



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Covid-19 Pandemic: E-Learning And Technical Constraints

¹Megha Agarwal, ²Dr. Bineet Kumar Gupta, ³Nidhi Tiwari, ⁴Abhijityaditya Prakash

^{1,3,4}Assistant Professor, ²Associate Professor

¹Department of Computer Science and Information Systems,

¹Shri Ramswaroop Memorial University, Barabanki, UP, India

Abstract: The COVID-19 has massive impact on the people lives and habits, since it first outbreak in early 2020 in India. The Educational institutes across the country have been closed due to the COVID-19 pandemic disturbing the academic calendar of every institute. By the End of March'20, most educational institutes have shifted to online learning platforms to keep the academic activities going. However, for the developing country like India, E-learning poses a serious challenge due to digital constraints like availability of smart devices, internet connectivity issues like speed, bandwidth in remote areas. In this study, we focus on understanding the technical challenges faced by rural and urban students and their preference towards the online learning during COVID -19 pandemic. We conducted an online survey of students from various locale and explored their inclination for online classes. This survey will be helpful in designing the effective online learning education for one and all. The result indicated that online learning was good in the middle of pandemic but also spotted the light on the availability of internet access, smart devices and financial issues. Majority of the respondents are ready to opt for virtual classrooms to cope up with curriculum during this pandemic. The study also show that majority of the students have access to internet and smart devices for e-learning but for rural areas without broadband connectivity, it is still a tough challenge for students to make use of online classroom initiatives.

Index Terms - digital constraints ,virtual classroom, broadband Connectivity, Pandemic

1. INTRODUCTION

Hazards can be man-made or natural. Natural hazards are the threats to human populations where the actual source of the occurrence is found in the natural world, generally zoonotic. Biological natural hazards cause the emergence of infectious disease for which the vaccinations, remedies are unknown.

Pandemic: The global outbreak of an infectious disease where no vaccine, or natural resistance, exists that is able to stabilize the threat.

Covid-19: Since its first outbreak between late 2019 and early 2020 in China, the COVID-19 pandemic has had a massive impact on people's lives and habits. Across the globe, many countries have been badly affected by the virus spreading and are facing an unprecedented health crisis, whose effects will impact their economic and social structures in the time ahead. Corona virus positive cases in India continue to rise on a daily basis. In the absence of vaccination, the non pharmaceutical infection prevention methodologies have been implemented in the form of social distancing, nationwide lockdown, workplace non-attendance, school closure, "janata curfew", etc. to contain the epidemic in India.

The measures adopted to restrict the spread of virus led to a shift in the functioning of various services like increased usage of home delivery, online lessons, remote working solutions, etc. Pandemic Covid-19 was very well felt by the world of education also. Social distancing was respected so as to minimize the kind of community transmission that could develop quickly in dense social networks like the university campus. In this tough time, the education sector across the globe shifted to common trend in response to the pandemic with "E-Learning" protocols, marking the instant transition from face-to-face learning to online classes.

E-learning: Now a days, E-learning has been used a tool in the field of education and as another option to face to face education. Many definitions have been put up for the term "e-learning". For example "any learning that involves using internet or intranet", "anything delivered, enabled, or mediated by electronic technology for explicit purpose of learning", "evolving, enhanced, everywhere, every time and everybody." However E-learning gained momentum after the rapid progress of internet in the 21st century. With unlimited data packs at optimum cost, 24x7 accessible, anytime and anywhere, education apps like Google classroom, docs, forms, etc. ,education field is slightly moving from face to face interaction to virtual classroom. One of the main reasons for this is it gives students' greater access to education in comparison to traditional methods of teaching as students can undertake their study from anywhere and at any time as well as being given the option to study part-time or full-time.

With the multiple rolling of COVID-19 cases in the country every day, a possible alternative to continue education while preventing the spread of infection, is electronic learning (e-learning). For developed countries, E-learning has been a common delivery media for education. However for the developing countries like India, the challenges posed by E-learning in terms of financial and acceptance factors remain to be a problem that limits its full fledged use. This issue has also raised the question whether our teacher-learner community are fully prepared for the E-learning environment.

