this paper was to briefly analyse the initial, existing, and possible future effects of the pandemic. Beginning from China, a serious negative impact was seen across all forms of socio-economic activities due to the pandemic. With the spread of the virus from China to other countries, many countries have reported a decline in economic growth. With several economic projections made by experts and researchers, the impact of COVID-19 on countries that depend much on tourism and foreign trade will be heavily affected with estimated costs between 2.5 to 3.0 % of global gross domestic product each month. I observed that the over-dependence of retrospective estimations of other serious global health disasters like the Severe Acute Respiratory Syndrome (SARS), the Middle East Respiratory Syndrome (MERS), and Ebola Virus Disease (EVD) may lead researchers to underestimate the long-term effect of the COVID-19 pandemic. Notwithstanding this fact, some implications could be drawn from the devastating effects of these past traveler-related contagious diseases (SARS, MERS, and EVD) regarding gross domestic product growth, tourism, transportation, education, production of goods, and provision of services for the local and international economy.

Keywords: COVID-19, global economy, gross domestic product, review.

Introduction

Ever since the first case of coronavirus (COVID-19) in Wuhan was reported on the 30th of December, 2019, the global economy has been one of the worst to be affected. The outbreak of major contagious diseases is noted to destruct the economy through numerous channels (Madhav et al., 2017). These channels include short and long-term fiscal shocks to the growth of the economy. Nonetheless, the direct financial effects of pandemics are generally less compared to the indirect effects on economic growth (Maddhav et al, 2017).

China as the first to be affected by this pandemic underwent a strict lockdown of some provinces with increasing cases. Notwithstanding the strict enforcement of COVID-19 preventive measures by China to contain the spread of the COVID-19, the virus crossed the borders of China to other countries (Ayittey et al., 2020). In response to the spread, several initiated partial and complete bans on air travel which have hindered the movement of both citizens and foreigners.

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For example, the demand for air travels in China reduced by 40% by the end of January 2020 compared to preceding years according to the International Air Travel Association (Martin, 2020).

Apart from air travel, Toyota and Hyundai automobile factories at Wuhan where the virus was first detected were closed including other multinational companies like Apple and Starbucks (Cerullo, 2020; Conelly, 2020). Also, most papers have looked into the dependence of China on other countries for oil and water due to its vulnerability (Sun et al., 2017; Wang et al., 2014). However, the long term of COVID-19 on economies like China may not be easily estimated just like Severe Acute Respiratory Syndrome (SARS) as researchers like Beutels et al. (2009) revealed that there exist no effects in the long term due to the postponement of consumption expenditure. Notwithstanding this, it is noted that the economic effects of the COVID-19 epidemic may be underestimated presently owing to the over-dependence of experts and researchers on past evaluations of SARS (Fernandes, 2020).

Lessons from past disasters and pandemics

Keogh-Brown and Smith (2008) undertook a retrospective estimation with the help of macroeconomic variables of the countries that were affected by SARS. They revealed that the impact of SARS on the economy was not significant except for the restaurant and accommodation industries in Canada, Hong Kong, and Australia. Similarly, evidence from the United Kingdom shows that about 16.1 % of employee absenteeism during the influenza pandemic was due to the closure of schools. This increased to 30 % in the health sector as a greater percentage of the employees were women (Sadique et al., 2008). Likewise, Joo et al. (2019) also employed the Seasonal Autoregressive Integrated Moving Average model to estimate the effects of the Middle East Respiratory Syndrome on the travel-related and tourism sectors in the Korean economy. Their study revealed that the crisis of public health predicament owing to outbreaks of traveler-related contagious diseases can lead to substantial losses to the economies of the countries affected.

Gatiso et al. (2018) studied the impact of the Ebola Virus Disease (EVD) on households of Liberia using Sustainable Livelihood Frameworks. The findings from their studies revealed that the annual income of households affected by EVD was not different from the annual income of households who were not affected by the disease. However, a greater percentage of the sampled households compared to the previous year reported a reduction in annual income. Besides, Kodish et al. (2019) examined the effects of EVD on the food industry in Sierra Leone from the period of 2014 to 2016. Evidence from their study showed that the effects of the EVD epidemic and the policy restrictions on movements (21-day quarantine) also led to the distractions of the value chain in Sierra Leone's nutrition sector.

