



## TRANSFORMATIONAL EDUCATION - A POST COVID SCENARIO

KRISHNAN UMACHANDRAN<sup>1\*</sup> AND ROHANA SYAMSUDDIN<sup>2</sup>

<sup>1</sup>Nelcast Ltd., India.

<sup>2</sup>Universitas Negeri Makassar, Indonesia.

### AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

*Received: 15 May 2021*

*Accepted: 20 July 2021*

*Published: 26 July 2021*

*Case study*

### ABSTRACT

Education has the higher goal of bringing up humanity and with love for fellow beings, hence it is essential and core for every society, as it ensures knowledge and awareness for mastering evolving skills. In the Post COVID scenario the Education has become important because it makes us realize to be more humane and empathizes life and love as common ingredients to live. The fag end of Pre COVID witnessed too many conflicts among nations along with the ever-rising global climatic issues affecting our life's in general. At certain stages the very essence of education was undermined even with the exponential growth of highly responsive emerging technologies which was binding the world seamlessly on a common connection. Education streamlines the thinking process and prepares for a common good for transitory migration across borders through employability, and building a cultured person to serve the purpose of bringing in oneness. Pre COVID proved that the existence of education is the only knowledge and not of value facts which was driving the development engine of any nation. Education, makes a society strong enough to stand for long. The educational process is a service for society and to learn – unlearn - relearn from our mistakes and transmit our knowledge to the next generation, is a progressive contribution. Eventually formal and informal education together consolidate our present and future states. With limited resources, creative learning with digital technology can circumvent bottlenecks for the peaceful existence of humans. Radically the changes have happened as never before building self-confidence and equalizing globally in the last two years, with anywhere-anytime learning process, devoid of a physical face to face and touch-feel-collective environment. We find the emerging approach to technology enabled education and customization would keep up the humanity and culture building for a safe living connected world.

**Keywords:** Education; classroom; digital learning; COVID; culture building.

### 1. INTRODUCTION

Education has the most creative feature of making for sublimity and a uniform level of success in character formation influencing life of younger generations, as it helps to acquire knowledge and provides the individual with the ability to receive information and creates a wonderful opportunity for growth and

expansion. Globally Teachers are debating about the need to rethink the changes required for educating the future generations. This disruption requires us to learn-unlearn and relearn the educational process, by questioning the teaching content suitability for preparing our students towards the future [1]. The world moved towards an educational agenda increasing the emphasis on learning rather than

\*Corresponding author: Email: [umachandran\\_k@hotmail.com](mailto:umachandran_k@hotmail.com);

simply access to basic education, thus expanding educational opportunities to reduce income inequality, underdevelopment and poverty, by upgrading the quality of education. Investment in education provided a much higher rate of return, and shifted emphasis on economic rationale for emphasizing education in the Millennium Development Goals [2]. Educational institutions with emerging technologies can plan, implement, and adopt shall provide access to content and people to share knowledge freely [3]. Having taken to online classes, students spend more time on virtual platforms, leaving them to become vulnerable to online exploitation, such as exposure to potentially harmful and violent content, including the risk of cyberbullying. In addition to the school closures and strict lockdown measures made families to use technology and digital solutions to keep their children engaged in learning, entertained and connected to the outside world, however this access is not commonly available to all children to garner the necessary knowledge, skills and resources to keep themselves competitive. Technology is the main vehicle in the development of a society for creating an environment filled with creativity and innovation for unleashing the full potential of teachers and students collectively, by influencing knowledge, the society and behaviour. Technology is a good tool for improving educational assistance by leveraging the best of big data infrastructure encompassing the knowledge and skills for the rapid growth of the society. Open communication and teamwork environment can enhance pedagogical innovation as an essential requirement for teaching and improving the effectiveness of education through emerging technologies.