Role of internet:

Internet is now the backbone of academic community. Now a days, millions-billions people are connected and dependent on internet. It is one stop solution to all the problems and caters the need of different people from different backgrounds. However, still this web is not accessible to most people due to certain issues like remote areas, unavailability of smart devices, electricity, infrastructure etc. According to TRAI, it has mentioned in its latest report that the internet subscribers have been growing in urban and rural India, but still there are many especially rural area who have lower level of internet access. Basically a large percentage of upcoming web users will come from emerging markets, particularly from countries such as India. India has over 10 billion people; approximately 750 million people live in 637,000 villages in rural India, in which 43,000 rural areas are without mobile services. So it can be argued, that a greater percentage of villages in rural India are without internet connectivity.

Many factors make digital learning a challenge like poor infrastructure of rural India, 24x7 electricity, low bandwidth, lack of affordable computer system, internet connections due to lower income in rural areas, low literacy rate, unofficial spoken languages, etc. Many attempts have been taken to offer better connectivity over the last decade, which has given significant results but still most of the rural India remains unconnected. With the social distancing policies during COVID-19 pandemic, we hope that online learning culture will continue even after the COVID-19 disappears.

II. RELATED WORK

The primary purpose of this study was to examine the technical availability and perception of students regarding the online classes. Majority of the respondents referred online classes to keep pace with the academic curriculum due to lockdown imposed because of COVID-19 pandemic, whereas some respondents were having default to cope up with the online learning due to unavailability of technology especially in rural areas. In order to probe into the matter, analysis of students perception regarding online classes was required.

We also identified the learners' perceptions of successful components and hindrances in online learning environment. Some early work in the field of online learning has provided the fundamental insight into the prospects of online learning (Cereijo *et al.*, (1999); Hartley & Bendixen, (2001); Hill, (2002)). One of the primary factors listed for determining the success of online classes was structure of online classes. This finding is reinforced by the studies of Dempsey and Van Eck (2002); ;Song *et al.*(2004); Allen (2011).Long duration classes should be avoided to increase the productivity of learners' and sufficient interval should be provided between two consecutive classes. As we learn in Human Computer Interaction, cognitive load should be avoided and due care must be taken due to prolonged use of electronic gadgets which may affect cause physical strain. It was supported by Thompson's (2014) formula of work for 52 minutes and break for

17. Technical proficiency of teachers and learners related to usage of computer and internet is a major factor determining the effectiveness of online classes. It was in line with the findings of Tsai & Lin (2004); Peng, *et al.* (2006); Convenience and flexibility were identified as the strength of online classes. Petrides (2002) claimed that respondents indicated that it was convenient to work in an online course in collaborative groups without rearranging the schedule for everyone as one would do in traditional classroom learning. Poole (2000) found that learners often accessed resources for the course from their home computers, the most convenient location for them. Hence care should be taken to fix the online classes based on the learner's convenience and it will be better if recorded videos are uploaded in the university website so that the learner can access the videos as per the convenience.

Interactivity was found to be one of the major driving forces for success of online classes. For example, the findings by Johnson *et al.* (2008) indicates that developing and sustaining a collaborative learning space within an e-learning environment is essential for maximizing the satisfaction of the participants. In addition to this Gunawardena and Zittle (1997) found a strong correlation between learners' social presence and their overall satisfaction in the medium. Online classes must engage participants through frequent, meaningful activities that helps to keep them focussed. The importance of frequency of interaction in making online classes was also explained by Huggett (2014). It was also found that lack of immediacy in getting answers to their queries was also found to be a challenge in online learning. It was also reported by Hara and Kling's (1999); Petrides' (2002); Vonderwell's (2003). Hence care should be taken by the instructor to answer the queries of the learners' immediately. Suggestions were also taken from the participants to enhance the effectiveness of online learning. It was found that appropriate content, connectivity, recorded videos along with proper follow up makes online classes on par with the traditional classroom situation. Majority of the participants reiterated the point several times. Therefore, Online learning thus allows institutions and/or teachers to reach learners virtually, enhances convenience and strengthens educational opportunities (Bourne *et al.*(1997); Owston, (1997); Hara & Kling,(1999), (2001); Schrum, (2000); Rourke,(2001); Hill, (2002); Hofmann, (2002);). Due to increase in online learning environment and collaboration due to lockdown measures , it was observed that the Internet traffic was affected significantly. This analysis was in line with the findings of Thomas Favaley et al.(2020). It observed that incoming traffic drastically decreased, while outgoing traffic has more than doubled to support remote learning. The major challenge to E-learning was typically faced by developing countries where infrastructure was still long way to go. It was stated in the findings of Mark M. Alipio(2020) that learners in a less economically developed country are passive to e-learning approach. Although, we are living in the era of Internet, but for the country like India, which is viewed as Rural and urban India, the internet access rate is growing rapidly which was in line with the findings of M. Prabu, R. Manoov(2013);

