

Infrastructure-Technology, Socio-Economical Issues and Challenges in ICT-based Education and Digital Education with Possible Solutions-*A Scientific Observation*

P.K. Paul¹, P.S. Aithal², Sushil K. Sharma³ and Ricardo Saavedra⁴

¹Executive Director (MCIS), Asst. Prof., Department of CIS, Information Scientist (Offg.), Raiganj University, India

²Vice Chancellor, Srinivas University, Karnataka, India

³Associate Provost, Texas A&M University Texarkana, USA

⁴Director & Chair, International Programs, Azteca University, México, America

Corresponding author: pkpaul.infotech@gmail.com

ABSTRACT

Digital Education is an important emerging educational way these days powered by different technologies of Computing or Information Technology. Digital Education is helpful in designing and developing sophisticated educational practices including instructional practice and is considered effective not only in the traditional or face-to-face modes of education but also in other modes of education viz. Online learning, electronic learning, digital learning, and all these treated as a sub-field of Digital Education. In general, Adaptive and Intelligent learning, Learning analytics & Delivery, Learning objects and Contents, and Open educational resources are considered as important in better and more intelligent Digital Education practice. Different educational models viz. Blended learning, Classroom-based teaching including E-textbooks, E-Contents, Technology-enhanced learning, M-Learning, Personalized Learning, and Real-time (Online) Education become benefited from the utilization of Digital Education. It is worthnoting that different tools and strategies are being used in Digital Education and offer a lot of benefits and advantages but it has various issues and challenges, particularly in a country like India. This work illustrates the basics of Digital Education including its features, functions, and nature with special reference to the issues and challenges of Digital Education ingeneral, and in contrast to India.

Keywords: Digital Education, Education Technology, E-Learning, Online Education, Digital Divide, Indian Education

Introduction

Digital Education in generally considered as a technology required for proper educational practices and effective teaching-learning practice. Subfields of Information Technology like Communication Technology, Database Technology, Networking Technology, Multimedia Technology, and Software Technology are important in proper Digital Education System designing and development^{[1][29][39]}. Some of the allied nomenclature viz. Digital Learning, Online Education, and ICT in Education

are also simultaneously being used in place of Digital Education. Digital Education is not only useful in the teaching-learning process i.e., classes but also in examinations, educational operations, and administration. The most common form of Digital Education may be the following—

- ☛ Adaptive learning,
- ☛ Electronic textbooks,
- ☛ Learning and contents,
- ☛ Objects and analytics,
- ☛ Open and free educational content& resources,
- ☛ Content and streaming content,
- ☛ Teaching and learning enabled with technology, etc.

Previously Digital Education was only considered as a field of practice later as a research area and very recently as a field of study with various educational programs at Bachelors, Masters, and Doctoral levels. *E-Learning* or Educational technology is also treated as a branch of study. Digital Education is focused on educational approaches including proper and healthy knowledge transfers. Moreover, proper development including exchange among the learners and teachers becomes possible with Digital Education practice. Digital Education approaches are effective in a variety of educational processes (as depicted in Fig: 1) and traditional on-campus education including corporate education which are deployed in companies, and organizations known as 'Job based or On Job Training'. This is also effective in proper and healthy Continuing Learning and Education, Skills development, etc., and especially regarding blended learning^{[5][6]}. As Digital Education is technology dependent therefore it seeks various infrastructure-related support and requirements. It also needs proper manpower to design, develop and manage the infrastructure and proper contents which are useful, easy, and effective. Users of Digital Education also should be Digitally educated and with basic Computing and Technology skills. Implementing Digital Education is difficult enough without proper funding and financial support. Further, Digital Education needs societal and educational institutions adjustment^{[7][18]}. It is a fact that Digital Education is not only about getting education or teaching in online mode, rather it is the applications of Digital Technologies and Systems in Education, Research, and Educational Administration.

Objective

This work titled 'Infrastructure-Technology, Socio-Economical Issues and Challenges in ICT based Education and Digital Education with Possible Solutions-*A Scientific Observation*' is a theoretical work outlined with the following core aim and objective—

- ☛ To learn about the basics of Digital Education including features, natures, and characteristics.

- ☛ To know about the foundation, and stakeholders of Digital Education including other available nomenclature.
- ☛ To find out the basic issues of Digital Education with a strong focus on technological and computational infrastructure.
- ☛ To learn, analyze and report on Digital Education issues, particularly on social, emotional, and educational aspects.
- ☛ To gather and observe the issues related to economics, and psychology in respect of Digital Education.
- ☛ To propose some of the solutions in respect of issues on Digital Education in an Indian context.

Method

This work i.e., ‘Infrastructure-Technology, Socio-Economical Issues and Challenges in ICT based Education and Digital Education with Possible Solutions-*A Scientific Observation*’ is completely theoretical in nature, and interdisciplinary. This scientific work has been prepared based on analyzing existing resources on Digital Education i.e., papers published in the Journals, Books, Edited Volume, