



Indian government E-learning initiatives in response to COVID-19 crisis: A case study on online learning in Indian higher education system

Madanjit Singh¹ · Sulaimon Oyeniyi Adebayo² · Munish Saini² · Jaswinder Singh¹

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Abstract

Recently, the whole world has faced the deadliest and dangerous consequences due to the transmission of infectious novel coronavirus (nCoV). With the outbreak of COVID-19, the education learners, practitioners, and other stakeholders were at the sake of a loss, as it causes the suspension of physical classes and physical interaction of the learners. In these circumstances, Electronic learning (E-learning), Online learning, and the use of Information and Communications Technology (ICT) tools came in handy. It helped the learners in the dissemination of ideas, conducting online classes, making online discussion forums, and taking online examinations. Like the government of each country, the Indian government was also caught off-guard but the existing E-learning infrastructure was able to leverage on while devising plans to tailor them to new situations and launching new ones. The initiatives at the forefront of this noble battle launched by the Department of School Education and Literacy, Ministry of Human Resources Development (MHRD) includes Diksha, Swayam Prabha Channel, Shiksha Van, E-Pathshala, and National Repository of Open Educational Resources (NROER). It worth noting that apart from the Indian central government efforts, each state has various online education initiatives that are tailored to their needs. This research evaluated each of these initiatives commenced by central and state governments and present a detailed analysis of most of the relevant initiatives. Additionally, a survey is conducted to get insights of learners in concern to online learning. Despite the issues raised in this learning, the outcomes come to be satisfactorily favoring online learning.

Keywords Information and Communications Technology (ICT) · E-learning · Online education · Government initiatives · Open Educational Resources (OER) · Ministry of Human Resources Development (MHRD) · Education · COVID-19

✉ Madanjit Singh
madanjit.csc@gndu.ac.in

Extended author information available on the last page of the article

1 Introduction

Electronic Learning (E-learning) is the acquisition of knowledge with the help of electronic media or devices such as laptop computers, desktop computers, mobile phones, iPods, and iPads (Bakare & Orji, 2019). In the modern world, E-learning (online education) meaning can be extended to the use of different applications of computers such as Artificial intelligence (Gams et al., 2019), Quantum Computing (Cox, 2013), and Machine learning in knowledge acquisition (Lykourantzou et al., 2009). It also gives students the liberty to be in charge of their learning activities (Gomes & Gomes, 2011) and can be interpreted as virtual learning as only the electronic copy of the learning materials is available and not the hard copy.

A noteworthy development in E-learning over the past decade has a great impact on educational and training practices in the information society (Khan, 2015). Educational institutes are investing huge capital in E-learning systems to align with the new developments (Levy, 2006). E-learning development is not limited to academia alone. With the arrival of the internet and online learning methods and emerging technologies, E-learning has become more acceptable in the workspaces. (Khan, 2015).

Manual or traditional ways of learning are becoming more obsolete day by day because of the evolvement of ICT. Employment of ICT is becoming more popular in the modern education system (Sood & Saini, 2020) and the majority of the students do not find it interesting to learn with the physical copy of books or other study materials (Rambli et al., 2013). Furthermore, the manual ways of learning require more space, money, and time in maintaining the learning materials than electronic ways, physical materials can be misplaced, stolen, or damaged easily (Iwayemi & Adebayo, 2019).

ICT is one of the major tools driving the learning system in the twenty-first century (Oliver, 2002; Khlaisang & Koraneekij, 2019). The manual ways of learning are being faced out in academia as well as various industries in the world. According to research conducted by Quinn in 2011, it was established that the percentage of companies planning to provide E-learning support for their staff has risen from 38.5% in 2007 to 51% in 2011 (Quinn, 2011). Different researchers have the opinion that traditional learning methods should be used alongside ICT-driven learning methods (Yom, 2004; Hameed et al., 2008; Ariana et al., 2016). Another example is Adzobu in his 2014 research, where he opined that online learning platforms will co-evolve with traditional learning platforms in the future (Adzobu, 2014). Also, Iwayemi and Adebayo gave the same opinion that automated systems should not eliminate existing manual systems but should work side by side with the existing system (Iwayemi & Adebayo, 2019).

The significance of E-learning can no longer be veiled. The evolvement has been rapid over the last decade and several agencies, companies, and government bodies are embracing the changes. This evolution sees limelight in the mid-1990s as an initiative of the World Wide Web Consortium (Cerón-Figueroa et al., 2017) and has been massively engraved into our daily activities since then. E-learning

can be segmented into two approaches, asynchronous and synchronous (Shahabadi & Uplane, 2015). Asynchronous gives a flexible approach and enables learners and teachers to learn and teach at a convenient time without being dependent on each other and is mostly used in online courses (Hrastinski, 2008). The synchronous approach on the other hand gives real-time feelings of physical classroom experience (Hrastinski, 2008). The experience is more social and enables real-time interaction between teachers and learners. Typical examples include video conferencing and webinars. Educational Institutions, Organisations, and Government Agencies should be aware of the cons and pros of the two approaches for them to make productive decisions in their online learning initiatives.

The highly transmissible Corona Virus (Shereen et al., 2020), also known as COVID-19 which emanated from China in December 2019 (Zhang et al., 2020) has since its inception date claimed over 2,000,000 lives with over 120,000,000 infected worldwide.¹ United States of America (USA), India, Brazil, Russia, and the United Kingdom (UK) are the most affected countries. The USA has over 30,000,000 confirmed cases to date and UK has the lowest among the five has over 4,000,000 confirmed cases with 120,000+ deaths.²

The advent of COVID-19 called for the closure of physical classes (Pal & Vanijja, 2020), which left government and educational bodies with the only option of virtual learning to curb the novel coronavirus. Government with working E-learning systems and procedures find it easier to transit to the online learning space (Uju & Olofu, 2020) while those without solid E-learning programs or systems take a longer time to adjust to the sudden development.

2 Aim and objectives

This study aims to evaluate the Indian Government Initiatives for E-learning especially during the COVID-19. In extension, we intend to perform the following objectives:

- (i) Assess the E-learning (online learning) initiatives of the Indian government in response to the COVID-19 outbreak.
- (ii) Evaluate student's and teacher's responses to E-learning initiatives and their tools.
- (iii) To examine the insights into the outcomes (or responses) of online teaching in Indian higher education institutes.

To attain the above-mentioned objectives the study is conducted in two phases (refer to Fig. 1). Phase 1, emphasizes explaining and exploring the various online learning initiatives taken by the government of India in the period of COVID-19. In Phase 2, we have conducted an online survey to access and explore the responses of

¹ <https://covid19.who.int/>

² <https://www.worldometers.info/coronavirus/#countries>

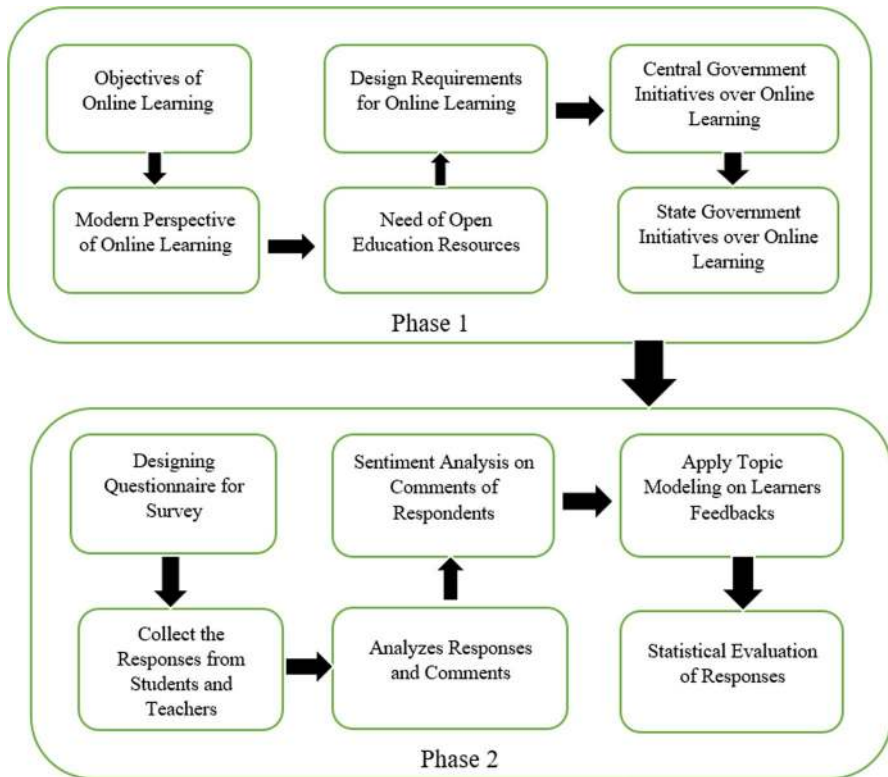


Fig. 1 Phases to conduct the study

the online learners (students and faculty members) specifically belonging to higher education institutes or organizations.

3 Organization of the Paper

This paper is organized into the following sections. The “*Related Work*” section covers a review of research work on E-learning (online learning) and the educational initiatives taken by the Indian central and state governments in response to COVID-19. The Section “*Modern Perspective of E-learning*” encompasses an overview of the Merit and Demerit of E-learning as well as requirements for developing a standard E-learning system. Necessity, History, and modern perspectives of Open Education Resources (OER) are discussed in the “*OER*” section while E-learning tools evaluation is given in the “*Evaluating the use of E-learning and its tools*” section. Indian Government E-learning initiatives are covered in the “*Indian Central State Government Initiatives*” and “*Indian Central State Government Initiatives*” Sections. The “*Case Study*” section provides insight into Indian Government Initiatives for E-learning. It mainly consists of the data collection process, data pre-processing,

methods, and algorithms employed in conducting and evaluating responses of the respondents (teacher and student). The elaborative explanation of the conducted research is provided in the “*Discussion*” section highlighting a detailed analysis of the conducted survey. The later part of the study concludes the major findings and also specifies the possible future recommendations.

4 Related work

E-learning is a concept that has been in existence since the 1960s but became widespread with the advent of the internet and the web (Bezovski & Poorani, 2016). Observing the growth of E-learning from the early 2000s, there has been increasing research on internet technology which is the bedrock of E-learning (Elango et al., 2008; Verawardina et al., 2020). Since then, scholars around the world have been assessing and evaluating the E-learning systems and giving recommendations that will optimize the process.

The novel coronavirus which broke out in 2019 acted as a catalyst in boosting the outreach and usage of E-learning. E-learning has been raised to be one of the major driving forces in the academic space. It has been a key player in ensuring the continuation of teaching and learning during the COVID-19 outbreak (Chang & Fang, 2020).

It is observed that before the COVID-19 outbreak, there have been several government initiatives relating to E-learning. Virtual School of the National School of Government in the United Kingdom established in 1970, GoLearn now known as USALearning by the United States of America, the Canada School of Public Service Campusedirect initiated in 2004 and the Civil Service College Open Academy of Singapore established in 2001 (Chen, 2014) are few of the old government initiatives towards E-learning. Government initiatives on E-learning have increased tremendously over the last decade, Indian government’s SWAYAM³ and DIKSHA⁴ both initiated in 2015 are typical examples of this.

It is no doubt the advent of COVID-19 is sudden, governments are left with no choice but virtual learning, especially amidst lockdown. The COVID-19 outbreak has elevated E-learning solutions by making it mandatory (García Vazquez et al., 2020; Radha et al., 2020). Though some governments had to pause learning activities because of the unavailability of working E-learning strategies, this research piece will help in solving similar problems in the future by collating detailed information about E-learning initiatives.