III. STATEMENT OF THE PROBLEM

The spread of novel corona virus has put an indefinite hold on face to face interaction. With efforts to prevent the spread of COVID-19, the contours of education system are changing with virtual classrooms becoming the primary means of instruction. Universities and institutions are shifting to online platforms to catch up with the curriculum. It may be difficult to say how students and teachers will cope with online learning as they figure out the constraints, reorient to address them but the perception of students is an important consideration which we have tried to document. The student community have to cope up with the system of online learning as they have limited resources. The resources required to access E-learning content like availability of smart devices, high speed internet connection, smart devices supporting educational apps, storage issue in smart devices, etc.

We are living in the digital world where Internet is one stop solution for everything. This can be felt by all those people who have access to internet and smart devices. but again the question arises, are we all prepared? Do we have all the technicality and technology available to us. In the developing country like India, the urban people has a upper hand with all technological advancement, but for rural people, this is really challenging. According to the report released by TRAI in Jan'2020, the internet access in rural India is advancing but still this figure stands far below as compared to urban India. Here is the snapshot of "Indian Telecom Services Performance Indicator Report" for the internet and broadband subscribers :

Table 1: Internet/Broadband Subscriber:

Total Internet Subscribers	687.62 Million
% change over previous quarter	3.35%
Narrowband subscribers	62.20 Million
Broadband subscribers	625.42 Million
Wired Internet Subscribers	22.26 Million
Wireless Internet Subscribers	665.37 Million
Urban Internet Subscribers	439.99 Million
Rural Internet Subscribers	247.63 Million
Total Internet Subscribers per 100 population	52.08
Urban Internet Subscribers per 100 population	104.25
Rural Internet Subscribers per 100 population	27.57

This study will also focus on the positive attitude of the student community towards online classes in the wake of COVID-19. The online learning was found to be advantageous as it provided flexibility and convenience for the learners. Students preferred well-structured content with recorded videos uploaded in university websites. They also indicated the need for interactive sessions with quizzes and assignments at the end of each class to optimise the learning experience. However, most students also reported that online classes could be more challenging than traditional classroom because of the technological constraints, delayed feedback and inability of the instructor to handle effectively the Information and Communication Technologies. Therefore, all these factors should be considered while developing an online course to make it more effective and productive for the learner. It's possible that once the COVID-19 pandemic settles down, we may see a continued increase in education systems using online platforms for study aids, as well as students embracing online education for their higher learning degree programs. Hope this study will prove useful for conducting effective online classes.

IV. OUR APPROACH /METHODOLOGY/MECHANISM

4.1 Participants

Computer Application first year graduates were chosen as the respondents for this study as the fresher students are new to professional world and many of them are not used to and doesn't not have ready access to electronic media for online classes.

Although the students were pursuing a computer course, so it was expected that they are aware of information technology. But due to lockdown imposed without any prior information, instantly shifting form face to face interaction to digital mode was very challenging, as different students have different technical challenges.

4.2 Procedure

A structured and unstructured preliminary questionnaire was designed with the help of literature survey and informal discussions with the students who are currently attending the online classes. Pre-testing was done with 12 respondents and their feedbacks were considered for designing the final questionnaire.

4.3Domain of the study

First of all, we identified key-informants for online survey. The link for Google form was sent to the key- informants through the WhatsApp. After submitting their responses, they circulated the questionnaire among other university students like snowball sampling. We have disabled the link after 10 days of circulating the Google forms. In this way, responses were received and they were further used for data analysis.

4.4 Data Analysis

Data were collected on demographic features, followed by learners' preferences, perception, advantages, constraints and suggestions. To analyze and summarize the perception, statements were rated on a five-point continuum scale (five being most effective and 1 being the least effective). Frequency and percentage were calculated for most of the questions to summarize the data. Apart from calculating the percentage table for the perceptions, we used a measure of consensus for each of the statements. The consensus was calculated by the formula suggested by Tastle & Wierman, (2007)

$$cons(X) = 1 + \sum_{i=1}^n p_i \log_2 \{1 - (|X_i - \mu_X|/d_X)\}$$

p_i = probability or frequency associated with each Likert attribute X_i ; i ranges from 1 to 5

d_X = width of X

μ_X = mean of X .

