Resilience, Adaptability, and Sustainability of Higher Education: A Systematic Mapping Study on the Impact of the Coronavirus (COVID-19) Pandemic and the Transition to the New Normal

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Abstract: The coronavirus (COVID-19) pandemic has been a global crisis, affecting many areas of society, including higher education, which has not been immune to its effects. This study, therefore, examines COVID-19 from the perspective of higher education, applying data mining and analytics approaches, i.e., t-SNE analysis, text-mining, and social network analysis, to identify research themes and patterns. The results obtained show that studies have not been restricted to addressing only the impact of COVID-19 on learners and educational institutions in terms of pedagogical issues. The study identified three broad themes from the body of research on this subject: (1) educational crisis and higher education in the new normal: resilience, adaptability, and sustainability, (2) psychological pressures, social uncertainty, and mental well-being of learners, and (3) the rise of online distance education and blended-hybrid modes. The study concludes that the survival of higher education depends on the resilience, adaptability, and sustainability skills of higher education institutions.

Keywords: COVID-19 pandemic, higher education, teaching and learning, emergency remote education, online distance education.

Introduction

The coronavirus (COVID-19) has struck the entire globe, sparking in its wake a turning point, not only for education but for every aspect of our lives. The hope was that the vaccination would stop the pandemic, yet the different variants of coronavirus that have emerged signal that the virus may be with us for some time and, therefore, we must ensure our educational ecosystem is resilient and sustainable. Even if the virus were to be completely eradicated, it is believed that the ripples created by the COVID-19 pandemic will continue in the near and distant future, and that there will always be the threat of a similar global-scale crisis occurring again. In the light of the global scale of the COVID-19 crisis and the deep impact it has had on the educational landscape, this study aims to gain a deeper understanding of the effects that the COVID-19 pandemic has had on education.

Literature Review

According to Bozkurt and Sharma (2021), the COVID-19 pandemic created a deep and wide rupture in human history, prompting researchers from a broad range of fields to examine the crisis through their respective perspectives. One of the earliest studies to be conducted on the impact of COVID-19 on higher education (HE) was by Aristovnik et al. (2020), who analysed how the COVID-19 pandemic affected the life of HE students on a global scale. They reported that the mental wellbeing of learners in HE was most affected by the radical changes caused by the measures instituted to address COVID-

19, and that this impact on their wellbeing negatively affected their academic performance. They further noted that the onset of the pandemic in the northern hemisphere occurred in the middle of the academic year, while in the southern hemisphere the onset occurred at the beginning of the academic year, and that this triggered a different emotional response in the two hemispheres. Crawford et al. (2020) conducted a systematic review of the state of HE during the COVID-19 crisis and highlighted the need to develop strategies aimed at not only digital education but also at digital pedagogies. Carrillo and Flores (2020), in their study seeking to identify research patterns in online teaching and learning from the perspective of teacher education during the pandemic, found that the most recurrent themes were related to interactions and discussions, online communities involving teacher participation or engagement, teacher knowledge, the use and effects of video, and finally, feedback and peer assessment activities.

Many systematic reviews, mapping studies, and bibliometric analyses focusing on education, emergency remote teaching and learning, and HE have been conducted to analyse and understand the consequences of the COVID-19 pandemic. For instance, Bond et al. (2021) conducted an extensive systematic review on this subject and found that the most referenced concepts in the sampled studies were firmly established concepts like distance education, online learning, and e-learning, while Bozkurt and Sharma (2020a) and Hodges et al. (2020) argued that during the early waves of the pandemic, rather than traditional online distance education, emergency remote education better described the practices applied by educational institutions. Bond et al. (2021) noted that HE research tended to focus on the experiences of learners, while an earlier study by the same author (Bond, 2020) that examined the body of literature related to the K-12 level reported that students' wellbeing was one of the primary concerns at this level. Another study, which investigated learning with technology, particularly internet-based technologies and non-internet-based technologies, at the K-12 level, was conducted by Crompton et al. (2021), who reported that, "Six categories emerged on how teaching strategies and technologies were used to continue K-12 learning in emergency situations: communication, delivery systems, student ERE readiness, partnerships, promoting student learning and engagement, and resources." (p. 1571).