As the government trying to get acquainted with the latest development of a complete virtual learning environment, teachers and students are also in the process of getting used to the new development brought by the COVID-19 pandemic (Abbasi et al., 2020). Though teachers show better growth in the development than students. More than half of the student population face challenges with electricity, internet

³ <https://swayam.gov.in/>

⁴ <https://diksha.gov.in/>

among other factors that affect their E-learning experience (Subedi et al., 2020). Students' negative experiences also affect the teachers as they get disturbed during classes (Subedi et al., 2020), but teachers are performing better on the E-learning platforms (Gohiya & Gohiya, 2020).

Different researchers have successfully accessed the E-learning platforms, users' (tutors and learners) perspective, developers, and government efforts in enhancing these platforms and initiatives before the COVID-19 outbreak. Shahzad et al. (2020) having performed an empirical analysis on Malaysian students dataset gathered with the help of google survey established that male and female have different usage levels of E-learning in Malaysian Universities.

Research conducted at the University of Tabuk established that above 60% of faculty members' overall responses range from negativity to uncertainty (Albalawi & Badawi, 2008). Hoq (2020) argues otherwise in his 2020 survey performed to verify teachers' preference towards diverse features of E-learning. He found that majority of teachers have a positive opinion towards E-learning.

Assessing the quality of E-learning in the Middle East, Elango et al. (2008) revealed that students attest to receiving all the needed support similar to the classroom environment. In the same manner, Loh et al. (2016) affirm that students perceive better learning outcomes in E-learning though they still have concerns about the flexibility of self-paced learning, lack of human interaction, self-motivation, and fostering teamwork.

Liaw (2008) surveyed 424 university students with a standard questionnaire to examine the learners' satisfaction, behavioral intentions, and effectiveness of the Blackboard E-learning system. It was revealed that self-efficacy influences learner's satisfaction with backboard E-learning. The same study also established that multimedia instruction, interactive learning activities, and E-learning system quality can influence the effectiveness of E-learning. In a similar direction, Al-Fraihat et al. (2020) gave the main determinants of E-learning perceived satisfaction as technical system quality, information quality, service quality, support system quality, learner quality, instructor quality, and perceived usefulness.

Kanjilal and Kaul (2016), while examining the Digital India initiative of the Indian Government gives more insight on Study Webs of Active Learning for Young Aspiring Minds (SWAYAM) and other initiatives like National Mission on Education Through ICT (NMEICT), National Programme on Technology Enhanced Learning (NPTEL), a joint program of IITs (Indian Institutes of Technology) and IISc (Indian Institute of Science). Similarly, (Chandwani et al., 2010) in their E-learning initiatives in India established that the Indian government always has given preference to the use of ICTs as a means of mass education.

Al-Rahmi et al. (2019), after evaluating the responses of 1286 students using E-learning systems in Malaysia observed that six perceptions of innovation characteristics (Relative Advantages, Observability, Trialability, Perceived Compatibility, Complexity, and Perceived enjoyment) have impacts on students' E-learning behavioral intention. A similar study, (Salloum et al., 2019) while examining the impact of Social Media Practices on E-learning systems acceptance established that social media practices have significant positive impacts on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU).

Smaili et al. (2021) proposed a sustainable E-learning system to tackle school dropout. The new model was achieved with an adaptive E-learning system by manipulating the traces left by users' interaction with their learning environment.

After referring to all these previous studies, we concluded that they gave different views on the usage, needs, advantages, and disadvantages of E-learning. The researchers are driving the common conclusion that the E-learning system will serve better and be more productive if properly implemented (Ristic & Stefanovic, 2020). These key points serve as the foundation on which we build the present research work. Although several studies have been conducted on COVID-19 and E-learning, few delve into the realm of government responses and initiatives on E-learning during the COVID-19 outbreak which is the main focus of this research. Furthermore, we also look forward to evaluating the responses of 354 students and 49 teachers, studying and working in 7 universities and 15 colleges (targeting only the higher education institutes/organizations) by surveying their online learning and teaching feedbacks especially in the period of this pandemic. We expect the outcomes of this study to help students, parents, and teachers in employing the best online education platform(s). Further, it will assist the Indian government as well as other governments in taking swift action in the future.

5 Modern perspective of E-learning

Usage of modern ICT for teaching and learning in the Indian higher educational institutions has become paramount (Arkorful & Abaidoo, 2015). The development that information technology has brought to the field of education cannot be overemphasized (Chen & Lien, 2011). The modern perspective of E-learning is becoming more diverse as it is being influenced by many factors. Sun et al. (2008) categorized these factors into six dimensions; student, teacher, course, technology, system design, and environmental dimensions. Though user satisfaction is one of the salient factors in determining the success of a system (DeLone & McLean, 1992), the students are more concerned about the quality of course content in terms of E-learning systems (Sun et al., 2008). Ease of use, usefulness, system quality, information quality, and computer self-efficacy are major determinants influencing user's perception of E-learning systems (Hammouri & Abu-Shanab, 2018). Faculty members on the other hand have different perspectives that influenced their perception of E-learning. Abdekhoda et al. (2016) established that performance expectancy, effort expectancy, social influences, and behavioral indentation have a direct impact on faculty perception of E-learning. Novice faculty members as well as lecturers from Computer Science, Engineering, Education, and Arabic show more positive perceptions than other faculty members (Albalawi & Badawi, 2008). Voluntary participation of teachers in the E-learning initiatives is also a major factor that will directly influence their perception (Hrtoňová et al., 2015).

5.1 Advantages of E-learning

With the recent COVID-19 outbreak, universities and other educational institutions around the world are able to continue the teaching activities with the help of E-learning (or online learning) initiatives. This is a major indicator that E-learning is paramount to the global educational system. E-learning provides useful content that will prepare learners for their studies (Chen & Yao, 2016).

The most significant advantage of E-learning is the flexible feature of the system (Kimiloglu et al., 2017). The system can be accessed anyplace anytime (Nedeva & Dimova, 2010). Compared to traditional learning, there is a huge savings of cost (Arkorful & Abaidoo, 2015) and time (Talebian et al., 2014).

Kimiloglu et al. (2017) ironed out other advantages of E-learning as; convenience & accessibility, customization, outsourcing, cost-effectiveness, as well as employee commitment and motivation. In a similar pattern, (Puri, 2018) listed five (5) advantages of E-learning as; Consistent, scalable, personation, better retention, and time & cost saving. While examining the merit and demerit of E-learning within agricultural students in Iran, (Talebian et al., 2014) gave advantages of E-learning to include; Time and place accessibility, equity, enhancing group collaboration, direct access to other training resources, enhancing international dimension of educational services and determining the rate of progression in courses.

5.2 Disadvantages of E-learning

E-learning systems are attracting more users day by day. However, these users also face some challenges which are preventing them to derive the full benefits of E-learning and eventually make some of them give up on its usage. A major shortcoming of E-learning is the inability of the tutors and cohorts to discuss course contents and subject matter frequently (Elango et al., 2008). Some of the basic challenges of E-learning include Credibility, Technical issues, Computer Literacy, Time Management, and Self-Motivation.

(a) Credibility

Everyone deserves to get value for time and resources invested which is justifiable but it does not work that way all the time on E-learning platforms. Since the struggle is not visible like attending physical classes or attending seminars/workshops, people tend to have some doubts about the credibility of E-learning (Mungania, 2003). Also, there are certain discriminations between online degree programs obtained through E-learning and the ones obtained physically in the college (Motlik, 2008).

(b) Technical issue

Technical issues can be referred to as problem (s) that arise from hardware/software resources of the platform. Most users of E-learning platforms lack the

basic technology requirements for the course they are enrolling for (Alkharang & Ghinea, 2013). Platform portability, which is the ability for the platform to be accessible from any device, weak internet bandwidth, unstable power supply, and hardware challenges such as weak monitor display can be a threat for the users in deriving the full benefits of the platform.

(c) **Computer Literacy**

Although an average twenty-first-century student will be computer literate. However, most users lack knowledge of computer usage (Gagnon et al., 2007) such as basic skills to troubleshoot hardware failure, file handling, and word processing. Users with a lack of the above skills are likely to create the problem (s) for themselves even though the entire platform is working well. Furthermore, this may make it hard for them to follow the designed Learning Management System and their learning experience becomes problematic which may eventually prevent them from being on the same level as their virtual classmates.

(d) **Time Management**

Online courses are as time demanding as their offline counterpart. While E-learning gives freedom to students to learn at their desired time (Nedeva & Dimova, 2010), extra care must be taken to schedule the learning because of the regular day-to-day engagements of the students. The vague (Claxton & Murrell, 1987) and digital nature (Kumbhar, 2009) of E-learning indicate that bad-time management could lead to failure.

(e) **Self-Motivation**

E-learning requires self-discipline which is lacked by many students. The distraction of being on the internet (Azlan et al., 2020) is already there. YouTube, Facebook, Twitter, news websites, Ads are enough to distract students. Users should manage their internet usage closely to avoid wasting precious study time. E-learning (online learning), unlike classroom learning, lacks check and balance. If a student lacks proper discipline, he can lag with his virtual classmates which may eventually arise the desire to quit the course.

6 Open education resources (OER)

Open Education Resources (OER) is a movement for openness in higher education that can be attributed to larger trends such as Open Source Software (OSS) and Open access (Hylén, 2006). Mainly, OER includes educational resources like textbooks, curriculum maps, course materials, streaming videos, multimedia applications, podcasts, and other learning & teaching materials that are openly available for the use of students and teachers without the need to pay royalties or license fees (Butcher, 2015). OER works with Creative Commons, founded in 2001 to revive the shrinking public domain for content owners to retain their copyright while licensing them as free for certain uses, on certain conditions (Atkins et al., 2007).

6.1 Need of OER

The primary need of OER is to serve as a robust platform that encompasses learning and teaching materials that are readily accessible to students, teachers, and open source contributors. It is believed that openly licensed education materials can contribute to increasing the quality as well as the effectiveness of education at a reduced cost (Butcher, 2015).

6.2 Historical perspective

OER came to the limelight in 2002 during the conference held by the United Nations Educational, Scientific and Cultural Organization (UNESCO). UNESCO convened a group of academics, majorly from developing countries to access a new development – the Open Course Ware (OCW) initiatives of the Massachusetts Institute of Technology (D’Antoni, 2009). The Mission coined the term “Open Educational Resources” as;

“The open provision of educational resources, enabled by information and communication technologies, for consultation, use, and adaptation by a community of users for non-commercial purposes. (UNESCO, 2002)”

OER movement is still new as it is less than two decades since its inception but significant initiatives have been undertaken since its inception to ensure its development.

6.3 Modern perspective

Traditionally, OER includes textbooks, course readings, and other learning materials for educational purposes (Gerald & Mary, 2020). With the tremendous evolution of the internet and online platforms, OER also advanced to be more efficient, effective, and productive. One of the major challenges of the early OER is the end user’s accessibility to high-speed internet connections, most especially in developing countries (Johnstone, 2005). This problem is deteriorating with modern OER as the high-speed internet connection is becoming widely spread than it used to be, especially with the advent of 4G and 5G technologies. Also, modern OER platforms have undergone several modifications from open source contributors and this has made it to be more user-friendly, cost-effective, more accessible, efficient, and productive.

6.4 Tools, platforms and other open educational resources (OER)

The longest-running and largest OER initiative named OpenCourseWare Project was released in 2002 by the Massachusetts Institute of Technology (Gerald & Mary, 2020). The initiative now provides course materials for more than 2500 Massachusetts Institute of Technology (MIT) courses.

Another OER initiative is Connexions founded in 2000 by Richard Baraniuk and his colleagues at Rice University. It was changed to OpenStax CNX in 1999. The new OpenStax was based on the philosophy that scholarly and educational content can and should be shared, reused and recombined, interconnected, and continually enriched.⁵ Connexions' resources are still available under a CC BY Creative Commons license, which indicates that the content can be used, adapted, and remixed as long as attribution is provided (Kelty, 2008).