### **1.1 Pre-Covid Educational scenario**

The world expanded in education over the past two centuries, suggesting education yielded higher individual income and construction of social capital and long-term economic growth [4]. Education laid the foundation for the economic, social, and political growth and development of society through its quality of upbringing, facilitating all round development of its future citizens. However, in the current scenario, none can predict the impact of school closures on the future development of the students. As per past research on school attendance and learning outcomes which had greatly dented the employment chances and economic development, this closures are sure to have numerous consequences on the socio-emotion and motivation, cleaved contact with classmates and the strain on families during an unprecedented extended stay in cramped living conditions [5]. The pandemic impacted education as institutions and universities closed their premises, while countries closed the

borders in response to lockdown measures. However, they were quick to replace face-to-face lectures with online learning, in spite of the closures affecting the safety, legal status of international students and their examinations. COVID crisis has exposed many hurdles and inequities from access to the internet, gadgets for online education, supportive learning environments and the misalignment between resources and needs affecting our education systems [6]. Till 2019, the goal was to deliver Quality education as part of transitioning to the knowledge economy, where educational systems and strategies were related to national development, institutional availability and capacities, participation in marginalised and excluded groups, were the driving points. These priorities ensured high quality and support progression of economic development, social justice, equality, environment, scientific advancement and culture preservation, through ethical reasoning, socio-emotional learning, quantitative logical reasoning, computational thinking, digital literacy, scientific temper, languages, and communication skills, in a manner that is developmentally appropriate [7]. The Pre COVID scenario had the teaching as rigid, formal, stereo-typed, transmitting knowledge and ideas, while students cram by-heart the class notes or the textbook content, at times even not understanding the essence but simply reproducing on the answer paper during examination. The students were expected to remain silent and restrain themselves from not disturbing the class session with queries or independent thinking of their own [8]. With computing technologies becoming mobile and embedded, the future of learning is at a quickly reachable location, disrupting educational delivery becoming a close knit arrangement for knowledge transmission from teacher to student, conceptualized, and visualized with no physical textual materials and instruments [3].

### **1.3 Impact of COVID Pandemic on Education**

The pandemic curfew warranted closure of all educational institutions. This unpreparedness from this sudden disruption, affected learners, and made the institutions to quickly respond and rebound with the pace to cope up with the outside world [9]. The COVID-19 crisis has changed our global outlook; education needs to change to prepare our students for the future, orienting towards Citizens for an interconnected world, redefined roles, future skills and unlocking technology for education. [1]. Many technology firms have leveraged the occasion with online classes which have met overwhelming response by teachers and students towards e-learning, as it seemed to be a viable option to continue the educational process [9]. Virtual mode of teaching and

learning is the new normal for the community impacted by COVID-19. Technology has impacted students' learning and also created an opportunity for teachers to quickly equip and face the challenges posed on education [10]. Thus the change in the educational process made an inclusive context of equalizing educational opportunity from various socioeconomic groups, with the widespread use of communication technology. Use of data, processed with artificial intelligence [AI] can improve Performance Management Systems in business operations. AI enabled digital tools can assess skills, and PMS can be realigned to record and serve as skills transcripts to develop skills across educational institutions and employers. These gaps should be mended through virtual training, mentoring, and on the job orientations [11]. Co-developing the education and learning framework sets out the types of competencies required for students to thrive in and shape their future [12]. The current crisis reminds the importance of education in societies, communities, and individuals affirming, reinforcing the opportunities to protect and fortify to advance international cooperation by seizing the moment of transformational change which happened suddenly immediate to the aftermath of COVID. Ideas for actions, that will advance the education to commit, should be for a common good without inequalities expanded to everyone to flourish, with the right to education and accepted value of collaboration among the teaching profession, promoted with student's participation rights, protecting the school social spaces, use of free and open source technologies, application oriented learning, opportunity from domestic and international funds, and finally global solidarity [13].

#### **1.4 Changes in Teaching Approach**

Technology is a great tool for transformed learning, affirming advancements in teacher taught relationships, by reinventing adoption approaches, reducing the inequity and accessibility gaps [14]. The COVID-19 pandemic undeniably caught education off-guard, revealing the gap of preparedness, along with the COVID restrictions, a new normal adoption integrated the content and competencies formed to become the curriculum goal [15]. Understanding and achieving success with new technologies requires the know-how, know-what and know-where on the background and affordances of Simulations, Digital Games, and Social Networking. The cognitive implications attend to the specific challenges while the tools are being used. Finally, a well drawn out strategy is required for overcoming the challenges while foreseeing the life of these technologies and their impact and learning and teaching [16].