In their bibliometric study, Mishra et al. (2021) reported that remote teaching, the assessment of distance learning, emergency online teaching, virtual learning environments, and student readiness were trending topics in online distance learning during the COVID-19 pandemic. They also highlighted that technologies for teaching and learning and psychosocial issues were emerging issues in the sampled publications. In the systematic review conducted by Talib et al. (2021), it was found that the transition from face-to-face education to online distance education and the impact of the pandemic-related lockdowns and other imposed measures on the academic and personal lives of students and on their experiences with online distance education were the most salient themes. The same authors also noted that the pandemic itself could be an impetus for change but warned that there were potentially serious issues that needed to be addressed, such as inequality and inaccessibility, inadequacies, poor communication quality, technical difficulties, the need for technology literacy, the balance between professional and personal life, privacy concerns in online environments, difficulties in the assessment of student performance, lack of student engagement, participation and motivation, and lastly, stress, workload and morale.

Di Pietro et al. (2020) noted in their study that while emergency remote teaching and learning was implemented to ensure continuity of education during the pandemic, the separation of K-12 level learners from onsite learning environments during quarantine or lockdown periods led to learning loss as a result of less time spent in learning, stress and anxiety due to isolation, loss of in-person communication, changes in the way students interact, and lack of learning motivation. They further emphasised that the sudden shift from offline/onsite education to online education could exacerbate existing educational inequalities. Along similar lines, the study conducted by Bozkurt et al. (2020) that was aimed at presenting a global outlook on the interruption of education reported that social injustice, inequity and the digital divide have been compounded during the pandemic. Their study also highlighted that all educational stakeholders have experienced different degrees of trauma, psychological pressure, and anxiety, which suggests that a pedagogy of care, affection and empathy is needed. Pointing out that the COVID-19 pandemic has been more than a biological crisis, as it has social, psychological, and educational aspects, Jandrić et al. (2021) argued that emergency remote teaching and learning was a survival reflex, and that educators have learned to adapt to the changing teaching requirements. The same authors also noted that the pandemic was viral in nature and, likewise, hope was also viral, and, therefore, individuals kept hoping, teaching and learning as a survival mechanism. Farnell et al. (2021) investigated the impact of COVID-19 on HE and presented from the results three issues to consider during and after the pandemic: teaching and learning, the social dimension of HE, and student mobility. The authors offered suggestions for each of these issues. Accordingly, in the teaching and learning area, HE institutions need to develop assessment and evaluation strategies for online learning, develop the digital literacies of teachers and students, adapt quality assurance mechanisms, and identify at-risk students to minimise inequalities. In the social dimension of HE, there are challenges related to "studying conditions (access to a quiet place to study, access to equipment and a reliable internet connection, access to course study materials, and confidence in using online platforms), funding (loss of employment/income, difficulties in meeting living costs, issues with receiving scholarships), and wellbeing (lack of supportive social networks; feelings of frustration, anxiety, and boredom with academic activities)" (Farnell et al, 2021, p. 10). For the student mobility area, they reported that there should be flexibility in access, the same support provided to domestic students and international students, alternative solutions offered through the lens of equity and diversity, and a reworking of the traditional models governing international mobility.

Corell-Almuzara et al. (2021), in their bibliometric analysis, revealed that the psychological impact of the pandemic on mental wellbeing is one of the major themes in the field of education. Monjaraz-Fraustro et al. (2021), who examined e-learning research in the COVID-19 context, found that distance learning, the effects of distance education, telemedicine, and virtual training were the most dominant research clusters. Mustapha et al. (2021), in their investigation involving a bibliometric analysis of the effectiveness of digital technology, reported the following thematic research clusters: quick shift to online teaching and learning, digital education during the pandemic and rethinking of the sustainable community, digital education for medical education and healthcare in hospitals, and digital education and digital innovation development during COVID-19. Similarly, the study by Arias-Chávez et al. (2021) identified online teaching and e-learning as central nodes in medical education.

Since the COVID-19 phenomenon is still relatively recent, this study aimed to identify the research themes and patterns relating to COVID-19 from the perspective of HE. To this end, the study examined scholarly papers through data mining and analytic approaches to identify how the COVID-19 pandemic has impacted the HE landscape.

Methods

Research Design

This study applied an exploratory approach involving systematic review and bibliometric analysis methods to analyse published scholarly documents on the subject in question. Unlike traditional review techniques, this study used data mining and analytic approaches (Fayyad et al, 2002), specifically text mining (Aggarwal & Zhai, 2012) and social network analysis (Hansen et al, 2020), to visualise the large volume of data. Multiple data analysis approaches were used to triangulate the data (Thurmond, 2001), which served to increase the validity and reliability of the research findings.