Another OER initiative is the California-based non-profit organization founded in 2007 named the CK-12 Foundation. It aimed at reducing cost and increase access to K-12 (from kindergarten to 12th grade) education in the USA and the world at large. CK-12 foundation tools are used by more than 38,000 schools in the USA alone alongside a growing number of international schools (Hepler, 2014).

OER tools have evolved widely today that we almost lost counts, there are hundreds of tools for Open Education Resources. Educause, Cloe, Open Class, Google in Education, Ariadne, WikiEducator, ATutor, Open of Course, The Open University, Olat, Canvas, Citizendium, Commonwealth of Learning, SchoolTool, are few among them.

7 Indian government E-learning initiatives

In this section, we present the content on prominent and effective E-learning initiatives taken by the Indian central and state governments, pre and peri COVID -19 pandemic.

7.1 Central government pre COVID-19 E-learning initiatives

The Indian government has always been giving preference to the use of ICT as a means of mass education. CLASS (Computer Literacy and Social on Schools) project was launched as far back as 1984 by the Indian government to make computer literacy a compulsory project for class XI and XII. 2598 and 2371 schools started computer literacy in the seventh five-year plan and eight five-year plans respectively (Chandwani et al., 2010).

A communication satellite is known as EDUSAT (Educational Satellite); the satellite primarily devoted to the education sector was launched on the 20th of September, 2004 by the Indian Space Research Organisation (ISRO) (Khanchandani et al., 2015). EDUSAT provides education to millions of people at their doorstep and enables information to be disseminated in local languages and dedicated long-distance learning in India (Chandwani et al., 2010).

SWAYAM, a major initiative of the Indian Government on E-learning was initiated to provide an integrated platform and portal for online courses in the education sector of India (Kanjilal & Kaul, 2016). SWAYAM was developed by the Ministry

⁵ https://en.wikipedia.org/wiki/OpenStax_CNX

of Human Resources Development (MHRD) and All India Council for Technical Education (AICTE) with the help of Microsoft and was specifically designed to benefit working professionals, college dropouts, and students from remote areas (Nayek, 2018). The strength of SWAYAM lies in its qualitative evaluation system, recognition of credits and equity access, and affordability (Kaveri et al., 2016). Its history can be traced back to 2003 with the initiation of the National Programme on Technology Enhanced Learning (NPTEL) by the IITs and IISc. Though it focused on courses in Engineering, Science, and humanities stream, the horizon was broadened to all disciplines in the higher education sector in 2009 with the launch of the National Mission of Education through ICT (NME-ICT) (Kanjilal & Kaul, 2016).

Other Indian government pre-COVID19 E-learning initiatives includes; Consortium for Educational Communication (CEC), National Programme on Technology Enhanced Learning (NPTEL), Indira Gandhi National Open University (IGNOU), Online Education Broadcast and Virtual Classrooms, Sakshat, Institute of Life Long Learning (ILLL), and School of Open Learning (SOL) E-learning Gateways.

7.2 Response to COVID-19 outbreak

The Corona Virus Outbreak was sudden and unexpected, the government and educational institutes are not adequately prepared. The government ensures learning continues even during the lockdown. State and UTs individual efforts to take education to the doorstep of every child is commendable and a strong indication that E-learning remains one of the tools that leverage the effect of COVID-19 in the country.

7.3 Central government Covid-19 era E-learning initiatives

With the demanding nature of COVID-19, the government had to provide alternative means for teaching and learning, especially during the lockdown. The first initiative is to access existing systems and leverage them to meet the current demand. DIKSHA (Digital Infrastructure for Knowledge Sharing) launch in September 2017 was one of the tools the government leveraged in the COVID-19 era. VidyaDaan was launched in April 2020 as a national content contribution programme to leverage the DIKSHA platform.

A comprehensive initiative of the Indian government called PM eVidya aimed at unifying all efforts related to digital, online, and on-air education was announced on the 17th of May, 2020. It was aimed at enabling equitable multi-mode access to education.⁶

Further E-learning initiatives that are employed during this COVID-19 era include; Swayam Prabha TV Channels, For open schools and pre-service education, On Air, For the differently-abled, E-textbooks, and National Repository of Open Educational Resources (NROER).⁷

⁶ mhrd.gov.in

⁷ <https://www.education.gov.in/hi>

Swayam Prabha TV channels MHRD dedicated thirty-two (32) channels to broadcast high-quality educational programs. It provides separate channels for school education and higher education. The initiative is still undergoing development and upgrading as the content & topics are expected to be organized by chapter and topic-wise in the future to ensure asynchronous usage by everyone anywhere, anytime.

For open schools and pre-service education Approximately ninety-two (92) course contents relating to the National Institute of Open Schooling from grades 9 to 12 were uploaded on the SWAYAM portal. The contents can be accessed through SWAYAM.

On air Radio broadcasting focused on learning-based activities are being used for children in remote areas. 289 community radio stations were also employed to broadcast NIOS for grade 9–12 students. Shiksha Vani Podcast with 430 audio contents owned by Central Board for Secondary Education (CBSE) is being used to deliver all the subjects of grades 1 to 12.

For the differently-abled One Direct-to-Home (DTH) channel is dedicated specifically to hearing-impaired students. Study materials in sign language are developed in Digitally Accessible Information System (DAISY) for visually and hearing-impaired students; the materials are available on YouTube and NIOS website.⁸

E-textbooks Electronic textbooks are available on the e-Pathshala web portal and applications. It has mobile applications for android and iOS as well as windows desktop app.⁹

National Repository of open educational resources (NROER) NROER has approximately 17,500 pieces of e-content of The National Council of Educational Research and Training (NCERT) and other collaborative partners. The materials are available for various school subjects.

The struggle of the central government in upgrading the existing E-learning tools and working on new initiatives is a continuous task. More initiatives on E-learning are expected to be inaugurated in the nearest future even after the COVID-19 phase.

7.4 State governments' E-learning initiatives

Alongside the efforts of the Central government, State and Union Territories are not leaving the task to the Central government alone as the majority initiated several E-learning initiatives to meet the demand of the present situation. States/UT like

⁸ <https://www.nios.ac.in/>

⁹ <https://epathshala.nic.in/>

Delhi, Rajasthan, Odisha, Andhra Pradesh, Kerela, Jammu & Kashmir, Himachal, Meghalaya, Punjab, Ladakh, Telangana, Tripura, and many others also leveraged DIKSHA solutions for their E-learning initiatives. In particular, there are 28 states and 8 Union Territories (UT) in India.¹⁰ It is found that covering and exploring the initiatives of each state is not possible in the present form of study, as we have faced the following set of problems and considered the subsequent inclusion and exclusion criteria:

- i. As the complete count of E-learning (online learning) initiatives and the total number of states is high. It is not feasible to perform the fine-grained analysis with the present set of research objectives.
- ii. A limited number of initiatives are taken by a specific state¹¹ in comparison to other states. Therefore, we have excluded the states based on the frequency of initiatives taken by them.
- iii. We specifically, included the state of Jammu and Kashmir (J&K). As it among the most disturbed and sensitive states in India.¹²
- iv. Few states (like Delhi) have executed and implemented the most renowned initiatives.
- v. The *level of education* (or literacy rate¹³) is also taken into consideration while the selection of the states.
- vi. Excluded the states those have taken a limited number of E-learning initiatives but are utilizing the initiatives taken by central or other state governments.
- vii. The *state-wise rate of population*¹⁴ below poverty is also taken under consideration while finalizing the state for consideration.

With the consideration of all the above-mentioned criteria and limitations, we have selected only five states (Delhi, Punjab, Andhra Pradesh, Bihar, J&K) from the sample of around 28 and 8 UT's.

E-learning schemes by some of the States/UTs selected using the above parameters are given below.

a. Delhi:

School Education: Chief Minister (CM) of Delhi launched “parenting in the time of Corona” on 4th April 2020 with the theme “Every home a school, every parent a teacher”. Other school education schemes are live online classes, digital entrepreneurship mindset class, Online happiness class for family among others.

¹⁰ <https://knowindia.gov.in/profile/the-union-and-its-territory.php#:~:text=India%20comprises%2028%20States%20and%208%20Union%20Territories>

¹¹ https://www.education.gov.in/sites/upload_files/mhrd/files/India_Report_Digital_Education_0.pdf

¹² https://www.business-standard.com/article/pti-stories/centre-bestows-on-itself-powers-to-declare-any-area-in-jk-disturbed-under-afspa-119110100967_1.html

¹³ <https://www.businessinsider.in/education/news/these-are-indias-most-literate-states/slidelist/77991055.cms>

¹⁴ <http://socialjustice.nic.in/UserView/index?mid=76672>

Teacher Education: The government also established programs for the training of teachers and faculty members. These include among others; Online Capacity Building Programme (OCBP),¹⁵ and Learning Never Stop (LNS) lecture series.

b. Punjab

The department of school education, Punjab initiated schemes to bring online education to each student. These involve; Creation of Mobile Application & System (iScuela Learn) which have hit over 100,000+ downloads as of January 2021, YouTube channel (Edusat Punjab), Radio & DTH/Cable TV channels, EDUSAT Contents through Satellite Network (Receive Only Terminal), E-books & month-wise e-book distribution, ICT Computer Labs, and Smart Classrooms.

c. Andhra Pradesh

The government of Andhra Pradesh has the following initiatives as part of her efforts to provide quality education to students; Abhyasa APP for teachers and students, E-contents for students, Toll-free voice and video calls for students in clearing their doubts and understanding critical topics, Facebook live training program, Radio and TV lessons, Webinar based ICT training, among others.

d. Bihar

E-learning schemes in Bihar include; Digital Education Portal,¹⁶ Social Media Based Learning (Facebook and WhatsApp), YouTube Channel, TV Channel, and Mobile Applications (Unnayan: Mera Mobile Mera Vidyalaya, Vidyavahini Bihar).

e. Jammu and Kashmir

Jammu and Kashmir Knowledge Network (JKKN) Samadhan AI-Based Educational Chatbot, Radio & TV Classes, Teachers Initiatives, are part of the tools used in ensuring learning continues during the COVID-19 era in Jammu and Kashmir.

8 Analyzing the outcomes of online teaching and learning with the conduct of online survey: A case study

In this section, we present the case study to investigate the ground truth on the usage of E-learning tools, online classes, and other initiatives of the Indian Government by stakeholders (teachers and students) of the Indian higher education sector. It provides insights on data analysis and methodology along with the outcomes of the conducted case study.

¹⁵ www.chalklit.in

¹⁶ <http://www.bepcssa.in/en/digital-learning.php>

Table 1 Descriptive statistics of collected data

Respondent Category	Number of Responses
Total Number of Responses	403
Teachers	49
<i>Male</i>	24
<i>Female</i>	25
Age:	
50–60	1
40–50	4
30–40	27
<i>Less than 30</i>	17
Students	354
<i>Male</i>	199
<i>Female</i>	155
Age:	
30–40	2
20–30	268
<i>Less than 20</i>	84
Number of Universities	7
Number of Colleges	15
Based on Qualification:	
<i>Undergraduate</i>	271
<i>PostGraduate</i>	121
<i>Doctoral</i>	11
Number of Streams	28

8.1 Data analysis and methodology

The data analysis methodology presents the information on the process of data collection and design of the questionnaire, data preprocessing, methods, and algorithms that are used to conduct the survey and to process the collected data.