Overcoming the uncertainty surrounding the emerging technology development, adoption and acceptance are transformations driven by their complexity and interconnectedness across sectors that imply that all stakeholders who have a responsibility to work together [17]. Currently, the students are not a mere empty vessel to be filled in by facts and figures, they have ample resources through various media and learning materials, along with interactive interpersonal communication. The Students expect their teachers to help, guide and facilitate the development, by inspiring, motivating and assisting in the quest for knowledge and skills. Thus provides accessibility and moves from being passive listeners by engaging students for knowledge sharing, problem-solving and creativity [8]. Applying a well designed and suitably crafting education technology to accelerate, amplify, and expand the impact of teaching will transform the imbibing process of the knowledge and skills to its fullest advantage [14]. The technological innovation is rapid and exists in education but with a wide gap between the teachers and students. The technology infrastructure is normally provided by the institutions, while the students have experimentally and accidentally followed the use of many emerging technologies in their social and open networking platforms. At times the students remind and guide the teachers, of how to use technologies for communication and interaction. These can be some of the tools that can be accepted easily by students who are the end users of the rapid growing technological innovation.

#### **1.5 Changes in Learning Styles**

The emerging technologies had developed Social Networking connected to unimaginable levels of process explosion and capacities development to collaborate and leverage others' abilities in new ways [16]. Teachers should facilitate learning, by seeking and acquiring new knowledge and skills alongside their students, thereby creating very valuable learning experiences with tools and support to thrive [14]. Preparing the future generations to excel in digitally technological, interactive and AI-driven work environments, emerging technologies can be applied to transform teaching and learning. Expanding the Digital Platform applications for Teaching and Learning opens up rapidly and changes the landscape of job-skills for employment. Therefore the learning support should be focused on the real time requirement for learning, skilling, and reskilling to a new unprecedented and unexpected reliance on on-line learning. Predominantly teacher's interest and institutional support plays an important role in transforming education with emerging technologies, where the faculty participating in new technologies

assert their own creativity by challenging the knowledge and skill context in education. Use of social media and other web related technologies brings in learning trends and interest that are novel and seeks participating groups of students as well as teachers, to get dwelled within the potential of emerging technologies. To improve teaching and learning, requires recognition to influence and create new policies that can be controlled by institutions while delivering online learning systems.

### **1.6 Changes in Evaluation Process**

Evaluation is feedback for learning and is an important part of quality assurance. Evaluation should be orientation on students' engagement, participation and task engagement, for identifying to improve learning, or specific outcomes [18]. Technology-enabled assessments communicate transparent evidence of the educational progress with clear insights to students, families, teachers, general public and administrators with better reach of information and also facilitates pride building in the progression. Online digital worksheets, multiple-choice tests and videographic presentation of project activities in evaluation instills trust and transparency in the process [14]. Challenging the impact of education, relevant tools and methodologies are required for appraisals and evaluations within the settings of the learning environment. The process should seamlessly integrate a computing system along with the emerging technology to offer secured values that includes elimination of travel, the need for newer facilities and infrastructure etc., expanded well on the concept and implementation of evaluation in the learners [3]. The COVID has dramatically shifted away from the learning and teaching from a traditional setting with physical interactions to a distant and home scenario and virtual connection. Posing problems to the children living in underdeveloped areas, who predominantly rely on the physical setting of the school infrastructure along with educational materials, guidance, and the only decent meal of the day. During these periods of quarantine, students also face multiple forms of abuse and violence, along with crowded conditions, lack of resources such as digital devices and connectivity; which costs their education, in addition to their well-being in the current health crisis. These exceptional measures have put a significant number of students to great discomfort, affecting the mental health and well-being, endangered, impacting lasting repercussions [13]. The evaluation purpose should determine what-is-measured, the investigation of what-is-observed, the focus on the individual using the system, and the cultural factors surrounding the system are to be included in the analysis. The interactions between the

usability of the system and the extent of learning, identifies the participation in the role of the learning interface, suggesting that outcomes are not alone important but perceptions may be informative. At times the process and outcome are appropriate during the evaluation of learning happening through technologies [18].