Inclusion Criteria and Sampling

The inclusion criteria used for creating the research corpus were that the publications were written in English, indexed by Scopus, and have the search strings (see Table 1) included in their titles. The use of only English language publications was preferred because lexical analyses are better able to identify meaningful patterns in one language. Scopus was selected as the database for its breadth of publications, as it is the largest academic database, and because it indexes the publications available in different databases. The explicit use of search strings that were included in the title of publications was done to get a more focused, concentrated outlook by sampling publications whose research focus was the COVID-19 pandemic and HE.

Table 1: Search strings used to create the research corpus

Title	"Covid-19" OR "pandemic*" OR "Coronavirus*"
	AND
Title	"higher education" OR "graduate" OR "undergraduate" OR "tertiary education" OR "academ*"

The query using the above shown search strings returned a total of 841 publications. After applying the PRISMA protocol (Page et al, 2021) (Table 2), the final phase included a total of 572 publications. The scholarly findings from peer-reviewed journal articles and conference papers that met the predefined inclusion criteria were included in the analysis.

Table 2: The PRISMA flow chart

Stages	Flow
Identification	● 841: Total identified documents.
Screening	● Documents in other languages excluded (n = 51). ● Non-empirical documents excluded (Letter, 33; Note, 30; Editorial, 25; Book Chapter, 11; Erratum, 18; Short Survey, 3; Book, 1; Data Paper, 1) (n = 90). ● Irrelevant documents excluded (n = 5). ● Out of scope / Not primary research documents excluded (n = 123).
Included	● A total of 572 papers (510 articles; 62 conference papers) included in final research corpus.

Data Analysis and Research Procedures

Operating under the assumption that the title, abstract, and keywords of a paper when taken together adequately represent its essence, this study examined the sampled publications in three research phases. The first phase used t-distributed stochastic neighbor embedding (t-SNE) analysis (van der Maaten & Hinton, 2008) to examine the titles of the publications in the research corpus. The t-SNE is helpful for visualising "high-dimensional data by assigning each datapoint [words in titles] a position within a two or three-dimensional map" (van der Maaten & Hinton, 2008, p. 2579). The second phase used text-mining (Aggarwal & Zhai, 2012) to examine the abstracts of the publications. In this phase, a lexical analysis, which "employs two stages of co-occurrence information extraction, semantic and relational, using a different algorithm for each stage", was performed on the abstracts. (Smith & Humphreys, 2006, p. 262). Lastly, the third phase used SNA (Hansen et al, 2020) to examine the keywords identified by the authors. In this phase, the keywords were considered as nodes and their relationships were considered as links between them (Hansen et al, 2020), a process which helped to identify and visualise the significant nodes.

Limitations

The study acknowledges the following limitations. First, although the research corpus was created from publications indexed by the largest database, Scopus, there are other publications in the grey literature that may have provided additional invaluable insights. However, this limitation was to a certain degree compensated for by applying the criterion of selecting only peer-reviewed publications. Second, the research corpus only included English-language publications. However scholarly papers in languages other than English could have provided deeper insight into the study subject. Yet, with that said, given that the study aimed to develop a global perspective on the subject in question, it was determined that publications in English offered the best opportunity to achieve this.