8.1.1 Data collection and design of the questionnaire

An online survey was conducted to record and gain insights into the feedbacks of Indian students and teachers (or faculty members) on the conduct of online learning (online classes) during the COVID-19 situation. The survey contains a questionnaire, designed to collect information on the experience of learners for online study (learning), various issues faced by the learners, comparative responses with offline study, suggestive changes, and feedbacks from respondents. Specifically, A questionnaire is a research instrument consisting of a set of questions intended to

Table 2 Conversion of response to Likert scale

Response	Likert Scale Value	Response	Likert Scale Value
Excellent	5	Very High	5
Good	4	High	4
Average	3	Average	3
Below Average	2	Below Average	2
Poor	1	No Disturbance	1

capture responses from respondents in a standardized manner.¹⁷ The quality of the data analysis in the survey process depends upon the quality of the questions asked in the questioner (Williams, 2003). The richness of the questionnaire depends on many factors like the content of questions, topics covered, their wording, format, and sequencing, all of which can have important consequences for the survey responses (Williams, 2003).

In this study, a total of 33 questions was asked in the questionnaire. The questions were divided into three categories; the first one is general information (including personal and online learning experience), the second is about possible issues/problems faced while using online learning, and the last one is the suggestion part (consisting of feedbacks and comments from the respondents). For deciding and making the efficient list of questions, we have referred to the specification of designing survey by Blair et al. (2013) in their research. For more details on the designing of the questionnaire, on inclusion (or exclusion) of a specific question, how to choose the appropriate set of responses, we suggest the readers explore the work of Blair et al. (2013).

An online version of this questionnaire was prepared and specified links were shared over e-mails, social media (like WhatsApp, Facebook, etc.), and other academic groups, targeting the audience consisting of students and teachers of higher education institutes (universities or organizations). We have preferred to conduct an online survey than offline to target a wider range of audiences while keeping in place all the COVID19 guidelines by the government (Wright, 2005). Additionally, the data was collected for the fortnight and stored in the database linked with the form. Samples were taken from each part of the audience (including students and teachers) of diverse age groups, levels of education, education institutes (colleges or universities), gender, streams (education specializations or fields), and from the parts of the country as shown in Table 1 (Acharya, 2013). A total of 403 responses have been collected, including 49 responses from teachers and 354 from students. It is also noted that the percentage of male respondents who participated in an online survey is more (approx. 55%). We also examined that most of the students belong to the age group of 20–30 years, whereas 63% of the teachers reside in the age group of 30–50 years.

¹⁷ <https://courses.lumenlearning.com/suny-hccc-research-methods/chapter/chapter-9-survey-research/>



Fig. 2 Pre-processing steps sequence

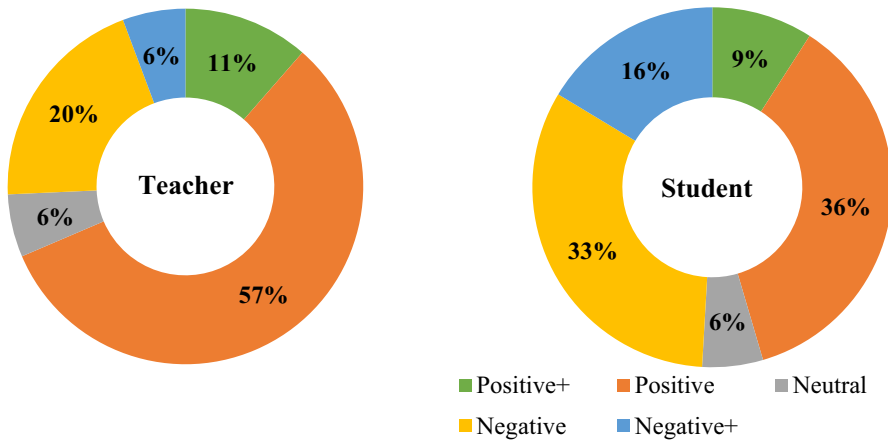


Fig. 3 Sentiment analysis of respondents feedback

8.1.2 Data preprocessing

Data preprocessing includes data cleaning, data transformation, and filtration of the collected data. It helps in removing the anomalies from the dataset and make it ready for the analysis phase. In particular, Data cleaning refers to the technique of cleaning data by removing outliers, replacing missing values, smoothing noisy data, and correcting inconsistent data (Gupta & Sabitha, 2019). It is a significant step as the missing, incorrect, and erroneous data can pose a significant problem to the reliability and validity of study outcomes (Salkind, 2010). In our study, we prepared the data for further processing by following two methods.

- (i) While evaluating the responses it was observed that different sets of questions have distinct values (on different scales) for the responses. It causes the problem of uncertainty and heterogeneity during the evaluation of responses. To tackle such an issue, we have applied the data transformation technique. It converts (or maps) the responses of the respondents into the Likert scale (Allen & Seaman, 2007). The Likert scale allows the assigning of the numerical weightage to the obtained responses. Additionally, it helps in effective statistical evaluation, as we have used a single scaling score for each question in the survey. One of the examples of Likert scale conversion is demonstrated below in Table 2.

- (ii) Further, the reviews (textual feedbacks) of the respondents are preprocessed for performing the quantitative content-based analysis (Riffe et al., 2019). This includes removal of special characters, numbers, grammatical and formatting errors, conversion of text from regional to English language, repetitive comments, missing values, abusive or vulgar comments, and misleading information. We have applied both manual and automatic techniques for data cleaning. The manual technique includes checking the responses for any vulgar or misleading information and automatic techniques like R libraries for removing missing and repetitive values, google translator to convert text into English form were also employed in our research. The sequence of the preprocessing steps is mentioned in Fig. 2.

8.1.3 Sentiment analysis

Sentiment analysis (or opinion mining) is a Natural Language Processing (NLP) approach to investigate the emotions, polarity, attitude, and opinion of the people from the written text (Liu & Zhang, 2012; Wook et al., 2019). In our survey, we have taken the feedbacks (suggestions or comments) from the respondents expressing their experience with the online conduct of the classes (online teaching and learning). Further, we performed opinion mining on the quantitative responses of the respondents, to examine and analyze the behavioral responses of the stakeholders.

Each feedback comment presents a sort of emotion that dignifies the acceptance or rejection of the online classes by teachers and students. The sentiment analyzer classifies the quantitative feedbacks as positive, negative, and neutral based on the extracted emotions (refer to Fig. 3). The working of the sentiment analyzer is shown in Algorithm 1.

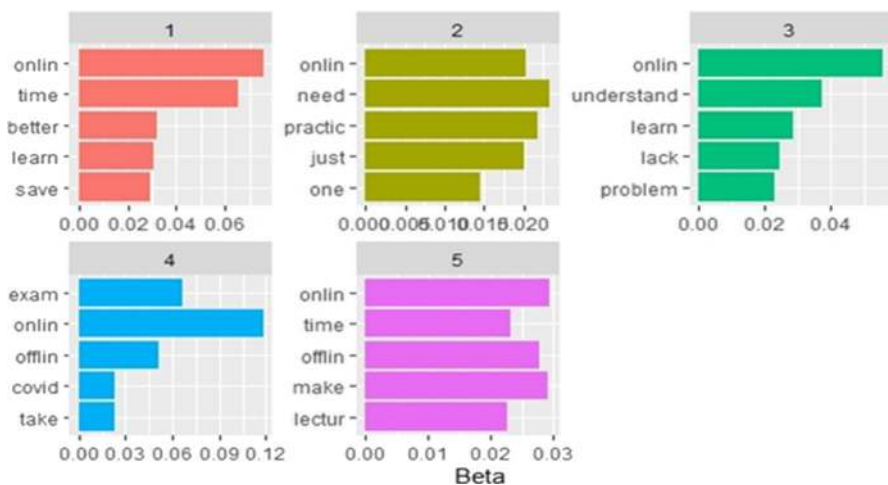


Fig. 4 Topic modeling using LDA

Algorithm 1: Sentiment analysis

```

INPUT: CSV FILE (CONTAINING USER COMMENTS) CV, The sentiment lexicon L.
OUTPUT: Pol = { P+, P, Neu, N, N+}
INITIALIZATION: SumPP, SumP, SumNeu, SumN, and SumNP =0, where all of these
show the polarity of respective category tokens.
Start
Step 1: for each  $t_i \in CV$  do
  Step2:   Search for  $t_i$  in L
  Step3:   If  $t_i \in PosP\_list$  then
            SumPP= SumPP +  $t_i\_smt$ 
            Print(P+ to the front of the comment in the resultant file)
  Step4:   Else if  $t_i \in Pos\_list$  then
            SumP= SumP +  $t_i\_smt$ 
            Print(P to the front of the comment in the resultant file)
  Step5:   Else if  $t_i \in SumN\_list$  then
            SumN= SumN +  $t_i\_smt$ 
            Print(N to the front of the comment in the resultant file)
  Step6:   Else if  $t_i \in NegP\_list$  then
            SumNP= SumNP +  $t_i\_smt$ 
            Print(N+ to the front of the comment in the resultant file)
  Step7:   Else
            SumNeu= SumNeu +  $t_i\_smt$ 
            Print(Neu to the front of the comment in the resultant
file)
            End if
          End for
End

```

The results of the sentiment analysis depict the presence of around 57% of the positive and 11% of the highly positive feedbacks by the faculty members. The students responded with only 45% of the positive comments in total. From the observed results, we may conclude that Indian higher education faculty members seem much satisfied with the online learning methods and tools in comparison to the students. Stickney et al. (2019) also presented similar outcomes, indicating the satisfaction of Higher education faculty members for online education. Furthermore, we have discussed the possible reasons for obtaining such results in the discussion section of this paper.

Moreover, there are some comments (of the respondents) specifying neutral sentiments (no emotion). We found the existence of approximately 6% of the neutral comments by both categories of the respondents. The negative feedbacks illustrate the unhappiness of the respondents with the conduct of online classes and learning. In the future study, we plan to perform an in-depth quantitative analysis on the negative comments. We also look forward to conducting the thematic analysis, to get insights into the limitations, problems, or issues faced by the learners in online learning. The negative emotions of students indicate their dissatisfaction with online teaching methods and other common problems like electricity failure, internet issues, disturbance by other participants, among others. In the collected data, we observed a total of 49% and 26% of the negative emotions (including the sum of negative and highly negative) from students and teachers respectively. This outcome pinpoints the presence of resistance and dissatisfaction among the respondents. Exploring the appropriate reasons for such a behavior is a topic of future research itself.

8.1.4 Topic modeling

Topic modeling is the statistical method to extract the relevant topics of discussion from the corpus of documents (Setiawan et al., 2020). It allows performing the semantic analyses and grouping (clustering) of the set of words (or similar expressions) from the documents corpus. The data points in the same group (cluster) are more similar to each other, in comparison to the data points in other groups (Saini et al., 2020). In this case study, we have applied the LDA (Latent Dirichlet allocation) algorithm, to analyze the comments (feedbacks or suggestions) of the respondents (teachers and students) concerning the conduct of online teaching and learning during the COVID-19 pandemic outbreak. LDA is among the most prominent and widely used algorithms for extracting the topics of discussion from the set of documents. This extraction of semantic topics from the respondent's feedback helped us to investigate the pros and cons of online learning, other problems faced by respondents, areas of improvement, the success rate of online learning, and future suggestions for online learning and teaching. With all these extracted scenarios, it will be a huge task to explore deeply into all the topics. We take it as a future challenge to explore thoroughly all the possible reasons for these scenarios. The results of the LDA algorithm are shown in Fig. 4. The findings indicate the formation of 5 clusters, with the five most frequent and important topics in each cluster.

8.1.5 Finding the relation among teaching and learning parameters

The conducted surveys illustrated the presence of variations in the responses of the teachers and students. We have used the Karl Pearson coefficient of correlation (Blyth, 1994) to get the degree of the dependency among the responses of both responders group. The value of the coefficient is expected to range between 0 and 1. The 0 signifies there exists no dependency among responders, whereas 1 signifies the perfect correlation (fully dependency). The degree of the correlation can be computed by using Eq. 1 (Blyth, 1994).

$$r = \frac{N \sum TS - \sum T \cdot \sum S}{\sqrt{N \sum T^2 - (\sum T)^2} \cdot \sqrt{N \sum S^2 - (\sum S)^2}} \quad (1)$$

N represents the number of the questions on which analysis has been observed.