### **1.7 Emerging Technologies in Education**

The Pre COVID education system is broken, and insufficient or ineffective in meeting the demands of the Post COVID scenario. Digital technologies with AI interfaces can be used in teaching and learning solutions to integrate data-driven systems to deliver context driven systems, bringing changes to learning experience adjusted to the learning environment for creating personalized learning experience [19]. During the Pre COVID period, computers bridged the gap and increased the equity in education with interconnected devices like multimedia with students as the centre, and in that process the teacher as organiser assisted by service providers used the network environmental resources through cooperative learning, with self-initiated enthusiasm and spirit of the students to achieve the goal [20]. Emerging technologies in education include Cloud Computing, Virtual and Augmented reality, Additive manufacturing, Big Data and Robotics [21,22]. Agility in education transforms the systems, to keep pace with technological advancements rising up to the skills shortages in digital technologies. Digital and online methods require curriculum development to reorient education approaches towards being practical, applied and experimental, then developing the skills, competencies and capacities for continuous learning. AI experienced periods of progress and advanced exponentially, with major breakthroughs in machine learning and deep learning, accessed through huge amounts of big data, cheap and massive cloud computing, and advanced microprocessors. AI exceeds human capabilities and greatly improves language translation, including voice translation through natural language processing, and has proved more accurate than experts in their domain [23]. Recent technologies in the classroom connect students in a way the outside world approaches socialization, meaning-making, and accomplishment, as critical to mitigate the disconnect and seamlessly leverages the power of these emerging technologies for instructional gain [16]. The initial thrust for any responsive, dynamic emerging technology adoption requires a strategic imperative. However in this case the pandemic did not offer any other choice for the educational segment to get sheltered from the competitive disruption brought in by the adoption of digital technologies. Acceptance and shared

understanding would be arrived upon continuous use, as they mature, overcome the uncertainty phase and progress from the beginning stage to expert levels [17]. The emerging technologies position the teachers, students, families, and administrators to transform learning through innovative teaching, educating, and mentoring practices in a variety of virtual settings, and informal spaces to enhance the cognitive, social, and behavioral aspects. AI applications through emerging technologies can lead to exciting new innovations in teaching and learning, providing an ethical, equity and secured engagement to a wide range of complementary perspectives to the stakeholders through cross-disciplinary teams in teaching and learning with scientific rigor.

### 1.8 Infrastructure Support

Technology Infrastructure covers all access to computing gadgets, high-speed Internet, access to other necessary peripherals as paraphernalia which the institution itself supports or the individual needs to procure and use [16]. Technology personalized learning offers students more choices, preparing them to organize and direct themselves towards the future. Learning, teaching, and assessment enabled by technology require a robust infrastructure available to teachers and students whenever needed along with digital learning resources and expert processing for development. Accessibility includes the design of apps, gadgets, contents, and supportive environments to the educational activity enabling students to be inclusive with processes that are adaptive, built-in, and assistive technology [14]. Educational strategies should be inclusive at all levels, connected with the economy and society with a throughput of skill building, training and infrastructure development. Universities promote interdisciplinary research on community needs, Higher Education Research Centres [HERC] and Collaborative Research Centres [CRC] should research and publish together on Online learning platforms using emerging digital technologies, delivering with quality [24]. Strengthening the education as a common good, with the responsibility of right to education, teachers should collaborate with students for their participation and rights, in the social spaces provided by schools, through free and open source technologies available for scientific literacy within the curriculum. They need to have financial support with global solidarity to end current levels of inequality. These are the nine challenges that require sharing of responsibility from action by governments, international organizations, civil society, academics, learners and stakeholders at all levels [UNESCO, 2020].

### 1.9 Will Digital Education Exist for Long

The current generation of students uses the power of working collaboratively to solve global challenges such as climate change and health being top on their agenda [1]. The losses require systematic and sustained actions to improve the educational process of the current and future students [5]. This necessitates that skills and quality are important for providing cutting-edge deliverables, preparing for a better opportunity and employability of students requires grooming and equipping themselves with industry 4.0 competent skills [25]. Digital imbalance exists among active technology enabled learners and passive content consumers, for quick understanding and reinforced learning which is a creative learning support offered through technology use [14]. The use of blogs, social network sites and video sharing are common among students; in addition knowledge sites such as Wikipedia and podcasts promote multi-dimensional interaction among the younger generations. Team work environments can enhance emerging technology when used within the existing and highly popular social networking sites for promotion of research based projects, help support distance and off-campus learning; and interactions. Knowledge sharing happens both inside the classroom and even outside, hence allowing students to participate in asynchronous learning is required for enabling students who missed the opportunity to get engaged in a real time learning environment.

