



Perspective

## Covid and the virtual classroom: the new normal?

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### ABSTRACT

Virtual learning can be defined as software systems created to support the teaching- learning process that allows teachers and students to communicate in an integrated manner through cyberspace. The rapid developments in technology over the past few years, have led to the innovation of systems through which information can be delivered independent of location. The current COVID-19 climate has resulted in the restructuring of the educational system and the adaptation of technology globally, so as to portray didactic ideologies. Investigation of efficacy of the use of design software platforms in a virtual learning environment is paramount as digitation has become a significant factor in the synthesis and dissemination of learning materials within the educational system. The use of virtual classrooms is deemed advantageous as it enables the incorporation of learning styles, decreases the incidences of learning barriers, allows for adherence of Covid-19 restrictions, and enhances mental encoding and information retention. It also comes with certain disadvantages, which are attributable to the technological divide, economic and technological infrastructure, the user's knowledge, perception and usage of these technological advancements, and its possible alienation and educational dissatisfaction. What and who benefits with these learning platforms; Is this the new normal going forward?

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### INTRODUCTION

Virtual learning describes software programs that support and enhance the teaching-learning process and provides a means through which students and teachers can engage in integrative communication remotely through internet / networks (Bri et al., 2009). E-learning involves a platform - that consists of the software and hardware components that are programmed to operate and regulate the development of forecasted academic profiles or lessons; contents – which regard the quality or design of the information been projected; and communication tools- that speaks about the instruments that are fundamentally necessary to facilitate the teaching-learning process (Bri et al., 2009). They confirm that amidst common parodies between e-learning and virtual learning platforms, e-learning is contained within or is considered to be a constituent of virtual learning platforms/ environments. Virtual or e-learning being a powerful instructional strategy, surpasses the corridors of the traditional

classroom dictations, creating virtual schools which facilitate learning at the student's advantage (any time, any place) (Powell & Barbour, 2011). Virtual learning promotes equity by providing pupils access to courses that would have otherwise be unavailable, for example, in remote rural areas courses can be facilitated or accelerated (Powell & Barbour, 2011). Software-engineered digital platforms curated towards the distribution of information through cyberspace governs the modality of virtual learning (Jackson, 2013). Cyberspace is conceptualized as a virtual technological realm geared towards the facilitation of web-based platforms used to enable social integration, mobilization and dissemination of thoughts, ideologies, data and hypotheses which formulate research information. Signification of its importance has heightened due to the emergence of the strict protocols implemented as the COVID-19 virus upsurge continues to influence the restructuring of societal norms thus impacting the social, educational, and economical systems globally. Dhawan (2020), added that virtual or learning allows students to engage in video conferencing, it allows discussions with students to keep classes as normal or natural (organic) as possible, it allows multiple device accessibility mobile phones as

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well as on laptops, it allows the possibility of viewing previously recorded lectures and allows feedback from students to be facilitated in addition to assignments delivery with flexibility of time and location.

Learning style is defined as the composite cognitive, affective, and physiological characteristics indicating learner perception, retention, and response to the learner environment (Bhagat et al., 2015). Virtual learning platforms when used in an integrative method result in the production of learning materials curated for diverse learning styles (Pashler et al., 2009), the optimal stimulation of higher centers of the brain, improved cognition and information retention are attained enhancing the learning experience.

Language is assimilated through visual (iconic), auditory, read/ write and kinesthetic modalities. Knowledge of learning styles may function as a mechanism by which educators and students design their learning materials to improve the quality of learning and ensure an efficient learning style is utilized. Visual learning may be achieved with text accompanied by use of pictures, symbols and animation which form graphical abstracts. Graphical abstracts are created to produce displayed digital visual art depicting succinct findings capturing the main idea. Displayed content aids in ease of learning by creating visual illustrations comprised of systemic depictions of a topic or processes. Pearson et al. (2015) explained that visual learning results in the creation of mental imagery which function as a depictive internal representation for perception.

Education and knowledge will continue to adapt to culture and digital technology as time progresses regardless of the arena in which it is employed. Therefore, to appreciate the relevance of virtual learning today, we must first understand its evolution and technological advances throughout the years. The creation of virtual (distance or online) learning was so to make knowledge accessible to more than just a privileged few. So, like subsidiary assistance and scholarships which are given to enhance the educational possibilities of under-privileged individuals who have financial constraints, to attain their education especially when these students are unable to participate in the traditional classroom setting (Kentnor, 2015). Online learning aims to diversify the way education is “transmitted, preserved, and generated” and not about modifying the knowledge being portrayed as such highlighting the necessity of this kind of platform with a significant focus on impact over profits (Appana, 2008; Kentnor, 2015; Guzman et al., 2020).