'T' is used to represent the value of the response of the teacher and the symbol 'S' is used to identify the student response value.

We have applied the Karl Pearson correlation method to the overall gathered responses of the students and teachers (faculty members). With the implication of eq. 1, we got a strong relation ($r = 0.712$) among the responses of the two respondents (Benesty et al., 2009). It pointed to the fact that both respondents have shown a similar degree of acceptance (or rejection) for online teaching methods, tools, and problems faced.

Table 3 General Information from the respondents

S.no	Questions	Category	Teacher	Student
1.	Do you have a device for online learning/teaching	YES NO	93.9% 6.1%	98.9% 1.1%
2.	Which device you use for online learning/Teaching	Desktop Laptop Smart Phone Tablet	18.4% 32.7% 46.9% 2%	1.1% 41.5% 56.5% 0.8%
3.	Rate your Computer/Digital Proficiency.	Excellent Good Average Below Average Poor	26.7% 61% 12.3% 0% 0%	34% 42.7% 16.8% 3.7% 2.8%
4.	Rate the overall Computer/Digital Proficiency of other Participants/Host.	Excellent Good Average Below Average Poor	16.3% 61.2% 22.4% 0% 0%	12.7% 42.7% 36.4% 5.1% 3.1%
5.	Which online tool do you prefer to deliver/attend the class?	Zoom Google Meet CISCO Webex Classdojo EkStep DingTalk Lark Other	22.4% 69.4% 4.1% 0% 0% 0% 0% 4.1%	6.5% 91.2% 2% 0% 0% 0% 0% 3%
6.	Do you teach/learn mostly with your camera on?	Yes No Sometimes	42.9% 18.4% 38.8%	5.9% 72% 22%

Table 3 (continued)

S.no	Questions	Category	Teacher	Student
7.	Which language do you prefer to communicate with over online class ?	Only English	18.4%	11.9%
		Only Hindi	0%	5.1%
		Only Regional	4.1%	1.4%
		English and Hindi	42.9%	63.6%
		English and Regional	34.7%	18.1%

Table 4 Issues faced in Online Learning

S.no	Questions	Category	Teacher	Student
1.	Have you ever faced the problem of Electricity during online class?	Most of Times Sometimes Never	6.1% 73.5% 20.4%	14.7% 60.2% 25.1%
2.	Have you ever faced the problem of the Internet (Network) during online class?	Most of Times Sometimes Never	18.4% 75.5% 6.1%	41.5% 48.9% 9.6%
3.	Rate the level of Stress you faced to attend/deliver the online class/lecture.	Extremely Stressful Stressful Averagely Stressful No Stress	4.1% 46.9% 24.5% 24.5%	12.4% 41.2% 24.6% 21.8%
4.	Rate the level of disturbance you faced while attending/delivering the online class.	Very High High Average Below Average No Disturbance	2% 14.3% 40.8% 30.6% 12.2%	9.9% 21.2% 33.1% 17.5% 18.4%
5.	Do you think online learning/teaching affected your health?	Yes No Maybe	63.3% 24.5% 12.2%	50.6% 33.1% 16.4%

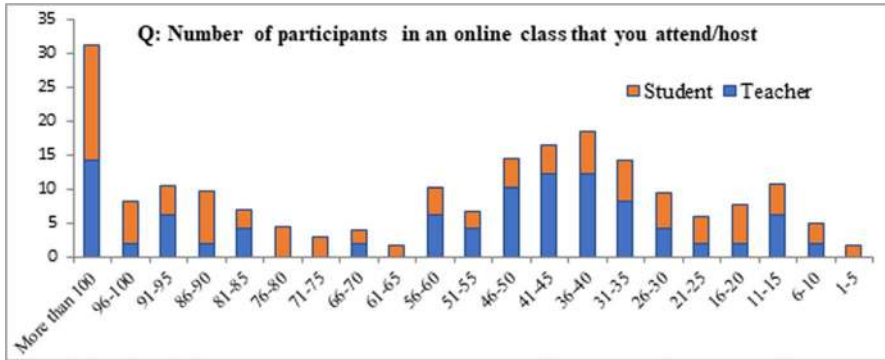


Fig. 5 Participants in a single session

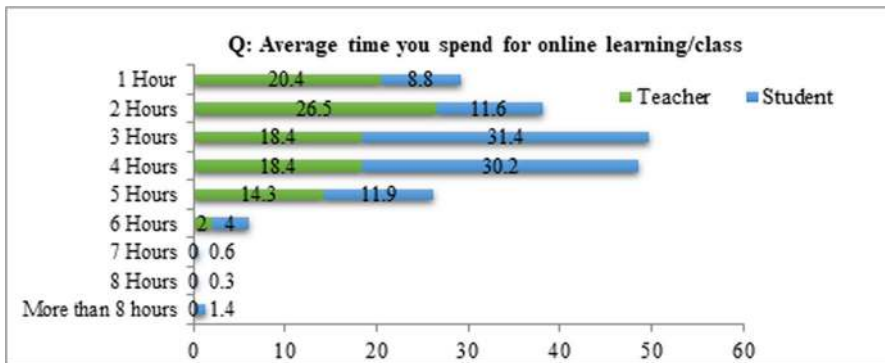


Fig. 6 Daily time spent on online learning

8.2 Outcomes of the case study

Table 3 shows the results of general information collected from the respondent responses. It is seen that in Q1, almost all the responders have their own devices for teaching/learning. The percentage of both types is above 90%. Furthermore, it is observed that the most frequently used device by both the teachers and students is the Smartphone. Laptop and desktops are the next in the series based on the usage. Google Meet; an online meeting tool for attending virtual classes is the leading service used by both groups of responders as depicted from the results of the Q5. The outcome of Q6 specifies that the majority of the teachers deliver lectures by turning their cameras on, whereas large groups of students prefer to attend lectures by keeping the camera off.

Furthermore, one of the sections of the questionnaire is used to collect the issues (or problems/challenges) faced by the respondents during the online teaching and

learning. The results pointing to these challenges are presented in Table 4. Network (or Internet) and electricity are among the foremost challenges that are faced by the learners. Around 76% of the teachers and 49% of the students have confronted network-related problems. 74% and 61% of teachers and students have encountered the problem of electricity during online teaching and learning respectively. Almost half of the respondents have also affirmed the presence of disturbance (or noise) in online classes. They specified different reasons like lack of specific student interest, network issues, hardware problems, disturbance from the surrounding environment, among others.

Furthermore, for the success of online classes (or education), it is worth knowing the average class size (number of participants). It is pointed that the appropriate size is a must for successful learning in online classes (McDaniel & Dickens, 2004). An oversize group or group with less than 2 participants can affect the overall outcomes of the online classes. For this purpose, we have asked the responders to specify the average number of participants attending online classes during COVID-19.

Figure 5 presents the graphical illustration of the collected responses on this data. Approximately 35% of responders mentioned that they attend an online class with around 100 other students. With these findings, we feel that it is very difficult to handle such a large size group in an online class. Moreover, in an outsized online class, it is obvious that students and teachers have to encounter common problems like disturbance, lack of interest, dissatisfaction (Ake-Little et al., 2020). Additionally, the teacher (or faculty member) cannot make an appropriate discussion with students and will not handle the queries of the students in a better way.

In further analysis, we have explored the average duration an online learner/teacher spent for attending and delivering the lectures or conducting the discussion sections. We observed that the average daily time spent by both teachers and students on online learning is approximately 3–4 h (refer to Fig. 6). Students are likely to spend more time as they have several lectures to attend daily whereas teachers are bound to take only 2–3 lectures. Moreover, it is also found that the average weekly time spent by the student for attending online classes (or for online study) is approximately 20 h. Whereas, the average teacher's per-week teaching workload is 17–18 h (approx.) as per the data provided by them in the survey. With these findings, it is further a topic of research to find the impact of online learning duration on the health of the learners. In the future, we want to explore this challenge in a detailed and elaborative manner.

The end section of the survey is dedicated to taking suggestions from the users. The results of the suggestion part of the questionnaire are shown in Table 5. It focuses on gathering information from respondents on the level of discussions, online examination, security, and their learning experience. Around 64% of teachers are in the view that online exams cannot be taken as an alternative for offline exams, whereas students are in the favour of online exams. On the other hand, both parties agree on the fact that online classes will not be able to replace offline classes.

Furthermore, we have asked the respondents to provide feedback (or suggestions) on the ongoing central and state government initiatives to promote education during the period of the COVID-19 outbreak. Additionally, we have requested the respondents to provide the name of initiatives they are using and rate them based on their

Table 5 User Experience of Online learning

S.no	Questions	Category	Teacher	Student
1.	Rate the level of Discussions that you think are possible in an online class/learning.	Very Good	2%	11%
		Good	32.7%	25.1%
		Average	42.9%	33.6%
		Below average	20.4%	22.9%
2.	Do you think online exams are a good alternative to evaluate student performance?	No Discussion	2%	7.3%
		Yes	6.1%	46.6%
		No	63.3%	27.4%
		Maybe	30.6%	26%
3.	Do you think online learning requires change/update the present marking/evaluation system?	Yes	61.2%	59.3%
		No	18.4%	11.9%
		Maybe	20.4%	28.8%
		Yes	34.7%	46%
4.	Do you think online learning helps in saving resources like time, money, etc.?	No	46.9%	36.4%
		Maybe	18.4%	17.5%
		Yes	26.5%	46%
		No	40.8%	30.8%
5.	Do you think online learning is secure?	Maybe	32.7%	23.2%
		Yes	22.4%	31.4%
		No	61.2%	46%
		Maybe	16.3%	22.6%
6.	Do you think online classes can replace offline classes in the future?	Excellent	8.2%	13.3%
		Good	49%	34.7%
		Average	36.7%	31.9%
		Below Average	6.1%	14.4%
7.	Rate your online learning/teaching experience.	Poor	0%	5.6%

Table 6 Rating of Government initiatives by respondents

Name of the Initiative	Number of responses				
	Below Average	Average	Good	Above Good	Excellent
NPTEL	0	24	58	21	14
PM eVidya	1	11	16	8	10
SWAYAM	0	3	19	36	28
iScuela Learn	3	31	17	6	2
Social media based e-contents	0	12	35	13	3

usability (or performance) on the rating scale of below-average to excellent (refer to Table 6).

In particular, Table 6 presents the compiled rating outcomes of the most popular initiatives marked by the respondents. It is observed that among all initiatives NPTEL gets the highest rank, mostly ranging between good to excellent scale. It also validates the fact that NPTEL assists the learners (students and teachers) by providing more flexible learning options in comparison to other initiatives.¹⁸ Further, we noted the higher rating (or acceptance) for SWAYAM and Social media-based e-contents. Paul et al. (2018) also pointed that SWAYAM has a wide spectrum of audiences and received the peak attention of its learners. The popularity of social media and the availability of study material on different platforms like YouTube, blogs, websites, Twitter, Facebook, Instagram, etc. cannot be eliminated (Cinelli et al., 2020). Social media is now being utilized as a pedagogical tool in institutes (or classrooms) to implement effective learning and teaching (Hamadi et al., 2021). iScuela Learn perceived the least rating in comparison to other considered initiatives. One of the possible reasons for such a behavior is the limited scope of the audience (only school students) targeted.¹⁹

9 Discussion

Online learnings have become a vital part of education, especially with the Coronavirus outbreak. With such a vast education system in the country, it is an obvious challenge for online learning methods to meet the requirements of the education sector. The present study is conducted on exploring different online learning and education initiatives taken by the Indian government during the COVID-19 pandemic. We focus to provide elaboration of the online learning environment and acknowledge why it is so important in the pandemic period. Particularly, the conducted research is distributed into two phases: the first phase provides detailed information about

¹⁸ <https://www.thehindu.com/education/nptel-will-offer-students-flexible-options-for-education/article32703310.ece>

¹⁹ <http://www.iscuela.com/projects/digitise-punjab/>

the Indian government (both central and state) initiatives. Moreover, while exploring these initiatives it is found that the Indian government has commenced several new platforms along with the enhancement of Open Education Resources to make online learning reachable to each learner. The central government already uses several E-learning platforms to promote education in the country, but with the sudden outbreak of COVID, many new significant initiatives came into the limelight. The Indian government promotes a few existing systems like DIKSHA, free access to e-books, radio channels, etc. Several other online programs like PM eVidya, Swayam Prabha TV, the channel for differently-abled persons, providing e-textbooks have been started in the COVID period (Kadam, 2021). Along with the central government, several state ministries also took comprehensive steps to assure continuity of education in corona time. The majority of the states participated in this process by either upgrading the current systems or starting new ones to meet the demand of the education sector. The success of these initiatives is determined by the feedback from the responders. In the second phase of the paper, a questionnaire-based survey was conducted to confirm the success of the online learning system. Though the outcomes indicated that online learning is the future of the education system, still it has certain hurdles in its path.