Further, each statement regarding perception of respondents based on effectiveness of online learning in comparison to classroom teaching was ranked based on mean rank obtained by Friedman's test. Formula used for calculating mean rank in Friedman's test is as follows:

$$\text{Mean rank} = \frac{\sum R_i^2 - 3n_r(k+1)}{n_r(k+1)}$$

Where, k =number of columns(treatments); n_r =number of rows(blocks); R_i =Sum of the ranks.

To identify the most important benefits and constraints of online learning, Garret ranking technique was used. For this, 5 benefits and 8 constraints were given to the respondents and they were asked to rank it based on their opinion. As a first step these ranks were converted into percent positions based on the following formula Percent position = $100(R_{ij} - 0.5)/N_j$ Where,

R_{ij} = Rank given for the i^{th} Benefit/constraint by j^{th} respondents

N_j = Number of Benefits/constraints ranked by j^{th} respondents

As a second step these percent position of each rank was converted into scores using the table given by Garrett and Woodworth (1969). And then for each factor, scores of individuals were added and divided by the total number of respondents to get the mean score of each factor. The Benefit and Constraint with the highest mean score was considered as the most important. To analyse the open-ended questions conventional content analysis was done. Content analysis is defined as a generic name for a variety of textual analyses that typically involves comparing, contrasting, and categorizing a set of data (Schwandt, 1997). We tried to perform content analysis to identify the trends in learners' perspective regarding online classes. As a foremost step, two authors after looking into all the responses of the open-ended questions, created the themes and sub-themes which was checked for inter-rater reliability using Kappa Coefficient with the help of the other two authors. The estimated Kappa co-efficient was found to be 0.72 which denotes substantial agreement between the two raters.

V. RESULT

This study was mainly conducted to access the technical availability of resources with respect from students perspective. As the internet is growing, so are the challenges posed by digital world is gaining gravity. The COVID-19 pandemic had put the hold on the academic activities during the peak time of admissions, examinations, results! As a result, E-learning gained momentum and face to face learning gradually shifted to virtual learning. Although, most students also reported that online classes could be more challenging than traditional classroom because of the technological constraints, delayed feedback and inability of the instructor to handle effectively the Information and Communication Technologies. Therefore, all these factors should be considered while developing an online course to make it more

effective and productive for the learner. Once the COVID-19 pandemic settles down, we may see a continued increase in education systems using online platforms for study aids, as well as students embracing online education for their higher learning degree programs.

Various devices preferred by the respondents for attending online classes were Smartphone (57.98%), laptop (35.83%), tablet (4.89%) and desktop(0.65%) which clearly suggests that if any organization which wants to develop an application for the online learning, it has to ensure that the platform is compatible with Smartphone. Another kind of technical availability was internet. Mobile data pack was the source of internet for 82 % of the respondents. However, financial issue was also argued as telecom companies give limited data depending upon the mobile data plan chosen. A lot of data is consumed in uploading, downloading, live streaming of video lectures, recording, etc. So, the more you spend, the unlimited data and speed you enjoy. Majority of the respondents (62%) said that WhatsApp was the best way to communicate class updates. Some also said that Google classroom(35%) is also a better option to manage class work and assignments but is slow and not easily accessible 24x7 like WatsApp. Many other platforms are also available like Zoom, Google meet, WebEx etc for conducting online classes in real time scenario.

Here we saw a digital divide between the learners who have ready access to internet and computers to those who don't have. India is a developing country where still the majority of people belong to rural and semi-urban areas where many don't have internet access. And even if they have internet access, the data seed is very slow. Online classes consume large amount of data which is very difficult to afford. There are other technical issue like poor audio and video quality, poor signal strength, low bandwidth which also make these classes monotonous and students lack interest in them. in these cases face to face classes hold an upper hand as the two-way communication is smoothly conducted. The technical constraint is divided into various subthemes listed below along with the criteria that is being used to access the subtheme and an example is also quoted in Table 2.