### *The Prevalence of Digitation*

According to statistical data collated by Clement et al. (2020), 4.66 billion internet users were recorded in October 2020 accounting for 59% of the total population of the world. This statistical data indicates that accessibility of web-based animation, graphical and illustrative integration designing software is attainable. Multimedia representation, digitation, and web-based designing platforms for efficient virtual learning as a substitute for traditionally structured educational environments is evidentially supported in many countries. Smartphone and computerized device usage have increased due to modernization and development of technological capabilities. 90% of young adults between the ages 18- 24 in the United States with access to internet facilities used social media platforms (Villanti et al., 2017). 69% of chief institutional leaders reported that online learning was crucial to their long-term vision in the autumn of 2012, and 6.7 million of the 20.6 million students registered in higher education were enrolled in an online course (Kentnor, 2015). These results indicate that social media platforms may be used in an integrative manner with online software programs which facilitate the designing of educational virtual learning materials in an attempt to improve cognizance and perception of such platforms. Statistical data indicating such a high percentage of social media usage in young adult may be used as inference or indication that virtual platform usage is largely accepted. It is vital to investigate and grasp the development and advancement in technological education and the various means used to administer knowledge to enhance the standard of education provided presently and to influence, inspire and educate students of the 21<sup>st</sup> century (Kentnor, 2015). Villanti et al. (2017) explained that electronic cultivation may harvest advantageous learning environment as a virtual classroom may eliminate economic, social, physical and psychological barriers which may otherwise limit optimal cognitive performance.

Social media platforms such as WhatsApp, Instagram, Snapchat, Twitter, and Facebook are easily accessible and offers in-app features which allow the instantaneous sharing of text, video and photographs to numerous persons globally. High social media platform usage indicates that with altered perception of these mediums, virtual learning can occur conveniently as an addition to their current function. Graphical abstracts and illustrative designing software may be used in specific design modelling of chimeric processes resulting in expulsion of innovative ideas. Animated cardiovascular physiological cellular signalling pathways may be designed using web-based

programming software, creating a simulation of the step-by-step biological pathway otherwise inconceivable (Stith, 2004).

Macromedia tools allow for the creation of bitmapped animation which facilitates the importation, enlargement, and movement of photomicrographic objects for image and shape manipulation to achieve the desired simulation (Stith, 2004). Microscopic biological processes are therefore amplified and projected to simulate cellular signalling processes. Process depiction enables enhanced mental encoding capabilities and concretization. Animative designing tools include FLASH, Dreamweaver, Adobe LiveMotion, QuickTime, Ulead, Canva, CorelDraw Graphics Suite, Affinity Designer, GIMP, InkScape, Gravit Designer, Photoscape, biorender, SMART. Design and use of learning instruments using design software can be disseminated virtually using several virtual platforms interconnected through cyberspace. ZOOM, Google Doc, Blackboard Collaborate, Edmodo, Edulastic Flipgrid, Google forms, Kahoot, Nearpod, Padlet, pixton, Quizizz, Seesaw, Interactive whiteboard and Survey monkey are web-based platforms geared towards the enhancement and digitization of information for classroom engagement and creation of a virtual learning environment.

Many institutions missed the mark, leading to closures, because what was conceptualized by nonprofit organization to help or benefit the vast underprivileged populations of distance learners was thwarted due to the need to make profits over the need to express philanthropy. About 65% of institutions in 2011 outlined that online learning was vital to their long-term strategic plans (Kentnor, 2015). It can therefore be said that over 10 years later, about 100% of educational institution can attest same in the crisis of this pandemic. That has not only eroded economic livelihoods but have led to the re-evaluation of educational policies once upheld by our governmental bodies. As a result, virtual learning has refused to remain a trend and is now the fastest growing type or means of remote learning or education and is viable within both non-traditional and traditional universities and colleges (Kentnor, 2015).

#### *Age-Related Perception of Online Platforms*

Substantial alterations to the perceptions of individuals mainly of the elder age group may be required for full implementation of design software used for virtual learning. The use of online platforms and the concept of cyberspace may be deemed complex and difficult to understand by elders due to generational barriers and familiarity with tangible items such as books, letters, and newspapers. Computerisation has enabled

modernisation and digitation of platforms necessary for societal utilisation and have been integrated into society in a manner which is simplified and may be beneficial to persons of all age groups. As digitisation and online system utilisation becomes more prevalent an improved perception and knowledge of online platforms and animation and graphical illustrative software is required to bridge the technological proficiency gap between elders, adolescents and young adults who are more versed in online platform usage.