Question wise analysis of the conducted survey:

- (i) All online learners (respondents of the survey) have their devices for learning except a few would like to share with others (possibly the family members) or use cafes or departmental labs. Indian is a nation with a lot of diversity and divergence in terms of financial status (Ghosh et al., 1998). Everyone cannot purchase a smart device with internet data packs for attending classes. Moreover, there are certain geographical areas (even states) where it is limited or no access to the internet facility. It will become a real challenge for the Indian state and central governments to cover this digital inequality among the citizens of India (Pandey & Pandey, 2018).
- (ii) It is analyzed that SmartPhones are the most widely used device for online learning. Affordability, availability, portability, easier operation are the possible reasons for its high usage. Moreover, for online learning, accessible use may have adverse effects on the health of learners. The findings of this study pointed that teachers (or faculty members) preferably use a laptop or desktop to conduct online classes. Whereas, the other set of participants (students) prefer smartphones.
- (iii) In this digital era, it is expected that every educated person knows how to use digital devices especially mobile phones. Since our respondents are from the higher education sector (including colleges/universities) and between the age of 20–40 years. There is a good chance of them having excellent digital/computer proficiency. Age is certainly a prominent factor in determining the digital proficiency of a person. Young peoples are more familiar with the usage of modern technology as compared to older ones (Paul & Stegbauer, 2005; Hargittai & Hinnant, 2008; Broady et al., 2010). We also observed in our findings that the computer proficiency of the students is comparatively higher

than that of the teachers. Further, our results also claimed that all responders have average or good knowledge of operating digital devices. Moreover, the success of online education depends largely on the digital proficiency of the participants.

- (iv) With online teaching (or education) various set of ICT tools comes in trending. In this study, we observed that the majority of the education stakeholders preferred to use Google Meet, followed by Zoom meet, CISCO Webex, Classdojo, etc. The preference for a specific tool depends largely on additional services provided by the host (or company) along with the services for ensuring the security of the users.
- (v) Online teaching preferably comes as a replacement of offline classes in the corona pandemic period. The virtual classes create an environment where students and teachers interact face to face. It is reported in our research that some of the teachers sometimes keep their camera off, while most of the students always attend classes in camera off condition. It may be considered as a serious limitation of online classes (or education). For the success of two-way dialog, participants and hosts must have a virtual face-to-face interaction. Ultimately, it will help in building a classroom environment, forces you to stay attentive and focused, allow teachers to have a better gauge of the needs of their classes, and make the session more interactive.
- (vi) Teaching and learning will be more effective only when both (participants and hosts) can understand the language used for the process of teaching (or to disseminate the knowledge, ideas, or discussion). The results of the survey present that Indian higher education stakeholders (students/teachers) mostly interact in the English language. We have also found the trends where faculty members and students favor the use of more than one language (like English and Hindi, English, and other regional languages). The feedback from the faculty members also specified that some of the students are not able to properly understand either English or the regional language. In that case, it becomes mandatory to deliver lectures in the language on which students agreed.
- (vii) Every education method, methodology, or technique has a certain set of problems associated with it (Pelekh, 2020). The case of online learning and education is not an exception (Piwek & Savage, 2020). In many Indian states, continuous electricity is a problem itself (García-Herrero & Goldhammer, 2020). The respondents in this study have also specified that a barrier in the successful conduct of virtual classes. The electricity problem can also create other problems like a disturbance in the lecture, a lecture miss, or a part of the lecture will be missed.
- (viii) Network (or Internet) issue is also among the most cited problem faced during online education. It can initiate dissatisfaction for the learner, lack of interest, disturbance, voice (or video) distortion, inability to join class, and connection loss during the class. Moreover, some users may have limited access (amount of data) available for internet usage. They have many lectures to attend/deliver daily. It may cause exhaustion in the internet data. It can be considered as one of the reasons for not attending the classes.

- (ix) Since most of the users attend classes from their homes. They are on a higher verge to get disturbance from the surroundings. Moreover, in India, it is not possible in every household to have a personal space for attending classes. The results show that both teachers and students agreed that they faced disturbance during their classes while taking (or attending) classes from their respective homes.
- (x) For attending the virtual classes the learner must sit for multiple hours in front of the digital devices. Moreover, with social media additions (for some users) and the use of other digital devices by the learners, it may go to an alarming range. This will surely raise health issues for the digital device user. The most common health issue is the problem in the eyes (like watery eyes, weakness of the eyesight, tired eyes, etc) (Mohan et al., 2021).
- (xi) The size of the class also affects the quality and success of the online lecture (Toth & Montagna, 2002). A large number of participants (or oversize class) will lead to many problems in the online session like higher disturbance, lesser individual interactions, affect the network traffic, etc. In our survey results, it was observed that most of the respondents have class(es) of an immense number of participants.
- (xii) Effective and efficient teaching is never considered as the method of one-way communication. The success of teaching and learning depends largely on discussions, interactions, questioning, and timely evaluation of students (Kyriakides et al., 2013). In the era of online teaching (or education) these factors may get escaped if teaching and learning compromise on the primary objective of education.
- (xiii) Online classes are taken as an alternative to offline (physical) classes. Can the exam be also taken online effectively? Can online exams be a good alternative to evaluate student's performance? These are the few questions that arise while considering the option of virtual learning. It was seen in survey outcomes that most of the teachers agreed with the statement that online exams cannot evaluate a student's performance in a better way. Whereas, several student respondents have shown a favoring trend in the conduct of online exams. The possible reasons for students supporting online exams will be (a) it saves the travel time (b) in the situation of COVID-19, it reduces the chances of transmission of disease (c) if classes are online why should the exams not be.
- (xiv) There exist significant differences between the online and offline classes. Therefore, a change in the present exam evaluation (or marking system) in the online mode is required. It will be better if assignments, projects (minor or major) based evaluation are made part of old systems. In offline mode, students write the answers using pen and paper, while in the online environment it can be done either by typing (or writing on paper using a pen and then scan copy the document). Both of the techniques are time-consuming and practically difficult. For such reasons, the evaluation system for online learning should be implemented differently.
- (xv) Security is a major concern in the digital era. Mixed reactions about the security in online learning have been reported from the respondents. The compromise of protection and privacy due to hacking (or other activity) may cause

theft of personal data and information, which is considered as the major threat to online learning.

- (xvi) In India, online classes are chosen as an alternative to the offline in the urge of imposed traveling restrictions (due to lockdown) in the corona period. Therefore, the question arises here if the online classes can fully replace offline classes in the future or not? In our survey, the feedback comes in the favour of offline classes considering online classes only as a substitute in the corona era. The possible reasons may be the lack of one-to-one interactions, fewer possible discussions, and all other issues discussed above.
- (xvii) There is a wide range of government initiatives to aid education in a COVID era specifically focusing on the level of education, streams, languages, category of study materials, etc. These initiatives help in providing study content in the form of video lectures, radio broadcasting, TV channels, and e-books. The success or failure of the initiatives is best portrayed by its users. The responses revealed that these initiatives are very valuable for students and teachers considering the unavailability of offline classes.
- (xviii) The feedbacks of the users rectify the acceptance or rejection of any system. In the last question of the questionnaire, users were asked to provide their valuable views/suggestions in concern to their online learning experience. The responses are collected, preprocessed, and finally analyzed for evaluating their core emotion and extracting the topics of discussion. It was observed from the results (see Fig. 3) that most of the teachers have given positive feedbacks for online learning. It may be considered as their acceptance and satisfaction with the online learning methods. Whereas a mixed set of opinions (positive, negative, and neutral) are seen in the responses of the students. Students seem not to be impressed with the online learning environment as revealed by their comments. Furthermore, merely knowing the positive and negative emotions will not fulfill the purpose, there is a need to know the factors that are responsible for the observed results. For such reasons, we have applied a topic modeling technique to fetch the most repetitive topic of discussion in the feedback. The outcomes of LDA-based topic modeling will assist in knowing the pros and cons, issues, limitations, areas of required improvement in online learning.

10 Conclusion and recommendation

COVID-19 came all of a sudden and none of the countries were ready to tackle the situation created by this influenza. Over time, the governments have taken immediate and urgent actions in response to the outbreak caused by this deadly disease. The government of different countries had imposed the lockdown, forced people to stay in their houses and living places. Work from home moto has been initiated throughout nations. Likewise many other sectors, the education field also got largely affected by the spread of this pandemic. The Education institutes started to become digitized in that period and online learning became a necessity. Every country promoted the use of E-learning during the covid period. The Indian government had

also responded in the best manner to tackle the consequences of this deadliest and infectious disease. For rescuing education from the effects of COVID-19, the Indian government promoted the use of ICT in the field of education, especially during the lockdown period. The central government of India and the state governments of different regions have taken many initiatives to make education reachable to every student of the nation. The government publicizes the existing E-learning projects like CLASS, EDUSAT, SWAYAM, NPTEL, CEC, ILL, etc., and also launched new tools for encouraging E-learning. The VidyDaan was first in the series of the newly launched tool in the corona outbreak period. PM eVidya launched in the mid of May also aims to provide multi-mode access to education. Furthermore, the central government also employed and promote education TV channels like Swayam Prabha, Gyaan Darshan, etc. Other initiatives like open school and pre-service education, education on air with the help of radio channels, special classes for differently-abled students, providing free of cost e-books and digital libraries like the National Repository of Open Educational Resources are taken by the central government. The state governments also play a major role in promoting online learning in the situation of the pandemic. Most of the states incorporated the initiatives of the central governments along with their methods for providing the facility of online learning. The state of Delhi started several special classes and services like the Online capacity Building Programme, Learning Never Stops, parenting in the time of corona. The Punjab state is no behind the capital state for taking positive initiatives in concern of E-learning by creating a mobile application like *iscuela learn*, starting channels on youtube, TV and Radio, providing content through EDUSAT, e-book distributions, and promotion of Smart Classrooms.

The success of these initiatives can be better rectified by the reactions of the targeted audience. For such reasons, a survey was conducted to get the insights of the teachers and students of different colleges and universities throughout the country in concern to online learning. The outcomes are satisfactory, where most of the respondents favor online learning and find these initiatives as an appreciable step in maintaining the continuity of the study in the era of COVID-19. Although a wide range of users took online learning as a vital and necessary asset for education, they do not prefer it as a future replacement of offline classes because of certain limitations and issues. The issues like network connectivity, electricity problem, a large group of participants in a single class, disturbance faced during classes, and health-related issues are highlighted by the conducted study. Even though the issues affected the performance of the learning over web method, the users respond that the overall experience of the online learning is good to above average and it successfully filled the need of the education during the lockdown period in the country. Additionally, the conducted study provides insights into the learners' perspective towards the government's initiatives and online learning. Although the study covers a lot about the effectiveness of these initiatives still certain unavoidable limitations are existing in the study. First, we have not listed all the initiatives, we have selected only a few based on their popularity. In specific, popularity is measured by the number of daily users, the downloaded content, the rating, etc. There is a chance of getting false information while measuring these parameters. Secondly, only a few states have been selected for our observations, we might have missed the states where

these initiatives are implemented precisely. Third, the chosen sample (responses of the respondents) may have certain constraints: a) the majority of the respondents might belong to a similar course and locality, b) they have used the same initiative, c) experienced similar kinds of problems. In the future, we are focused to overcome these limitations by adding more clarity to the proposed system and sample chosen for the study.