Findings and Discussion

t-SNE Analysis of the Titles

To identify the foci of studies included in the research corpus, a t-SNE analysis of the titles was conducted. From the results of this analysis, a structure with three clusters was identified (see Figure 1). The first cluster shows that the COVID-19 pandemic has affected mostly undergraduate and graduate students and their learning processes, in terms of online learning and emerging challenges (see the green cluster in Figure 1). The second cluster represents the institutional crisis that emerged as a result of the shift to emergency online remote education, as this was an entirely new experience for several HE institutions. Within this cluster, learners' experiences in online/virtual learning spaces were a noteworthy issue (see the purple cluster in Figure 1). Finally, the third cluster reflects a variety of issues, outside of those in the other clusters, that emerged from the pandemic (see the blue cluster in Figure 1). The most salient issue was psychological problems, such as stress and anxiety from the uncertainty generated by the lockdowns and other measures taken to slow down the pandemic (e.g., closures of the educational institutions). This was followed by assessment and evaluation issues, particularly in terms of the challenges presented by having to develop and apply new assessment and evaluation strategies, different than those applied in traditional learning environments, for online learning processes. Overall, the studies included in the research corpus demonstrated a special interest in the perceptions, perspectives, and experiences of learners in HE institutions. The t-SNE analysis clearly outlines that the studies paid special attention to learners and the issues related to them, as well as to the institutional challenges and problems resulting from having to navigate in a new territory with many unknowns.
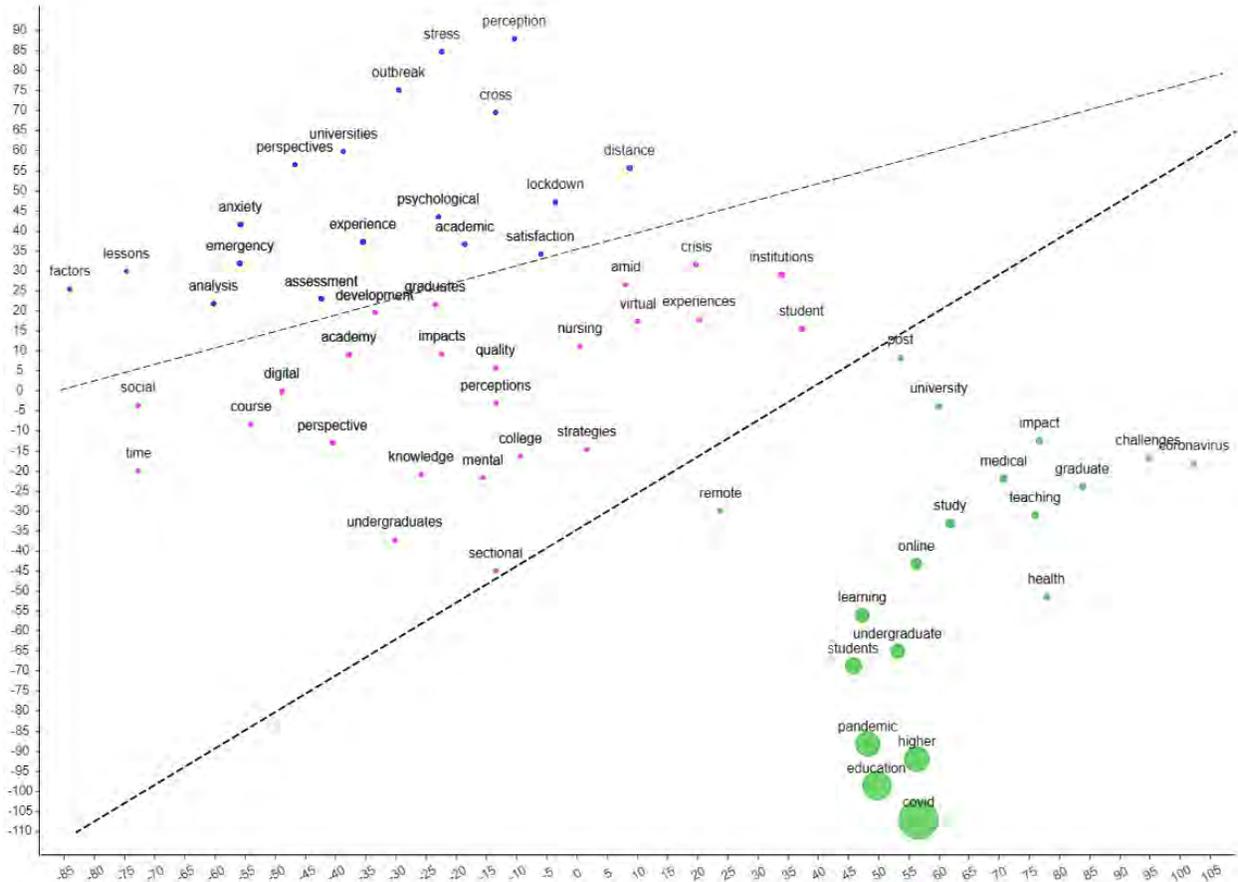
Figure 1: t-SNE analysis of the titles of studies included in the research corpus

Lexical Text-Mining of the Abstracts and Social Network Analysis of the Keywords

This section presents the three broad themes that were identified from the text-mining (Figure 1) and social network analysis (Figure 2). Accordingly, these themes are (1) educational crisis and HE in the new normal: resilience, adaptability, and sustainability, (2) psychological pressures, social uncertainty, and mental well-being of learners, and (3) rise of online distance education and blended-hybrid modes.