In addition, virtual learning for enhancement of the learning environment was described by Vasquez et al. (2014) as a means by which ubiquitous learning challenges of disabled students in standard classroom settings may be diminished. Physical and social barriers may negatively impact the learning structure necessary for disabled students to excel such as transportation difficulties as well as behavioural responses to external stimuli such as noise or social anxiety. Some disabled students respond positively with the use of digital instruments comprising of graphical abstracts and illustrations as the “playback” or “replay” feature will allow for a computerised version of the routine, repetitive learning instructions optimal for information retention and learning of these individuals.

Neale et al. (2002) stated that virtual learning environments are divided into two main types: the single-user virtual environment and the collaborative virtual environment. A virtual environment will therefore allow the educator to design a preferred learning environment to facilitate the creation of a simulation of either a single-user virtual environment suitable for disabled students with social anxiety or special structural learning preferences or a collaborative virtual environment allowing for social integration by creating a simulation of a face-face classroom experience thus improving social skills of a disabled student. (Vera et al., 2007) Virtual learning as such allows for the designing of a controlled learning environment as learning barriers characteristic of face-to-face learning is amended.

#### *Psychologists' Perspective on the Use of Virtual Learning Platforms*

Integrative designing software for virtual learning lessens the possibility for miscommunication, misconception, reduced cognition and retention as encoding information through graphical abstracts and illustrations heightens alertness and reduces language complexity. According to Olorinola and Tayo (2015), chromaticity of graphical abstracts illustration and animative design influence cognitive competence by aggrandising information encoding, perception, and retention capabilities of the human brain. Universal

identification of colours on the colour spectrum has allowed for the study of the effect of colour usage on brain activity (Zeki & Marini, 1998).

Graphical abstracts, illustrations and animations used to facilitate the virtual learning processes involves the use of a variety of designing techniques involving colour manipulation. These are now a constant for many manuscript submissions, reviews, and publications (Nwokocho et al., 2012; Palacios et al., 2018; Cifuentes et al., 2018), as they give a snapshot summary of a picture depicting many words. And the usage of such in the classroom space will go a long way in enhancing the comprehension and assimilation of lesson / lecture notes. Cognitive psychologists' research hypothesises that colour usage is constitutive in mental encoding, memory cementation and recollection and was described by Dzulkifli and Mustafar (2013) as "the most important visual experience of human beings". Colour is an integral element in the creation of digital media which may be used for virtual display of learning materials as each colour has an emotional and cognitive connotation. Colours of the colour spectrum are categorised in "temperature" ranges. Colours located in the red spectrum are characterised as "warm" and hypothesised to be mentally stimulated activating higher centres of the brain physiologically proven to stimulate brain activity, influencing alertness, information retention and improved cognition (Olurinola & Tayo, 2015). This hypothesis governs the common practice utilised by educators in using red ink for correctional implications as red is symbolic of restrictive or correctional association as seen in the "stop sign", "bus stop" or correctional ink by lecturers. In the same manner, red is hypothesised to be effective for achieving optimal learner attention by educators in an attempt to place emphasis on integral factors which would allow for idea cohesion in understanding a topic. The use of congruent colours, which are defined as colours which when visible cause psychological internalisation providing mental exemplifications of specific word correlation resulting in concept concretisation.

Graphical abstracts and illusions may be used as instruments in support of the dual coding theory which is governed by the cognitive theory which hypothesises that non-verbal representation coupled with verbal association heightens mental encoding, information representation, concreteness and memory as visual and verbal information are processed by different regions of the brain (Paivio & Clark, 2006). The auditory cortex is responsible for perception of sound while imagery is encoded by the posterior parietal cortex (Jenkins & Merzenich, 1984). These centres function via varying interconnected pathways activating multiple regions of

the brain resulting in orthographic and phonological processing. Graphical abstracts accompanied by verbal associations unify otherwise distinct images creating a mental representation. The substitution of text-only with graphical abstracts and illustration can influence heightened brain activity and activation of interconnected brain systems which may result in long-term memory.

#### *Covid-19 and the new learning platforms*

In December 2019, the world was challenged by an outbreak of the novel Covid-19 Coronavirus subsequently resulting in a worldwide pandemic (Nna et al., 2021). Coronavirus Disease 2019 (Covid-19) along with its mass causality effect on global health systems and facilities, did not by any means spare aspects of the educational arena (Onyema et al., 2020). They added that, its boundless impact has proven futile to manage to the level where the whole globe had to be restricted in movement and overall lifestyle, claiming millions of lives worldwide. As of April 2020, over a million cases and more than 220 thousand deaths were recorded, been only a few months prior to global notification (Onyema et al., 2020). With no signs of a regression, aspects including education, economy, entertainment, research, transportation, sports, worship, businesses, social gathering/operations, and politics were all affected (Onyema et al., 2020). The educational arena was by far the worst hit of the pandemic, and due to the aggressive nature of the Corona virus, universities were forced to initiate new methods of teaching allowing remote virtual learning for local and foreign students to adhere to the new Covid-19 protocols (Onyema et al., 2020).