Data availability An online survey is conducted to collect the data.

Code availability Not applicable.

Declarations

Ethics approval • The research meets all applicable standards concerning the ethics of experimentation and research integrity and the following is being certified/declared true.

• As an expert scientist and along with co-authors of the concerned field, the paper has been submitted with full responsibility, following the due ethical procedure, and there is no duplicate publication, fraud, plagiarism, or concerns about animal or human experimentation.

Consent to participate No clinical investigation is carried out on humans and animals.

Consent for publication Not applicable.

Conflicts of interest/Competing interests The authors declare no conflict of interest, financial or otherwise.

References

- Abbasi, S., Ayoob, T., Malik, A., & Memon, S. I. (2020). Perceptions of students regarding E-learning during Covid-19 at a private medical college. *Pakistan Journal of Medical Sciences*, *36*(COVID19-S4), S57.
- Abdekhoda, M., Dehnad, A., Mirsaeed, S. J. G., & Gavgani, V. Z. (2016). Factors influencing the adoption of E-learning in Tabriz University of Medical Sciences. *Medical Journal of the Islamic Republic of Iran*, *30*, 457.
- Acharya, A. S., Prakash, A., Saxena, P., & Nigam, A. (2013). Sampling: Why and how of it. *Indian Journal of Medical Specialties*, *4*(2), 330–333.
- Adzobu, N. (2014). Design, use and evaluation of E-learning platforms: Experiences and perspectives of a practitioner from the developing world studying in the developed world. *Informatics*, *1*(2), 147–159. <https://doi.org/10.3390/informatics1020147>.
- Ake-Little, E., von der Embse, N., & Dawson, D. (2020). Does class size matter in the university setting? *Educational Researcher*, *49*(8), 595–605.
- Albalawi, A., & Badawi, M. (2008). Teachers' Perception of E-learning at the University of Tabuk. In *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 2434–2448). Association for the Advancement of Computing in Education (AACE).
- Al-Fraihat, D., Joy, M., & Sinclair, J. (2020). Evaluating E-learning systems success: An empirical study. *Computers in Human Behavior*, *102*, 67–86.
- Alkharang, M. M., & Ghinea, G. (2013). E-learning in higher educational institutions in Kuwait: Experiences and challenges. *E-learning*, *4*(4), 1–6.
- Allen, I. E., & Seaman, C. A. (2007). Likert scales and data analyses. *Quality Progress*, *40*(7), 64–65.

- Al-Rahmi, W. M., Yahaya, N., Aldraiweesh, A. A., Alamri, M. M., Aljarboa, N. A., Alturki, U., & Aljerraiwi, A. A. (2019). Integrating technology acceptance model with innovation diffusion theory: An empirical investigation on students' intention to use E-learning systems. *IEEE Access*, 7, 26797–26809.
- Ariana, A., Amin, M., Pakneshan, S., Dolan-Evans, E., & Lam, A. K. (2016). Integration of traditional and e-learning methods to improve learning outcomes for dental students in histopathology. *Journal of Dental Education*, 80(9), 1140–1148.
- Arkorful, V., & Abaidoo, N. (2015). The role of e-learning, advantages and disadvantages of its adoption in higher education. *International Journal of Instructional Technology and Distance Learning*, 12(1), 29–42.
- Atkins, D. E., Brown, J. S., & Hammond, A. L. (2007). *A review of the open educational resources (OER) movement: Achievements, challenges, and new opportunities* (Vol. 164). Creative common.
- Azlan, C. A., Wong, J. H. D., Tan, L. K., Huri, M. S. N. A., Ung, N. M., Pallath, V., et al. (2020). Teaching and learning of postgraduate medical physics using internet-based e-learning during the COVID-19 pandemic—a case study from Malaysia. *Physica Medica*, 80, 10–16.
- Bakare, J., & Orji, C. T. (2019). Effects of reciprocal peer tutoring and direct learning environment on sophomores' academic achievement in electronic and computer fundamentals. *Education and Information Technologies*, 24(2), 1035–1055.
- Benesty, J., Chen, J., Huang, Y., & Cohen, I. (2009). Pearson correlation coefficient. In *Noise reduction in speech processing*. Springer topics in signal processing (Vol. 2). Springer. https://doi.org/10.1007/978-3-642-00296-0_5.
- Bezovski, Z., & Poorani, S. (2016). The evolution of E-learning and new trends. *Information and Knowledge Management*, 6(3), 50–57.
- Blair, J., Czaja, R. F., & Blair, E. A. (2013). *Designing surveys: A guide to decisions and procedures*. Sage Publications.
- Blyth, S. (1994). Karl Pearson and the correlation curve. *International Statistical Review / Revue Internationale De Statistique*, 62(3), 393–403. <https://doi.org/10.2307/1403769>.
- Broady, T., Chan, A., & Caputi, P. (2010). Comparison of older and younger adults' attitudes towards and abilities with computers: Implications for training and learning. *British Journal of Educational Technology*, 41(3), 473–485.
- Butcher, N. (2015). *A basic guide to open educational resources (OER)*. Commonwealth of Learning (COL).
- Cerón-Figueroa, S., López-Yáñez, I., Alhalabi, W., Camacho-Nieto, O., Villuendas-Rey, Y., Aldape-Pérez, M., & Yáñez-Márquez, C. (2017). Instance-based ontology matching for e-learning material using an associative pattern classifier. *Computers in Human Behavior*, 69, 218–225.
- Chandwani, A., Lihitkar, S., & Anilkumar, S. (2010). E-learning initiatives in India.
- Chang, C. L., & Fang, M. (2020). E-Learning and Online Instructions of Higher Education during the 2019 Novel Coronavirus Diseases (COVID-19) Epidemic. In *Journal of Physics: Conference Series* (Vol. 1574, No. 1, p. 012166). IOP Publishing.
- Chen, T. L. (2014). Exploring e-learning effectiveness perceptions of local government staff based on the diffusion of innovations model. *Administration & Society*, 46(4), 450–466.
- Chen, L. C., & Lien, Y. H. (2011). Using author co-citation analysis to examine the intellectual structure of e-learning: A MIS perspective. *Scientometrics*, 89(3), 867–886.
- Chen, W. S., & Yao, A. Y. T. (2016). An empirical evaluation of critical factors influencing learner satisfaction in blended learning: A pilot study. *Universal Journal of Educational Research*, 4(7), 1667–1671.
- Cinelli, M., Quattrocioni, W., Galeazzi, A., Valensise, C. M., Brugnoli, E., Schmidt, A. L., et al. (2020). The covid-19 social media infodemic. *Scientific Reports*, 10(1), 1–10.
- Claxton, C. S., & Murrell, P. H. (1987). *Learning Styles: Implications for Improving Educational Practices*. ASHE-ERIC Higher Education Report No. 4, 1987. Association for the Study of Higher Education, 1 Dupont Circle, Suite 630, Washington, DC 20036.
- Cox, M. J. (2013). Formal to informal learning with IT: Research challenges and issues for e-learning. *Journal of Computer Assisted Learning*, 29(1), 85–105.
- D'Antoni, S. (2009). Open educational resources: reviewing initiatives and issues. *Open Learning: The Journal of Open, Distance and e-Learning*, 24(1), 3–10. <https://doi.org/10.1080/02680510802625443>.
- DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research*, 3(1), 60–95.

- Elango, R., Gudep, V. K., & Selvam, M. (2008). Quality of e-learning: An analysis based on e-Learners' perception of e-learning. *Electronic Journal of E-learning*, 6(1), 31–43.
- Gagnon, M. P., Légaré, F., Labrecque, M., Frémont, P., Cauchon, M., & Desmartis, M. (2007). Perceived barriers to completing an e-learning program on evidence-based medicine. *Journal of Innovation in Health Informatics*, 15(2), 83–91.
- Gams, M., Gu, I. Y. H., Härmä, A., Muñoz, A., & Tam, V. (2019). Artificial intelligence and ambient intelligence. *Journal of Ambient Intelligence and Smart Environments*, 11(1), 71–86.
- García Vazquez, A., Verde, J. M., Dal Mas, F., Palermo, M., Cobianchi, L., Marescaux, J., ... & Gimenez, M. E. (2020). Image-Guided Surgical e-Learning in the Post-COVID-19 Pandemic Era: What Is Next?. *Journal of Laparoscopic & Advanced Surgical Techniques*, 30(9), 993–997.
- García-Herrero, A., & Goldhammer, A. (2020). Electricity shortages and industry: Evidence from India. *Europe*.
- Gerald, J. W. A., & Mary, A. J. B. L. (2020). Review on open educational resources-opportunities and challenges. *Journal of Shanghai Jiaotong University*, 16(7), 1079–1087.
- Buddhadeb Ghosh, Marjit, S., & Chiranjib Neogi. (1998). Economic Growth and Regional Divergence in India, 1960 to 1995. *Economic and Political Weekly*, 33(26), 1623–1630. Retrieved June 19, 2021, from <http://www.jstor.org/stable/4406929>.
- Gohiya, P., & Gohiya, A. (2020). E -learning during Covid 19 Pandemic. <https://doi.org/10.21203/rs.3.rs-29575/v1>.
- Gomes, B., & Gomes, R. (2011). Platforms to Support e-Learning in Higher Education Institutions. *2nd International Conference on Education And Management Technology, IPED*. Vol. 13.
- Gupta, S., & Sabitha, A. S. (2019). Deciphering the attributes of student retention in massive open online courses using data mining techniques. *Education and Information Technologies*, 24(3), 1973–1994.
- Hamadi, M., El-Den, J., Narumon Sriratanaviriyakul, C., & Azam, S. (2021). A social media adoption framework as pedagogical instruments in higher education classrooms. *E-Learning and Digital Media*, 18(1), 55–85.
- Hameed, S., Badii, A., & Cullen, A. J. (2008). Effective e-learning integration with traditional learning in a blended learning environment. In *European and Mediterranean Conference on Information Systems* (pp. 25–26).
- Hammouri, Q., & Abu-Shanab, E. (2018). Exploring factors affecting users' satisfaction toward E-learning systems. *International Journal of Information and Communication Technology Education (IJICTE)*, 14(1), 44–57.
- Hargittai, E., & Hinnant, A. (2008). Digital inequality: Differences in young adults' use of the internet. *Communication Research*, 35(5), 602–621.
- Hepler, L. (2014). The reinvention of Neeru Khosla. https://www.bizjournals.com/sanjose/print-edition/2014/03/28/the-reinvention-of-neeru-khosla.html?ana=sm_sjo_ucp27&b=1395941537%5e14150321.
- Hoq, M. Z. (2020). E-learning during the period of pandemic (COVID-19) in the kingdom of Saudi Arabia: An empirical study. *American Journal of Educational Research*, 8(7), 457–464.
- Hrastinski, S. (2008). Asynchronous and synchronous e-learning. *Educause Quarterly*, 31(4), 51–55.
- Hrtoňová, N., Kohout, J., Rohlíková, L., & Zounek, J. (2015). Factors influencing acceptance of e-learning by teachers in the Czech Republic. *Computers in Human Behavior*, 51, 873–879.
- Hylén, J. (2006). Open educational resources: Opportunities and challenges. *Proceedings of open education*, 4963.
- Iwayemi, A., & Adebayo, S. O. (2019). Development of a robust library management system. *International Journal of Computer Applications*, 975, 8887.
- Johnstone, S. M. (2005). Open educational resources serve the world. *Educause Quarterly*, 28(3), 15.
- Kadam, S. A. (2021). Flipped classroom based framework to repurpose online collaboration tool as learning management system for online education. *The Online Journal of Distance Education and e-Learning*, 9(1), 84–91.
- Kanjilal, U., & Kaul, P. (2016). The journey of SWAYAM: India MOOCs initiative. <http://oasis.col.org/handle/11599/2592>.
- Kaveri, A., Gupta, D., Gunasekar, S., & Pratap, M. (2016). Convergence or Divergence: MOOCs and Legacy of Higher Education Outcomes. In *2016 IEEE 4th International Conference on MOOCs, Innovation and Technology in Education (MITE)* (pp. 20–24). IEEE.
- Kelty, C. M. (2008). *Two bits: The cultural significance of free software*. Duke University Press.
- Khan, B. H. (2015). Introduction to e-learning. *International Handbook of e-learning*, 1, 1–40.