COVID-19 economic impact and recovery interventions

The effect of COVID-19 may vary across countries and continents. For example, the few studies that have looked at the African context of the pandemic have indicated a possible shortage of labour in African countries as a result of the outbreak of COVID-19 (Bamfo et al., 2020; Yaya et al., 2020). Bamfo et al. noted that Ghana "*Ghana's gross domestic product (GDP) growth rate had been reviewed downwards by the International Monetary Funds from 5.8 % to 1.5 %. This would be seen as the least recorded GDP growth since the year 1983*" (p. 3). Besides, the pandemic has affected not only the local economic activities but the global market at large. The impact on the global economy has been substantial specifically because China, where the Virus was discovered had turned out to be an economic giant (Ayittey et al., 2020).

Globally, all industries in the world are affected. The COVID-19 pandemic is known to destruct the production of goods and services which leads to a shortage of goods. The prices of staple goods increase and this affects private firms, households, and the government economically (Madhav et al., 2017). Furthermore, Gössling et al. (2020) also made a comparative analysis of the effects of COVID-19 and previous pandemics as well as other global crises. Their study also explored how COVID-19 might transform humanity, the economy, and tourism. The conclusion from their research suggests the critical need to returning to the usual business after the crisis, instead of reconsidering a change of the international system of tourism compliant with the Sustainable Development Goals (SDGs).

Also, Vivek et al. (2020) explored a Meta-Analysis of the effects of COVID-19 on the Indian economy due to the loss of labour. The results from their studies show that the increase in the loss

of labour in India was due to the rate of mortality and morbidity. Furthermore, Fernandes (2020) on the effects of COVID-19 on industries and countries revealed that the countries that rely more on tourism and foreign trade will be heavily affected. The results from the study also revealed that COVID-19 costs between 2.5 to 3.0 % of global gross domestic product (GDP) monthly.

Furthermore, Chronopoulos et al. (2020) studied the responses of consumer expenditure to the arrival and the spread of COVID-19 and the subsequent lockdowns imposed by the Britain government. The results of their studies revealed that discretionary expenditure was reduced in the few periods before the lockdown and continued to reduce during the period of the lockdown. Panic buying and stockpiling of foodstuffs also increased two weeks after the World Health Organisation (WHO) announced COVID-19 as a global pandemic. Furthermore, Psacharopoulos et al. (2020) estimated the loss of marginal future revenue using the number of months of school closure and found that the closure of schools reduces future earnings to about 15 percent of future GDP. This will mostly affect students from low-income countries.

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Misinformation in COVID-19 Media and Literature, with an Emphasis on Open Data Policies

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Abstract

Misinformation in the COVID-19 era may stem from social media, preprints, elite peer-reviewed journals, or predatory journals. In part, this has been caused by an infodemic of information. One extreme case was the retraction of a pseudo-scientific paper on 5G claiming that 5G induces COVID-19 in skin cells, published in a PubMed-indexed journal, *Journal of Biological Regulators & Homeostatic Agents*. In the COVID-19 era, social media has also catalyzed the spread of misinformation and false conspiracy theories about non-existent or unproven risks. COVID-19-related misinformation might also arise from poorly vetted literature, one reason being the continued failure of implementing an open data (OD) policy. This is a core reason for two high-profile retractions of COVID-19-related literature in leading medical journals, *The Lancet* and *New England Journal of Medicine*. Despite those retractions, those journals still do not mandate an OD policy, which, unlike an optional one, could instill greater rigor through heightened scrutiny of data sets, and thus fortified scientific integrity and public trust. If data is erroneous, it can negatively impact health policies. Thus, journals publishing original research on COVID-19 need to rethink their OD policies, and critically assess whether they are contributing to the medical misinformation stream, or not, and what this might imply to their reputation.

Keywords: COPE, health, infodemic, mandatory versus optional open data policies, open science, predatory publishing, PubMed, reproducibility, social media, transparency, trust.