This has led to the expeditious reassessment of our societal norms and more specifically, the restructuring of our education system, which has forced many institutions to adapt a 'new norm' and take pertinent actions to remain above the current distresses (Ali, 2020). The emergence of Covid-19 has redirected focus to several areas to enable online teaching and learning as well as the creation of a virtual environment. Ferdig, and coworkers (2020) emphasized that the framework which allows for learning in a virtual setting must encompass elements which amplify and mimic a teaching presence, social environment and mechanisms which enable cognitive stimulation. Ferdig et al. (2020) continued to explain that these elements must be accompanied by innovative methods to facilitate information exchange and retention during the teaching learning process.

As social distancing is preeminent, this medium is best suited to flexibly facilitate learning as well as escaping the potential danger social gatherings may incur;

forcing universities or institutions who are reluctant to chance, to accept and utilized updated technological systems (Dhawan, 2020). This therefore calls for unity and humanitarianism, and as such livelihood must go on but, in a manner, where life is preserved. He added that with all these restrictions the onus on the educational sector responsible for schools, colleges and University is great, as the responsibility to remedy the events these challenging times incur, requires great resources. Although, virtual learning affordability, flexibility, learning pedagogy, accessibility, policy, and life-long learning are many of the factors these institutions must consider (Dhawan, 2020). Amplifying that virtual or online learning is not just an option anymore but is now a need. However, among these the disadvantages must not be ignored. We agree that the seriousness of these times has cornered us to resort to virtual platforms, but students have not been able to adequately balance the demands from their social, work, family lives with their study lives in a virtual learning environment, in addition to their inability to maneuver or interface competently with data since they did not possess the requisite virtual learning and academic skills (Dhawan, 2020). In order for students to fully grasp what they have learnt practice must follow, and virtual learning does not facilitate this. Dhawan (2020), also stated that students are challenged by the many difficulties surrounding virtual learning platforms, ranging from internet speed issues, connectivity disturbances, downloading errors, system failures, video and audio challenges and a conglomerate of other barriers to virtual learning experience. In addition to, school policies, digital divide, resistance to change and a lack of funding (Onyema et al., 2020).

Ferdig et al. (2020) explained that the emergence of Covid-19 has redirected focus to a number of areas in order to enable online teaching and learning as well as the creation of virtual learning. They explained that the framework which allows for learning in a virtual setting must encompass elements which amplify and mimic a teaching presence, social environment and mechanisms which enable cognitive stimulation. Ferdig et al. (2020) continued to explain that these elements must be accompanied by innovative methods to facilitate information exchange and retention during the teaching learning process. According to Tabatabai (2020), the next generation of medical practitioners could be in jeopardy, acknowledging that a vital aspect to their training – the practical (experimental) aspect - is removed with the onset of the physical distancing restriction. She added that it has been quite challenging to adapt to the unique conditions imposed upon the medical personnel separate and apart from inability to

grapple with this ‘novel’ organism. However, the enactment of emergency contingencies has managed to cushion the impact of the outbreak to regulate means through which the population of medical students and staff can complete their studies and lectures respectively, remotely – via virtual learning platforms (Tabatabai, 2020). This now has set precedence through the determination of medical education priorities during the pandemic, assessing the available resources there are, determine the challenges and related solutions, establish a prognosis, and prepare for future transformation after the pandemic acknowledging that things may never be as they were before (Tabatabai, 2020). She also ventured to recommend that virtual simulation and virtual learning platforms could be the media through which adaptation for clinical education and assessment can be facilitated, and the damming effect of the Covid-19 pandemic lessened.

#### *Virtual Learning Applications and Efficacies*

The timely implementation, creative design and use of technological animations and illustrations through virtual platforms are ‘the necessity’ required to enhance learning and rebuild the breaches learning faculties have endured (Ali, 2020). According to Palvia et al. (2018), e-evolution or e-revolution has spurred e-education or online education and has rapidly transformed the perspectives through which teaching, and learning is delivered. As institutions around the world adjust to these changes, a highly dynamic educational landscape has generated tremendous interest among various sectors across the information sector including administrators, educators, policy makers, publishers, and researchers (Palvia et al., 2018). Therefore, revitalising the need for virtual education and online learning opportunities must be engaged (Tabatabai, 2020). By extension with these new changes set about by the ongoing crisis, maintaining the level or standard of education, and reducing assessment disturbances are vital factors that must be upheld to thwart the incurring challenges, especially within the medical arena (Tabatabai, 2020). There are various factors that determine how one relates to the information being portrayed to him or her. Either through the visual, auditory, read/ write or kinesthetic modality. Which means, that for the student to understand, the teacher must transparently add singly or combined a conglomerate of animative and pictorial expressions, audio recordings or narratives, script and aspects of practical engagement (touch, applied or ‘the hands-on’ experience).