Table 2: Technological unavailability affecting online classes:

SUBTHEMES	Criteria	Example
Digital gap	Divide between the students who have ready access to internet and computers and those who don't have.	"rural students generally don't have the privilege of internet and laptop"
Data limit/Data pack	Insufficient data pack to access the material/to attend the class.	"online classes consume large amount of data which is difficult to afford"
Poor connectivity	Interrupted internet supply that makes the learners difficult to learn	"dragging of classes due to network problem"
Issues with the device	Lack of device or device incompatibility to the applications used for online classes	"Unavailability of gadgets with some of the students"
Non recordable videos	Online classes that cannot be downloaded or recorded for future learning	"videos that cannot be recorded or watched later pose difficulty in learning"
Technical issues	Low quality audio or video; low bandwidth	"lack of voice clarity and poor signal strength"
Virtual presence only	No face to face interaction between the learners and teachers	"only one-way communication and no scope for interaction"

Poor learning environment	Lack of congenial learning environment	“home environment is not suitable for learning as it leads to lot of disturbances from children and relatives”
Noise	Distractions that deviate learner from learning	“two-way communication is loathsome as the voices from all the sides are raising”

Table 2 indicates that lack of connectivity was the ranked as the major hindrance in online learning. The situation is even worse for those from remote areas. The findings highlight the India's digital divide and lack of equity in access to uninterrupted internet proving to be a hassle to many students. The second and third constraints were data limit and data speed which were again the limitations of internet infrastructure. These give us an insight that if any country wants to move towards online education then as a pre-requisite it should focus on its internet facilities. Lack of traditional way of direct interactions in classrooms is also a major concern along with those mentioned above in conducting online classes.

VI. REFERENCES

- Driscoll, A., Jicha, K., Hunt, A. N., Tichavsky, L., & Thompson, G. (2012). Can online courses deliver in-class results? A comparison of student performance and satisfaction in an online versus a face-to-face introductory sociology course.
- Eastin, M. A., & LaRose, R. (2000). Internet self-efficacy and the psychology of the digital divide. *Journal of Computer Mediated Communication*.
- Evans, T. (2000). Flexible delivery and flexible learning: developing flexible learners? In V. Jakupec, & J. Garrick (Eds.), *Flexible learning, human resource and organizational development* (pp. 211–224) London: Routledge.
- Garrett, H. E., & Woodworth, R. S. (1969). Statistics in Psychology and Education, Feffer and Simons Pvt. Ltd., Vakils, P, 329.
- Garrison, D. R., Anderson, T., and Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, 15(1), 7-23.
- Gilbert, Brittany, (2015). "Online Learning Revealing the Benefits and Challenges" Education Masters. Paper 303.
- Golladay, R., Prybutok, V. & Huff, R. (2000). Critical success factors for the online learner. *Journal of Computer Information Systems*, 40(4), 69-71.
- Gunawardena, C. N., & Zittle, F. J. (1997). Social presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American Journal of Distance Education*, 11(3), 8–26.
- Hartley, K., & Bendixen, L.D. (2001). Educational research in the Internet age: Examining the role of individual characteristics. *Educational Researcher*, 30(9), 22–26.
- Hill, J.R. (2002). Overcoming obstacles and creating connections: Community building in Web-based learning environments. *Journal of Computing in Higher Education*, 14(1), 67–86.
- Huggett, C. (2014). The virtual training guidebook: How to design, deliver, and implement live online learning. American Society for Training and Development.
- Hung, M. L., Chou, C., Chen, C. H., & Own, Z. Y. (2010). Learner readiness for online learning: Scale development and student perceptions. *Computers & Education*, 55(3), 1080-1090.
- Johnson, R. D., Hornik, S., & Salas, E. (2008). An empirical examination of factors contributing to the creation of successful e-learning environments. *International Journal of Human-Computer Studies*, 66(5), 356–369.
- Kemp, N., & Grieve, R. (2014). Face-to-face or face-to-screen? Undergraduates' opinions and test performance in classroom vs. online learning. *Frontiers in psychology*, 5, 1278.
- McVay, M. (2000). Developing a web-based distance student orientation to enhance student success in an online bachelor's degree completion program. Unpublished practicum report presented to the Ed.D. Program. Florida: Nova Southeastern University.
- Petrides, L.A. (2002). Web-based technologies for distributed (or distance) learning: Creating learning-centered educational experiences in the higher education classroom.

International Journal of Instructional Media, 29(1), 69–77.