Figure 2: Text-mining of the abstracts from the sampled studies

Figure 3: Social network analysis of the keywords from the sampled studies

Educational Crisis and Higher Education in the New Normal: Resilience, Adaptability and Sustainability

The first theme demonstrates the responses HE institutions have had to the pandemic and the key features of these responses, namely, resilience, adaptability, and sustainability (see paths in Figure 2: *COVID-19, pandemic, lockdown, Coronavirus, outbreak, disruption, readiness, university, crisis, response* and *emergency, remote, education, educational, distance* and *higher, education, institutions, normal, future, sustainable, transformation, adoption*; see nodes in Figure 3: *COVID-19, higher education, higher education systems, challenges, resilience, sustainability).* Accordingly, it can be argued that the COVID-19 pandemic could be considered a benchmark test for identifying effective and ineffective HE services. The implementation of emergency remote education in response to the educational crisis witnessed in the first wave of the pandemic and to the major challenges it presented helped to soften the impact of this first wave. The first theme highlights the need for HE to develop strategies directed at strengthening the resilience and sustainability of HE institutions and the services they offer.

The related literature supports the ideas constituting the first theme and the conclusions drawn from them. The disruption to education caused by the COVID-19 pandemic deepened the bleeding wounds of educational systems and demonstrated how vulnerable these systems were (d'Orville, 2020). While emergency remote education (Bozkurt & Sharma, 2020a; Hodges et al, 2020) was adopted as a response to the pandemic, it only provided temporary solutions. In prompting the need to change (Ossiannilsson, 2021a; 2021b), all of the challenges that emerged from the pandemic have forced HE institutions to adopt new learning technologies and styles, the effects of which revealed the need to

develop a new type of digital resiliency in all stakeholders (Eri et al, 2021). Being prepared for the uncertainty and future challenges is a necessity at a time "when the future is unpredictable, capacity is uncertain and unknown, and learning is an issue of social and economic security" (Waller et al, 2020, p. 55). Such a view requires improving resilience, which means that HE institutions should "adopt new systems and processes, ensuring continued competitiveness and survival, especially when either internal or external interventions force them to undergo certain disruptions" (Bhagat & Kim, 2020, p. 368). However, improving resilience is not limited to an organisation's capability, it is also related to students (Bozkurt & Sharma, 2021) and instructors (Lagat, 2021) and a wide range of other factors (Cahapay, 2021). Lastly, it can be argued that with the fundamental transformations expected from the inevitability of change (Doerfel & Prezelj, 2017) and the new normal (Bozkurt & Sharma, 2020b; Xiao, 2021), it is critical for HE to reimagine and redefine itself to meet the requirements and needs of the post-Covid world.

Psychological Pressures, Social Uncertainty and Mental Well-Being of Learners

The second theme highlights how the impact of the COVID-19 pandemic on HE has reached beyond pedagogy (see paths in Figure 2: *psychological, coping, depression, stress, distress, anxiety and mental, health, care, well-being*; See nodes in Figure 3: *uncertainty, undergraduate, mental health, anxiety, stress, mental stress, psychologic, psychological distress, depression, fear*). It is clear that the COVID-19 pandemic was unexpected, unprecedented, and came as a complete element of surprise in this age of progress and advancement. In addition to its effect on education and educational institutions, the COVID-19 pandemic deeply impacted learners' mental wellbeing due to the intense psychological pressures and high uncertainty they experienced as a result of the dramatic changes to social mechanisms caused by the imposed restrictive measures.

This theme is consistent with the findings of the study by Mishra et al. (2021), who reported that the impact of psychosocial issues on teaching and learning is among the most researched topics. With the traumatic consequences of the pandemic (Bozkurt, 2021), a decrease in social (Saladino et al, 2020) and psychological wellbeing (Vindegaard & Benros, 2020) was observed throughout all of society, including the educational field (Cao et al, 2020; Sifat, 2021; Son et al, 2020; Sundarasen et al, 2020). In addition to the social distancing, lockdowns, and self-isolation (Nurunnabi et al, 2020), the sudden shift to online emergency remote education, social inequality, and ineffective educational strategies (Irawan et al, 2020) adversely affected learners' social and psychological wellbeing. As a result of these negativities, attention has been drawn to prioritising care-oriented, human-centered pandemic pedagogy by focusing on affective proximity in teaching and learning (Bozkurt & Sharma, 2020b), as well as on measures to narrow transactional distance (MacKenzie et al, 2022).