- Khanchandani, V., Kumar, M., & Kumar, R. (2015). E-learning Initiatives in India and Libraries. In *International Conference on Grey to Green* (pp. 517–527).
- Khlaisang, J., & Koraneekij, P. (2019). Open online assessment management system platform and instrument to enhance the information, media, and ICT literacy skills of 21st century learners. *International Journal of Emerging Technologies in Learning (iJET)*, 14(07), 111–127.
- Kimiloglu, H., Ozturan, M., & Kutlu, B. (2017). Perceptions about and attitude toward the usage of e-learning in corporate training. *Computers in Human Behavior*, 72, 339–349.
- Kumbhar, R. (2009). Use of e-learning in library and information science education. *DESIDOC Journal of Library & Information Technology*, 29(1), 37.
- Kyriakides, L., Christoforou, C., & Charalambous, C. Y. (2013). What matters for student learning outcomes: A meta-analysis of studies exploring factors of effective teaching. *Teaching and Teacher Education*, 36, 143–152.
- Levy, Y. (2006). Assessing the value of e-learning systems. Information Science Pub.
- Liaw, S. S. (2008). Investigating students' perceived satisfaction, behavioral intention, and effectiveness of e-learning: A case study of the blackboard system. *Computers & Education*, 51(2), 864–873.
- Liu, B., & Zhang, L. (2012). A survey of opinion mining and sentiment analysis. *Mining Text Data*, 415–463. https://doi.org/10.1007/978-1-4614-3223-4_13.
- Loh, C., Wong, D. H., Quazi, A., & Kingshott, R. P. (2016). Re-examining students' perception of e-learning: an Australian perspective. *International Journal of Educational Management*, 30(1), 129–139. <https://doi.org/10.1108/ijem-08-2014-0114>.
- Lykourantzou, I., Giannoukos, I., Nikolopoulos, V., Mpardis, G., & Loumos, V. (2009). Dropout prediction in e-learning courses through the combination of machine learning techniques. *Computers & Education*, 53(3), 950–965.
- McDaniel, S., & Dickens, C. (2004). Faculty variables that influence the effectiveness of online classes. In *Society for Information Technology & Teacher Education International Conference* (pp. 582–587). Association for the Advancement of computing in education (AACE).
- Mohan, A., Sen, P., Shah, C., Jain, E., & Jain, S. (2021). Prevalence and risk factor assessment of digital eye strain among children using online e-learning during the COVID-19 pandemic: Digital eye strain among kids (DESK study-1). *Indian Journal of Ophthalmology*, 69(1), 140.
- Motlik, S. (2008). Mobile learning in developing nations. *The International Review of Research in Open and Distributed Learning*, 9(2). <https://doi.org/10.19173/irrodl.v9i2.564>.
- Mungania, P. (2003). *Seven E-learning barriers facing employees: Executive summary of dissertation*. University of Louisville (Online), 21–25.
- Nayek, J. (2018). A survey report on awareness among LIS professionals/students about SWAYAM: A government of India initiative on E-learning. *Knowledge Librarian. An International Peer Reviewed Bilingual E-Journal of Library and Information Science*, 5(01), 39–45.
- Nedeva, V., & Dimova, E. (2010). Some advantages of e-learning in English language training. *Trakia Journal of Sciences*, 8(3), 21–28.
- Oliver, R. (2002). The role of ICT in higher education for the 21st century: ICT as a change agent for education. Retrieved April, 14, 2007.
- Pal, D., & Vanijja, V. (2020). Perceived usability evaluation of Microsoft teams as an online learning platform during COVID-19 using system usability scale and technology acceptance model in India. *Children and Youth Services Review*, 119, 105535.
- Pandey, A., & Pandey, A. (2018). Youth and Inequality: A Sociological Study of Digital Inequality among Youth in India. *Development*, 2019, 2019b.
- Paul, G., & Stegbauer, C. (2005). Is the digital divide between young and elderly people increasing? *First Monday*, 10(10). <https://doi.org/10.5210/fm.v10i10.1286>.
- Paul, P., Bhumali, A., Kalishankar, T., Aithal, P. S., & Rajesh, R. (2018). SWAYAM: The platform for modern and enhanced online and flexible education-a knowledge survey. *International Journal of Applied Science and Engineering*, 6(2), 149–155.
- Pelekh, Y. (2020). Urgent issues and modern challenges of higher education. *Problems of Education in the 21st Century*, 78(5), 671.
- Piwek, P., & Savage, S. (2020). Challenges with learning to program and problem solve: An analysis of student online discussions. In *Proceedings of the 51st ACM Technical Symposium on Computer Science Education* (pp. 494–499).
- Puri, S. (2018). 5 advantages of E-learning. Posted on November 16, 2018. . <https://trainingindustry.com/articles/e-learning/5-advantages-of-E-Learning/>.

- Quinn, C. N. (2011). *Designing mLearning: Tapping into the mobile revolution for organizational performance*. Wiley.
- Radha, R., Mahalakshmi, K., Kumar, V. S., & Saravanakumar, A. R. (2020). E-learning during lockdown of Covid-19 pandemic: A global perspective. *International journal of control and automation*, 13(4), 1088–1099.
- Rambli, D. R. A., Matcha, W., & Sulaiman, S. (2013). Fun learning with AR alphabet book for preschool children. *Procedia computer science*, 25, 211–219.
- Riffe, D., Lacy, S., Fico, F., & Watson, B. (2019). *Analyzing media messages: Using quantitative content analysis in research*. Routledge.
- Ristic, S., & Stefanovic, D. (2020). Factors Influencing Students Usage of an e-Learning System: Evidence from IT Students. In *Proceedings on 25th International Joint Conference on Industrial Engineering and Operations Management–IJCIEM: The Next Generation of Production and Service Systems* (p. 205). Springer Nature.
- Saini, M., Verma, R., Singh, A., & Chahal, K. K. (2020). Investigating diversity and impact of the popularity metrics for ranking software packages. *Journal of Software: Evolution and Process*, 32(9), e2265.
- Salkind, N. J. (2010). Encyclopedia of research design. *Encyclopedia of Research Design*. <https://doi.org/10.4135/9781412961288.n100>.
- Salloum, S. A., Al-Emran, M., Habes, M., Alghizzawi, M., Ghani, M. A., & Shaalan, K. (2019). Understanding the impact of social media practices on e-learning systems acceptance. In *International Conference on Advanced Intelligent Systems and Informatics* (pp. 360–369). Springer.
- Setiawan, R., Budiharto, W., Kartowisastro, I. H., & Prabowo, H. (2020). Finding model through latent semantic approach to reveal the topic of discussion in discussion forum. *Education and Information Technologies*, 25(1), 31–50.
- Shahabadi, M. M., & Uplane, M. (2015). Synchronous and asynchronous e-learning styles and academic performance of e-learners. *Procedia-Social and Behavioral Sciences*, 176(20), 129–138.
- Shahzad, A., Hassan, R., Aremu, A. Y., et al. (2021) Effects of COVID-19 in E-learning on higher education institution students: the group comparison between male and female. *Qual Quant* 55, 805–826. <https://doi.org/10.1007/s11135-020-01028-z>.
- Shereen, M. A., Khan, S., Kazmi, A., Bashir, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *Journal of Advanced Research*, 24, 91–98.
- Smaili, E. M., Sraidi, S., Azzouzi, S., & Charaf, M. E. (2021). Towards sustainable e-Learning systems using an adaptive learning approach. *Emerging Trends in ICT for Sustainable Development*, 365–372. https://doi.org/10.1007/978-3-030-53440-0_38.
- Sood, S., & Saini, M. (2021). Hybridization of cluster-based LDA and ANN for student performance prediction and comments evaluation. *Education and Information Technologies*, 26(3), 2863–2878.
- Stickney, L. T., Bento, R. F., Aggarwal, A., & Adlakha, V. (2019). Online higher education: Faculty satisfaction and its antecedents. *Journal of Management Education*, 43(5), 509–542.
- Subedi, S., Nayaju, S., Subedi, S., Shah, S. K., & Shah, J. M. (2020). Impact of E-learning during COVID-19 pandemic among nursing students and teachers of Nepal. *International Journal of Science & Healthcare Research*, 5(3), 68–76.
- Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education*, 50(4), 1183–1202.
- Talebian, S., Mohammadi, H. M., & Rezvanfar, A. (2014). Information and communication technology (ICT) in higher education: Advantages, disadvantages, conveniences and limitations of applying e-learning to agricultural students in Iran. *Procedia-Social and Behavioral Sciences*, 152, 300–305.
- Toth, L. S., & Montagna, L. G. (2002). Class size and achievement in higher education: A summary of current research. *College Student Journal*, 36(2), 253–261.
- Uju, E. F., & Olofu, P. A. (2020). *Sustaining learning activities in tertiary institutions in Nigeria amidst COVID-19 pandemic lockdown: The Perspective of E-Learning Strategy*. <https://benchmarkjournal.com/wp-content/uploads/2020/10/2-1>.
- UNESCO. (2002). Forum on the impact of open courseware for higher education in developing countries: Final report.
- Verawardina, U., Asnur, L., Lubis, A. L., Hendriyani, Y., Ramadhani, D., Dewi, I. P., Darni, R., Betri, T., Susanti, W., & Sriwahyuni, T. (2020). Reviewing online learning facing the Covid-19 outbreak. *Talent Development & Excellence*, 12. <https://www.iratde.com/index.php/jtde/article/view/281>.

- Williams, A. (2003). How to... write and analyse a questionnaire. *Journal of Orthodontics*, 30(3), 245–252.
- Wook, M., Razali, N., Ramli, S., Wahab, N., Hasbullah, N., Zainudin, N., & Talib, M. (2019). Opinion mining technique for developing student feedback analysis system using lexicon-based approach (OMFeedback). *Education Information Technologies*, 25, 2549–2560.
- Wright, K. B. (2005). Researching internet-based populations: Advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of Computer-Mediated Communication*, 10(3), JCMC1034.
- Yom, Y. H. (2004). Integration of internet-based learning and traditional face-to-face learning in an RN-BSN course in Korea. *CIN: Computers, Informatics, Nursing*, 22(3), 145–152.
- Zhang, T., Wu, Q., & Zhang, Z. (2020). Probable pangolin origin of 2019-nCoV associated with outbreak of COVID-19. *CURRENT-BIOLOGY-D-20-00299*.

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Authors and Affiliations

Madanjit Singh¹  · Sulaimon Oyeniyi Adebayo² · Munish Saini² · Jaswinder Singh¹

¹ Department of Computer Science, Guru Nanak Dev University, Amritsar, India

² Department of Computer Engineering and Technology, Guru Nanak Dev University, Amritsar, India