## 2. CONCLUSION

While the emerging technology applied education process leads to widen the scope of thinking, as it has evolved, as the very basis for the prosperity and progression of societies, bringing desirable changes in human behaviour and helps to decide and follow the right options available for a common good. Investment in education amply rewards the society, for preparing a productive citizen who are affective in terms of research and development, thus laying the foundation for the progression of the society. The pandemic is vulnerable to affect education for years to come. Many families in the world are heavily indebted, in addition to the burden for funding the children's investments in education. Without necessary debt restructuring, funding support by the government machinery, and a paradigm shift towards learning through emerging technologies, there is the risk that the students will be forced to choose between essential life requirements, and educational upgradation, which would seriously disrupt the educational opportunity in the near future. Everyone knows that without education, a society will become weak and fragile and cannot stand for long. The

educational process is a service for society and to learn – unlearn - relearn from our mistakes and transmit our knowledge to the next generation, is a progressive contribution.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Poornima Luthra, Sandy Mackenzie. 4 ways COVID-19 could change how we educate future generations, World Economic Forum; 2020.  
Available:<https://www.weforum.org/agenda/2020/03/4-ways-covid-19-education-future-generations/>
2. UNESCO. Revisiting global trends in TVET: Reflections on theory and practice, UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training. 2013;356.  
Available:[https://unevoc.unesco.org/fileadmin/up/2013\\_epub\\_revisiting\\_global\\_trends\\_in\\_tvete\\_book.pdf](https://unevoc.unesco.org/fileadmin/up/2013_epub_revisiting_global_trends_in_tvete_book.pdf)
3. Deborah J, Bradford. Emerging and disruptive technologies for education: An analysis of planning, implementation, and diffusion in florida's eleven state university system institutions, department of educational research, Technology and Leadership in the College of Education at the University of Central Florida Orlando, Florida. 2010;307.  
Available:[http://etd.fcla.edu/CF/CFE0002989/Bradford\\_Deborah\\_J\\_201005\\_EdD.pdf](http://etd.fcla.edu/CF/CFE0002989/Bradford_Deborah_J_201005_EdD.pdf)
4. Max Roser, Esteban Ortiz-Ospina. Global education; 2016.  
Available:<https://ourworldindata.org/global-education>
5. Eric A, Hanushek, Ludger Woessmann. The economic impacts of learning losses. 2020;24.  
Available:<https://www.oecd.org/education/The-economic-impacts-of-coronavirus-covid-19-learning-losses.pdf>
6. Andreas Schleicher. The impact of COVID-19 on education, Insights From Education At A Glance 2020. 2020;31.  
Available:<https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf>
7. GoI. National education policy. 2019;484.  
Available:[https://www.education.gov.in/sites/upload\\_files/mhrd/files/Draft\\_NEP\\_2019\\_EN\\_Revised.pdf](https://www.education.gov.in/sites/upload_files/mhrd/files/Draft_NEP_2019_EN_Revised.pdf)
8. Chinmoy Goswami. Role of technology in indian education. 2014;79(2):5.  
DOI: 10.7763/IPEDR  
Available:<http://www.ipedr.com/vol79/002-IC4E2014-1-003.pdf>
9. Deepali Kasrekar, Gayatri Wadhavane-Tapaswi. Impact of COVID-19 on education system in India; 2020.  
Available:<https://www.latestlaws.com/articles/impact-of-covid-19-on-education-system-in-india/>
10. CBSE. Free online training programme on educational technology and learning in collaboration with google; 2021.  
Available:[http://cbseacademic.nic.in/web\\_material/Notifications/2021/26\\_Notification\\_2021.pdf](http://cbseacademic.nic.in/web_material/Notifications/2021/26_Notification_2021.pdf)
11. McKinsey. What now? Decisive actions to emerge stronger in the next normal Six months into the COVID-19 pandemic, it is time for companies to act, not react. 2020; 159.
12. OECD. OECD future of education and skills 2030. 2020);15.  
Available:[https://www.oecd.org/education/2030-project/about/E2030%20Introduction\\_FINAL.pdf](https://www.oecd.org/education/2030-project/about/E2030%20Introduction_FINAL.pdf)
13. UNESCO. Education in a post-COVID world: Nine ideas for public action International Commission on the Futures of Education. 2020;26.  
Available:[https://en.unesco.org/sites/default/files/education\\_in\\_a\\_post-covid\\_world-nine\\_ideas\\_for\\_public\\_action.pdf](https://en.unesco.org/sites/default/files/education_in_a_post-covid_world-nine_ideas_for_public_action.pdf)
14. US,DoE. Reimagining the role of technology in education: 2017 national education technology plan update, U.S. Department Of Education. 2017;111.  
Available:<https://tech.ed.gov/files/2017/01/NETP17.pdf>
15. Cahapay MB. Rethinking education in the new normal post-COVID-19 era: A curriculum studies perspective. Aquademia. 2020;4(2):ep20018.  
Available:<https://doi.org/10.29333/aquademia/8315>