The COVID-19-infodemic within the wider context of fake news

Perhaps as never before, besides war-like crises or financial collapses, has society anywhere on this planet witnessed such an infusion of information about a single issue as is currently being experienced with the COVID-19 pandemic. Galvanized by common health and existential threat, populations are also being exposed to an extraordinary volume of information, an infodemic (Mheidly, Fares, 2020), that may leave them overwhelmed, and confused, especially if there are contradictory reports regarding, for example, the efficacy of a drug, a repurposed drug, a treatment, or more recently, vaccines (Cornwall, 2020). Misinformation may arise as a result of downstream source recontextualization, i.e., a modified interpretation akin to "spin" (Turrentine, 2017) that incorrectly portrays information in the original source, in part motivated by "altruism" or the desire to seek and share potentially useful information with others, seeking status,

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strengthening social ties (Apuke, Omar, 2020), or at another extreme, purposeful or deliberate transmission of false information (Pulido et al., 2020).

The fact that academia is already embedded in an era of fake (Teixeira da Silva, 2017), compounded by the current stream of fake health news and misinformation fueled by social media and academic and non-academic sources, including the mixture of both powerful and popular search engines like Google. This current stream adds additional pressure to academics, their institutions, health policymakers, and governments, who need to be increasingly perceptive, astute, and observant so as not to use or cite erroneous information, and journal editors, publishers and information platforms like PubMed or Publons, or indexing agencies or databases like Scopus or Web of Science, who need to be extra vigilant of attempts to use their platforms as vehicles for the propagation of fake news and misinformation, including conspiracy theories and pseudoscientific therapies (Naeem et al., 2020).

In this short *exposé*, select examples are highlighted that demonstrate the risks that exist at the information interfaces between academics, editors, journals and preprints, databases, funding agencies, policy proponents, health officials, and/or the general public.

COVID-19-inducing 5G paper retraction reveals PubMed weaknesses

5G networks are the next generation of communication technology that could offer better tracking, testing, and diagnosis of COVID-19 (Soldani, 2020). Despite its actual strengths and potential applications, there are unknown risks and challenges of 5G (Sicari et al., 2020). Social media has served as a catalyst to spread misinformation and false conspiracy theories about non-existent or unproved risks related to 5G technology (Ahmed et al., 2020). COVID-19-related misinformation might also arise from poorly vetted literature (Chirico et al., 2020).

The retraction of a nonsensical and pseudo-scientific paper that claimed that 5G technology causes or induces COVID-19 in skin cells (Fioranelli et al., 2020), and which sparked massive negative criticism on social media, raises some issues worthy of discussion. Although the *Journal of Biological Regulators & Homeostatic Agents* is indexed in PubMed, claims to be peer-reviewed and to follow COPE ethical guidelines, the retraction of the paper was not COPE-compliant, i.e., the original article should have been left intact with "RETRACTED" pasted across each page, but was not. The paper has silently disappeared, i.e., a silent retraction (Teixeira da Silva, 2016), leaving a 404 error message where the PDF file had existed previously, and the PubMed page was modified from a withdrawal to a retraction. Several social media sites and blogs claim that this journal and publisher display predatory qualities, fortifying some concerns that PubMed may be increasingly housing unscholarly literature, or providing a platform for the recognition of predatory entities (Manca et al., 2018). The issue of silently retracted papers or opaquely retracted information related to COVID-19 is not restricted to peer-reviewed literature: there are dozens of silently withdrawn preprints with no transparent explanations or apparent ethical consequences to authors who may have infracted upon established publishing guidelines (Teixeira da Silva, 2020a).

Several risks caused by the proliferation of fake or poorly vetted information in the COVID-19 pandemic are the expansion of predatory elements (Teixeira da Silva, 2020b), the risk of relying on false information to base health guidance or policies, and the degeneration of trust by the public in the scholarly enterprise (Roozenbeek et al., 2020), poor governance (Hartley, Vu, 2020), as well as the psychological and emotional well-being of academics, members of society and policy-makers (Xiong et al., 2020) that rely on accurate and strictly vetted science for reliable information and advice on health. To the author's knowledge, there is still no study that provides compelling evidence showing any health risk caused by 5G technology, or a link to COVID-19. Communication specialists seeking ways to improve the scalability and reliability of 5G technology (Jain et al., 2020) would benefit by conducting studies that assess its possible negative impacts on health.