Dhawan (2020), highlights that the remedy is not classified to the discovery and usage of new technology but also entails reimagining how technology is

imparted. This will help students and teachers to have a greater appeal to be digitally literate. This knowledge will then influence the way in which teachers teach and would affect the animations they use in their presentations to keep students attentive, intuitive and alert. Special attention, through this knowledge, will enhance students' communication, allow students to render feedback, ask questions and increase their understanding on the content been projected in a manner to adjust and become versed in an environment of little familiarity. The use of animation for medical educational purposes, require a learning-theoretic deliberation, since its use in this arena requires skill and acuity. Notably, in adynamic cases, animations can be used to display physiological images for example, blood flow, cardiac muscle wall responses and other functional processes. In other words, changes in object's (heart) shape, size and position overtime can be envisaged through these means. Animations are not only subject to portray simple displays or physiological systems; they can also be upgraded to a highly customized level to fully express multidimensional aspects of the object or theme. This enables a greater understanding of the facts regarding the complexities of the discussed subject but in a simplified animative expression. Animations or virtual expression can be applied to illustrate cellular biological pathways (Stith, 2004), and through biomedical engineering allows students to obtain experimental results from virtual procedures similar to what real physiological occurrences would produce (Hernández-Valdivieso, et al., 2011). The virtual lab in addition to the interactive biomedical engineering (BME) software efficiently eased the learning process and dramatically enhanced the student's capabilities. And with the right programming, help to dramatically reduce the specific course cognitive load (the amount of information projected), allowing the appropriate sequencing and delivery of information in a more concise but effective manner. This leads to benefiting students as complex spatial structures or physiological sequences are exchange in a manner that successfully develops understanding and propagate the retrieval or recall process which enhances both short- and long-term memory storage (Hwang et al., 2012; Upson-Taboas et al., 2019).

Additionally, Almarzooq et al (2020), commented that applications of the future will more likely be geared toward scaling aspects including student satisfaction, attendance, and clinical performance. They also exhibit support for virtual simulation technology as one of the best media forward regarding medical education. Almarzooq et al. (2020), explained that the pandemic and the requisite of physical distancing has birth the

opportunity to redefine and recreate how medical pupils are taught and engaged. Which they add, have created the means to foster a sense of belonging and promote welfare, reducing the incidences of fatigue and isolation (abandonment/ loneliness) with the level of delivery which is expected from medical students.

This does not come easy or without challenges and limitations, because some students failed to fully grasp the concepts and expressed dissatisfaction with the features used in the research activity, as such requiring further explanation or simplification (Kesner & Linzey, 2005; Hwang et al., 2012). It could also create social division among students in addition to the psychological disadvantages (distractions, anxiety, frustration, confusion, lack of physical or personal attention, financial involvement, technical, as well as time management challenges can also hinder its use (O'Donoghue et al., 2004; Dhawan, 2020). Such compatibility to usage is often dependent on the acceptance by students or personnel who would adopt, use, and manipulate them (Hone et al., 2013). Other challenges include low internet penetration or telecommunication infrastructures, availability of computers and internet tools, lack of online educational repositories or their affordability, power and electrical infrastructures, which may be lacking in many low- and middle-income communities, as well as governmental policies, engagement and stability (Oshi et al., 2017; Nwokocha et al., 2020). In a study done by Onyema et al. (2020), it was discovered that over 70% of participants consented that inadequate infrastructure in the form of insufficient computers and internet facilities were the predominant factors restraining virtual learning engagement.

Bri et al. (2009) emphasized that despite the increased usage and expansion in virtual learning platforms, studies show that many lecturers or teachers do not possess the requisite skills critical to operate these programs efficiently and effectively, and as such they are encouraged to detach from the traditional and outdated applications, and endeavor to grasp the skillset or expertise required to handle this class of systems. Schools, educational and governing systems, must invest in the implementation, expansion, and adoption of online or virtual learning platforms, which involves the use of relevant (medical) animations or illustration in their course delivery to students, easing the complexities or challenges which may arise with remote learning.

The learning communities will benefit immensely, students will operate and matriculate to high levels of scientific competence, interact and even take lectures / audit courses from other institutions, but universities will also benefit from a multiplicity of ways. Some of

which include increased enrolments and profits, university outreach, reducing infrastructure cost, increasing student technological skills, eradicating overcrowding within classrooms, alleviate the effects of the predicted shortfall in instructors, improving retention and graduation rates, allowing students to work at their own pace and learning style and reducing the chances of faculty bias (Palvia et al., 2018). It may also enhance the students' enrolment numbers, which translates to more funding, a reallocation of funding to infrastructural growth, and resource reallocation to the productive faculty, laboratories and institutes, which will in turn spur more research, publications, drive technological growth and development and funding.