16. Eric Klopfer Scot, Osterweil Jennifer, Groff Jason, Haas. Using the technology of today, in the classroom today, The Instructional Power of and How Teachers Can Leverage Them. 2018;23.  
Available:[http://education.mit.edu/wp-content/uploads/2018/10/GamesSimsSocNets\\_EdArcade.pdf](http://education.mit.edu/wp-content/uploads/2018/10/GamesSimsSocNets_EdArcade.pdf)
17. Michael Fitzgerald, Nina Kruschwitz, Didier Bonnet, Michael Welch. Embracing digital technology, a new strategic imperative, findings from the 2013 digital transformation global executive study and research project. 2017;15.  
Available:[https://www.capgemini.com/fin/wp-content/uploads/sites/27/2017/07/embracing\\_digital\\_technology\\_a\\_new\\_strategic\\_imperative.pdf](https://www.capgemini.com/fin/wp-content/uploads/sites/27/2017/07/embracing_digital_technology_a_new_strategic_imperative.pdf)
18. Mary C Dyson, Silvio Barreto Campello. Evaluating virtual learning environments: What are we measuring?, *Electronic Journal of e-Learning*. 2003;1(1):11-20.
19. Ashok Panigrahi, Vijay Joshi. Use of artificial intelligence in education, *The Management Accountant*. 2020;5.
20. Umachandran K, Corte V, Amudhalakshmi D, Ferdinand-James P, Said D, M, M, Sawicka T, B, Jurcic I. Designing learning-skills towards industry 4.0. *World Journal on Educational Technology: Current Issues*. 2019;11(2):12–23.
21. Roosefert Mohan T, Preetha Roselyn J, Annie Uthra R, Devaraj D Krishnan, Umachandran. Intelligent machine learning based total productive maintenance approach for achieving zero downtime in industrial machinery, *Computers and Industrial Engineering*. 2021;157. ISSN 0360-8352  
Available:<https://doi.org/10.1016/j.cie.2021.107267>.
22. Mutlu Cukurova, Rose Luckin. *Measuring the Impact of Emerging Technologies in Education: A Pragmatic Approach*. 2018; 18.  
Available:<https://discovery.ucl.ac.uk/id/eprint/10068777/>
23. UNCTAD. *Technology and innovation report, Harnessing Frontier Technologies for Sustainable Development*. 2018;134.  
Available:[https://unctad.org/system/files/official-document/tir2018\\_en.pdf](https://unctad.org/system/files/official-document/tir2018_en.pdf)
24. GoI. *Science, Technology, and Innovation policy, department of science and technology, ministry of science and technology, Government of India*. 2020;63.  
Available:[https://dst.gov.in/sites/default/files/S\\_TIP\\_Doc\\_1.4\\_Dec2020.pdf](https://dst.gov.in/sites/default/files/S_TIP_Doc_1.4_Dec2020.pdf)
25. Krishnan Umachandran. Industry 4.0 and its associated technologies, *Journal of Emerging Technologies*. 2021;1(1):10.  
Available:<https://journals.jfppublishers.com/jet/article/view/24>