Retractions of *The Lancet* and *New England Journal of Medicine* papers reveal flawed open data policies

January to June of 2020 data suggests that the level of corrections (errata and retractions) of COVID-19-related literature is similar to levels of general retracted literature (Teixeira da Silva et al., 2020b). In both COVID-19 and non-COVID-19-related literature, one of the risks that has arisen from a rush to publish research, especially in the first few months of the pandemic, was the failure of journals to request the raw data from authors, or the failure to mandate open data (OD)

policies. Even now, there is wide variation among OD policies in journals that are accepting and publishing COVID-19-related research, many – perhaps even the vast majority – still making OD policies optional.

The main reason for the high-profile retractions of *The Lancet* and *New England Journal of Medicine* COVID-19-related papers was unreliable and unverifiable data (Ledford, Van Noorden, 2020). The accompanying data should have been submitted by the authors and should have also been requested by the handling editors and peer reviewers had an OD policy been in place. In such a case, it is highly likely that the lack of data would have raised a red flag, and revealed papers potentially riddled with erroneous claims, and that would have led to an ethics investigation, with the subsequent papers not being published, thus ultimately avoiding their retractions. A mandatory OD policy would have also saved these highly ranked journals from long-term reputational damage.

Science's reliability, especially in the COVID-19 pandemic, can be a matter of life and death, so accurate, reliable, and reproducible science that is based on a mandatory OD policy serves all parties well: authors fortify their findings, peers and editors can pride themselves in more thorough peer review, and the journal and publisher gain public trust, confidence and respect from the academic community (Huston et al., 2019). Trustworthy science can then be used to confidently advance human health by policy-makers.

Research that employs open-source data and code has several advantages, and when combined with OD policies, can gain the trust of medical practitioners, such as the diagnosis of COVID-19 from medical images using artificial intelligence and machine learning, but this requires OD policies for verification, extension, and collaboration to effectively employ an open-source work to find solutions to combat this pandemic, an approach that has already led to its implementation in several leading hospitals worldwide (Shuja et al., 2020).

Ultimately, open science principles will increase the collaborative nature of COVID-19-related research, making findings more transparent and rigorous (Haddaway et al., 2020). If coupled with optimized peer review (Teixeira da Silva et al., 2020a), risks of COVID-19 misinformation, negative effects on public health, and reputational damage to science may be reduced, fortifying trust in medical findings (Falcone et al., 2020). Understanding the risk of uncertainty, determining the risk of misinformation, and appreciating that there exists inherent ignorance are needed for a strict epistemological ethos of COVID-19 research to advance and be useful (Solbakk et al., 2020).

Recommendations to reduce misinformation in the COVID-19 infodemic

Broadly, misinformation can originate from several sources: the public through social media (Twitter, Facebook, YouTube, personal web-pages, personal blogs, etc.) (Rosenberg et al., 2020), mass media, and independent media (online newspapers, media blogs, etc.), pseudo-academic sources (predatory journals), mixed academic sources (Google and Google Scholar), pre-peer reviewed sources (preprints) and claimed peer-reviewed sources (academic journals, indexes and platforms like PubMed, Scopus, Web of Science, Publons, etc.). Although one or more of these sources might be interlined, for example, a news media coverage of a COVID-19 preprint, the quality control, verification, and screening mechanisms of each operate independently. Consequently, even though it may be possible to implement rigorous policies in one source, for example, rigorous methods to fortify and optimize peer review in peer-reviewed journals (Teixeira da Silva et al., 2020a), this might not necessarily translate into effective information quality control by downstream users, whether these be members of the public, other academics, policymakers, or the media. This suggests that cross-source vigilance needs to be complemented by more stringent punitive measures to deal with those who peddle fabricated information, intentionally, or not. While not in any way suggesting a blanketed approach, since each case merits individual scrutiny, the retraction of false information from the literature (peer-reviewed or preprints), closure of web-sites, or even criminal prosecution of individuals who seek such methods to inflict harm on others, would be broad strokes to deal with extreme cases of misinformation. In all cases, heightened awareness, open and transparent communication, and greater vigilance would serve all parties well.

Author contributions

The author conceived the idea, wrote the manuscript, approved the submitted version, and takes public responsibility for its content.

Conflicts of interest

The author declares no conflicts of interest.

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