Increases in the cost of college education, distrusts regarding the incremental value of higher education, a decline in the rate of timely degree completion, disinclination to travel long distances, increasing cost of transport, a hesitation to incur long-term debts, and diverse social concerns, ranging from decreases institutional aid for low income families and exchange students and individuals from varying backgrounds, interests and way of life were some of the factors proffered by Palvia et al. (2018), and Almaiah et al. (2020) as the reasons for a decline in enrolment numbers in several higher institutions, these could be addressed by streamlining and advancing various aspects of virtual learning. But with these will come improved quality standards and the development of rules and regulations for virtual learning.

Optimal functionality of developed countries is governed by elements such as modernisation, industrialization, and technological advancement. Strategic infrastructure of developed countries allows for the placement of network systems within communities resulting in increased use, access and acceptance of internet platforms. These elements enable the easy use and implementation of virtual learning platforms in developed countries as the necessary placement for technological infrastructure and framework has been made available. Contrastingly, according to Andersson and Grönlund (2009) reluctance for the implementation of online platform utilisation for e-learning by governmental bodies of developing countries may be due to several challenges. Level of technological advancement, economic status of inhabitants, accessibility to computerised systems and design software may be significantly less in developing countries (Andersson & Grönlund, 2009).

## CONCLUSION

The new normal with virtual classrooms are increasingly being accepted globally, even with its noted disadvantages and advantages (Babu & Reddy,

2015). Its emergence has stupendously aided the shortage of teachers and has provided better quality education through students' ability to audit courses from institutions that may have been considered farfetched before now. Governments and institutional administrators should rise to these opportunities with the right policy formulation regarding the ICT intervention, provision of the right learning tools, enhancement of the collaboration initiatives with the industries and public sectors, training and retraining of the required manpower, reorientating the faculty and students to its merits through the auditing of the education curriculum, while bearing in mind the country's cultural and people's behaviour, rather than just copying or usurping other practices elsewhere. Such home-grown policies, often lacking in many developing nations (Paredes et al., 2016; Romero et al., 2019; Nwokocha et al., 2019a, b; 2020, 2021), should target all the stratum from the primary to the tertiary, such will easily be assimilated and put to practice effectively, with a view to bridging the educational gaps between institutions, countries, and regions.

## REFERENCES

- Ali, W. (2020). Online and remote learning in higher education institutes: a necessity in light of covid-19 pandemic. *Higher Learning Studies*, 10(3), 16-25.
- Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020). Exploring the critical challenges and factors influencing the E-learning system usage during covid19 pandemic. *Educ Inf Technol*, 25, 5261-5280.
- Almarzooq, Z. I., Lopes, M., & Kochar, A. (2020). Virtual learning during the COVID-19 pandemic: a disruptive technology in graduate medical education. *Journal of the American College of Cardiology*, 75(20) 2635-2638.
- Andersson, A., & Grönlund, Å. (2009), A Conceptual Framework for E-Learning in Developing Countries: A Critical Review of Research Challenges. *The Electronic Journal of Information Systems in Developing Countries*, 38(8), 1-16.
- Appana, S. (2008). A review of benefits and limitations of online learning in the context of the student, the instructor, and the tenured faculty. *International Journal on E-learning*, 7(1), 5-22.
- Babu, N., & Reddy, B. S. (2015). Challenges and opportunity of e-learning in developed and developing countries- a review. *International Journal of Emerging Research in Management & Technology*, 4(6), 259-262.
- Bhagat, A., Vyas, R., & Singh, T. (2015). Students' awareness of learning styles and their perceptions to a mixed method approach for learning. *International*