- Picciano, A. G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks*, 6(1), 21–40.
- Piccoli, G., Ahmad, R., & Ives, B. (2001). Web-based virtual learning environments: A research framework and a preliminary assessment of effectiveness in basic IT skills training. *MIS quarterly*, 401–426.
- Poole, D.M. (2000). Student participation in a discussion-oriented online course: A case study. *Journal of Research on Computing in Education*, 33(2), 162–177.
- Ricardo Pereira (SPRING 2008). Processes of Securitization of Infectious Diseases and Western Hegemonic Power: A Historical-Political Analysis. *GLOBAL Health Governance, Volume II, No. 1*
- Jiyong Jin, Joe thomas Karackattu. (2011). Infectious Diseases and Securitization: WHO's Dilemma. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science, Volume 9, Number 2, 2011.*
- Thomas Favaley, Francesca Soroy, Martino Trevisany, Idilio Drago z, Marco Melliay. (2020). Campus Tra_c and e-Learning during COVID-19 Pandemic. *arXiv:2004.13569v1 [cs.NI] 28 Apr 2020.*
- Mark Coeckelbergh (2020). The Postdigital in Pandemic Times: a Comment on the Covid-19 Crisis and its Political Epistemologies. *Springer Nature Switzerland AG 2020.*
- Michael P. A. Murphy (2020). COVID-19 and emergency eLearning: Consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy, Routledge.*
- S. Mahendra Dev and Rajeswari Sengupta (2020). Covid-19: Impact on the Indian Economy. *Indira Gandhi Institute of Development Research, Mumbai.*
- Rajesh Singh and R. Adhikari (2020). Age-structured impact of social distancing on the COVID-19 epidemic in India. <https://www.researchgate.net/publication/340209224>
- Vladimir Šimović Matija Varga Predrag Oreški (2012). Case Study: an Information System Management Model. *Management Information Systems, Vol. 7 (2012), No. 1, pp. 013-024.*
- M. Samir Abou El-Seoud 1, Islam A.T.F. Taj-Eddin1, Naglaa Seddiek1, Mahmoud M. El-Khouly2, Ann Nosseir1 (2014). E-Learning And Students' Motivation: A Research Study On The Effect Of E-Learning On Higher. *iJET , Volume 9, Issue 4, 2014.*
- Signe Schack Noesgaard and Rikke Ørngreen (2015). The Effectiveness of E-Learning: An Explorative and Integrative Review of the Definitions, Methodologies and Factors that Promote e-Learning Effectiveness" *The Electronic Journal of e-Learning Volume 13 Issue 4 2015, (pp278-290).*
- Mark M. Alipio (2020). Education during COVID-19 era: Are learners in a less-economically developed country ready for e-learning? <https://ssrn.com/abstract=3586311>.
- Sarah Guri-Rosenblit (2018). E-Teaching in Higher Education: An Essential Prerequisite for E-Learning. *journal new approaches in educational research Vol. 7. No. 2. July 2018. pp. 93–97 ISSN: 2254-7339 DOI: 10.7821/naer.2018.7.298.*
- ETGovernment.com (2020). e-learning: COVID-19 Pandemic: Impact and strategies for education sector in India. *Government News, ET Government.*
- M. Prabu, R. Manoov (2018). Analyzing the Impact of Internet in Rural India. <https://www.researchgate.net/publication/264159967>.
- Arti M.K. and Kushagra Bhatnagar (2020). Modeling and Predictions for COVID 19 Spread in India. <https://www.researchgate.net/publication/340362418>.
- Markus Deli Girik Allo (2020). Is the online learning good in the midst of Covid-19 Pandemic? The case of EFL learners. *Journal Sinesthesia, Vol. 10, No. 1, April 2020.*
- Sarah Sanford*, Jessica Polzerb and Peggy McDonougha (2015). Preparedness as a technology of (in)security: Pandemic influenza planning and the global biopolitics of emerging infectious disease. <https://www.researchgate.net/publication/277967666>
- Muthuprasad T. , Aiswarya S. , Aditya K. S. and Girish K. Jha (2020). Students' Perception and Preference for Online Education in India during COVID-19 Pandemic. <https://ssrn.com/abstract=3596056>
- Sushil Kumar (2015), Study paper on Telecommunications / ICTs for rural and remote areas of India.

- Leila Shahmoradi, Vahid Changizi¹, Esmaeil Mehraeen, Azadeh Bashiri, Behrooz Jannat², Mahsa Hosseini(2018). The challenges of E-learning system: Higher educational institutions perspective. *Journal of Education and Health Promotion* | Published by Wolters Kluwer - Medknow.
- TELECOMREGULATORYAUTHORITYOF INDIA(2020). "Indian Telecom Services Performance Indicator Report" for the Quarter ending July-September, 2019. *Information Note to the Press* (Press Release No. 04/2020)