Rise of Online Distance Education and Blended-Hybrid Modes

The final theme involved the issue of reflecting the paradigm shift in the delivery of education (see paths in Figure 2: *teaching, learning, instruction, digital, technology, virtual, blended, open* and *e-learning, pedagogical, online, experience, interaction*; see nodes in Figure 3: *teaching, learning, technology, e-learning, online learning, distance learning, virtual learning, remote learning, blended learning)*. Although distance and online education are not new to many HE institutions, the shift that occurred in the wake of the pandemic was massive and on a global scale. Metaphorically, the shift to online distance education can be understood as *the migration of the educational tribes to the digital landscapes* by leaving behind the

so-called gold-standard of education, face-to-face instruction, and moving forward with the hope of surviving and adapting to online distance education, which first appeared as emergency remote education during the first waves of the pandemic.

Other studies on this subject report similar findings. For instance, in the pursuit of achieving a proper balance between face-to-face and online distance education in the new normal, blended and hybrid educational modes were increasingly adopted by HE institutions (Pelletier et al, 2021; Singh et al, 2021). Being stuck in a state of *vu jàdé*, to borrow a French term, meaning to be unfamiliar with and never having experienced a situation (Weick, 1993), which in this case, refers to online distance education, was a real challenge for many HE institutions (Heng & Sol, 2020; Miller et al, 2021), especially for traditional brick and mortar HE institutions that were not familiar with online distance education and its modalities. It has also been reported that while online distance education can be a better fit for disciplines like the social sciences and humanities, it can be challenging for applied disciplines, like medicine (Adedoyin & Soykan, 2020). However, the biases regarding the application of online distance education in applied disciplines have been discredited through the success observed in the prominent use of telemedicine (see, for instance, Figure 2) in delivering education during the COVID-19 pandemic. Figuratively speaking, the pandemic coin has two sides, an 'opportunities' side and a 'challenges' side, where issues like online assessment and evaluation, digital divide, digital burnout and fatigue, misinterpreted technology adaptation, digital competencies and literacies, online distance education instructional and learning design, lack of interaction and communication, and the need for digital infrastructures to facilitate and operate online distance education represent the challenges, while the eliciting of best practices and resulting improvement to known online distance education practices, the encouragement of creativity and drive to transform the internal status quo of online distance education, the greater accessibility for learners with special needs, and the granting of autonomy and agency to students can be considered as opportunities in a post-pandemic world.

Conclusions

Applying data mining and analytics, this study identified three broad themes concerning the HE landscape. These are: (1) *educational crisis and higher education in the new normal: resilience, adaptability, and sustainability*, (2) *psychological pressures, social uncertainty, and mental well-being of learners*, and (3) the *rise of online distance education and blended-hybrid modes*. These themes imply that pedagogy cannot be confined to only teaching and learning activities but, rather, trauma-informed pedagogies of care and empathy need to be developed. There is a shift to online distance education with different modes (e.g., blended, hybrid, hyflex), yet it is still a challenge to apply online pedagogies without proper instructional/learning design and with purely techno-centric educational strategies. It can be argued that the institution of HE should equip itself with skills and competencies to navigate and survive in a time of global crisis. To be sustainable, being adaptive and resilient is a need and this requires learning from the past and reimagining a future where HE truly accepts its failures and mistakes as an opportunity for change and rebirth.

In all, the global state of HE indicates that there has been a tectonic shift in the entire educational landscape, and that our paradigms are changing due to the effects forced upon us by the COVID-19 pandemic. The unknown is always scary and, naturally, the COVID-19 pandemic has frightened

everyone. As noted by Bozkurt and Sharma (2020b), "It is high time for HE to renew, recalibrate, and reposition itself in the educational landscape. This would require the institution of HE to regenerate itself and be born again. Like the Phoenix (also known as *anqā, sīmorgh*), it needs to rise from the ashes, but to do this, it must first face the flames" (p. v). In line with these thoughts, it can be argued that the new normal is a time when HE will face to flames. However, if we consider the pandemic as a benchmark for global society, the question that should be raised is, 'What did we learn from our failures and will we keep on repeating our mistakes?'

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