- Journal of Applied and Basic Medical Research*, 5(4), 58.
- Bri, D., Garcia, M., Coll. H., & Lloret, J. (2009). A study of virtual learning environments. *Wseas transactions on advances in engineering education*, 1(6), 33-43.
- Castelló, R., & Mañanas-Villanueva, M. Á. (2012). Virtual laboratory for simulation and learning of cardiovascular system function in BME studies. *Revista Facultad De Ingeniería Universidad De Antioquia*, (60), 194-201.
- Cifuentes, F., Palacios, J., Kuzmicic, J., Carvajal, L., Muñoz, F., Quispe, C., ... & Paredes, A. (2018). Vasodilator and hypotensive effects of pure compounds and hydroalcoholic extract of *Xenophyllum poposum* (Phil) VA Funk (Compositae) on rats. *Phytomedicine*, 50, 99-108.
- Dhawan, S. (2020). Online learning: a panacea in the time of covid-19 crisis. *Journal of disadvantages of IT based education and the implications upon students. Interactive Educational Multimedia*, 9, 63-76.
- Efiloğlu Kurt, Ö., & Tingöy, Ö. (2017). The acceptance and use of a virtual learning embryology animation on short-term learning. *Advances in Physiology Education*, 43(1), 55-65.
- Ferdig, R. E., Baumgartner, E., Hartshorne, R., Kaplan-Rakowski, R., & Mouza, C. (2020). *Teaching, technology, and teacher education during the COVID-19 pandemic: Stories from the field*. Association for the Advancement of Computing in Education (AACE).
- Guzman, T., Pirog, M. A., & Jung, H. (2020). Cost of higher education: For-profit universities and online learning. *The Social Science Journal*, 1-15.
- Hernández-Valdivieso, A. M., Salazar-Sánchez, M. B., Urrego-Higueta, D. A., Costa Castelló, R., & Mañanas-Villanueva, M. Á. (2012). Virtual laboratory for simulation and learning of cardiovascular system function in BME studies. *Revista Facultad De Ingeniería Universidad De Antioquia*, (60), 194-201.
- Hone, K., Liu, X., & Tarhini, A. (2013). User acceptance towards web-based learning systems: investigating the role of social, organizational, and individual factors in European higher education. *Procedia Computer Science*, 17, 189-197.
- Hwang, I., Tam, M., Lam, L. S., & Lam, P. (2012). Review of use of animation as a supplementary learning material of physiology content in four academic years. *The Electronic Journal of e-Learning*, 10(4), 368-377.
- Jackson, M. (2013). Formalism and intuition in software engineering. *Perspectives on the Future of Software Engineering*, 335-347.
- Jenkins, W. M., & Merzenich, M. M. (1984). Role of cat primary auditory cortex for sound-localization behavior. *Journal of neurophysiology*, 52(5), 819-847.
- Kentnor. H. E., (2015). Distance education and the evolution of online learning in the USA. *Curriculum and Teaching Dialogue*, 17(1&2), 21- 34.
- Kesner, H. M., & Linzey, V. A. (2005). Can computer-based visual-spatial aids lead to increased student performance in anatomy & physiology? *The American Biology Teacher*, 67(4), 206-212.
- Nna VU, McGrowder D, Nwokocha C. Nutraceutical management of metabolic syndrome as a palliative and a therapeutic to coronavirus disease (COVID) crisis. *Arch Physiol Biochem*. 2021 Mar 26:1-20.
- Nwokocha CR, Bafor EE, Ajayi OI, Ebeigbe AB. The Malaria-High Blood Pressure Hypothesis: Revisited. *Am J Hypertens*. 2020 Aug 4;33(8):695-702.
- Nwokocha, C. R., Owu, D. U., Nwokocha, M. I., Ufearo, C. S., & Iwuala, M. O. (2012). Comparative study on the hepatoprotection to heavy metals of *Zingiber officinale*. *Pharmacognosy research*, 4(4), 208-213.
- Nwokocha, C. R., Warren, I., Palacios, J., Simirgiotis, M., Nwokocha, M., Harrison, S., Thompson, R., Paredes, A., Bórquez, J., Lavado, A., & Cifuentes, F. (2019). Modulatory Effect of Guinep (*Melicoccus bijugatus* Jacq) Fruit Pulp Extract on Isoproterenol-Induced Myocardial Damage in Rats. Identification of Major Metabolites Using High Resolution UHPLC Q-Orbitrap Mass Spectrometry. *Molecules (Basel, Switzerland)*, 24(2), 235.
- Nwokocha, C. R., Gordon, A., Palacios, J., Paredes, A., Cifuentes, F., Francis, S., Watson, J., Delgoda, R., Nwokocha, M., Alexander-Lindo, R., Thompson, R., Minott-Kates, D., & Yakubu, M. A. (2020). Hypotensive and antihypertensive effects of an aqueous extract from Guinep fruit (*Melicoccus bijugatus* Jacq) in rats. *Scientific reports*, 10(1), 18623.
- Nwokocha, M., Beaney, T., Holder, C., Thaxter Nesbeth, K., Whyllie, N., Leitch, J., Ferguson, T., Hosang, M., Riley, V., Soyibo, A., Oshi, D., Brown, P., Paul, T., Wilks, R., Poulter, N. R., & Nwokocha, C. (2021). May Measurement Month 2019: an analysis of blood pressure screening results from Jamaica. *European heart journal supplements: journal of the European Society of Cardiology*, 23(Suppl B), B82-B85.
- Nwokocha, M., Romero, C. A., Holder, C., Whyllie, N., Wong, H., Lietch, J., Wilks, R., Hosang, M., Francis,



- S., Brown, P. D., Paul, T., Abel, W., Barton, E., Wilks, R., & Nwokocha, C. R. (2019). Blood Pressure Screening Campaign in Jamaica: May Measurement Month 2017. *American journal of hypertension*, 32(12), 1186–1191.
- O'Donoghue, J., Singh, G., & Green, G. (2004). A comparison of the advantages and disadvantages of IT-based education and the implications upon students. *Interactive Educ. Multimedia*, 9, 63-76.
- Olurinola, O., & Tayo, O. (2015). Colour in Learning: Its Effect on the Retention Rate of Graduate Students. *J. Education and Practice*, 6(14), 1-5.
- Onyema, E. M., Eucheria, N. C., Obafemi, F. A., Sen, S., Atonye, F. G., Sharma, A., & Alsayed, A. O. (2020). Impact of coronavirus pandemic on education. *Journal of Education and Practice*, 11(13), 108-121.
- Oshi, D. C., Omeje, J. C., Oshi, S. N., Alobu, I. N., Chukwu, N. E., Nwokocha, C., Emelumadu, O. F., Ogbudebe, C. L., Meka, A. O., & Ukwaja, K. N. (2017). An evaluation of innovative community-based approaches and systematic tuberculosis screening to improve tuberculosis case detection in Ebonyi State, Nigeria. *International journal of mycobacteriology*, 6(3), 246–252.
- Paivio, A., & Clark, J. M. (2006). Dual coding theory and education. *Draft chapter presented at the conference on Pathways to Literacy Achievement for High Poverty Children at The University of Michigan School of Education*.
- Palacios, J., Fonseca, J. M., Ayavire, F., Salas, F., Ortiz, M., Sandoval, J. M., ... & Cifuentes, F. (2018). Ascorbate attenuates oxidative stress and increased blood pressure induced by 2-(4-hydroxyphenyl) amino-1, 4-naphthoquinone in rats. *Oxidative Medicine and Cellular Longevity*, 2018, 1-11.
- Palvia, S., Aeron, P., Gupta, P., Mahapatra, D., Parida, R., Rosner, R., & Sindhi, S. (2018). Online education: worldwide status, challenges, trends, and implications. *Journal of Global Information Technology Management*, 21(4), 233–241.
- Paredes A, Palacios J, Quispe C, Nwokocha CR, Morales G, Kuzmicic J, Cifuentes F. (2016). Hydroalcoholic extract and pure compounds from *Senecio nutans* Sch. Bip (Compositae) induce vasodilation in rat aorta through endothelium-dependent and independent mechanisms. *J Ethnopharmacol*. 4; 192:99-107.
- Pearson, J., Naselaris, T., Holmes, E. A., & Kosslyn, S. M. (2015). Mental imagery: functional mechanisms and clinical applications. *Trends in Cognitive Sciences*, 19(10), 590-602.
- Powell, A. & Barbour, M. (2011). Tracing international differences in online learning development: an examination of government policies in New Zealand. *Journal of Open, Flexible, and Distance Learning*, 15(1), 75-89.
- Romero, F., Palacios, J., Jofré, I., Paz, C., Nwokocha, C. R., Paredes, A., & Cifuentes, F. (2019). Aristoteline, an Indole-Alkaloid, Induces Relaxation by Activating Potassium Channels and Blocking Calcium Channels in Isolated Rat Aorta. *Molecules (Basel, Switzerland)*, 24(15), 2748.
- Stith, B. J. (2004). Use of animation in teaching cell biology. *Cell Biology Education*, 3(3), 181-188.
- Tabatabai, S. (2020). COVID-19 impact and virtual medical education. *Journal of Advances in Medical Education & Professionalism*, 8(3), 140-143.
- Upson-Taboas, C. F., Montoya, R., & O'Loughlin, V. D. (2019). Impact of cardiovascular embryology animations on short-term learning. *Advances in Physiology Education*, 43(1), 55-65.
- Vasquez, E., Straub, C., Nagendran, A., Marino, M., Schaffer, K., Koch, A., Delisio, L., & Russel, M. (2014). A comparison of simulated and traditional environments on the social responses for children with autism. Proceedings TeachLive Conference.
- Vekiri, I. (2002). What is the value of graphical displays in learning? *Education Psychology Review*, 14, 261 – 312.
- Vera, L., Campos, R., Herrera, G., & Romero, C. (2007). Computer graphics applications in the education process of people with learning difficulties. *Computers & Graphics*, 31(4), 649-658.
- Villanti, A. C., Johnson, A. L., Ilakkuvan, V., Jacobs, M. A., Graham, A. L., & Rath, J. M. (2017). Social Media Use and Access to Digital Technology in US Young Adults in 2016. *Journal of medical Internet research*, 19(6), e196.
- Zeki, S., & Marini, L. (1998). Three cortical stages of colour processing in the human brain. *Brain: A Journal of Neurology*, 121(9), 1669-1685.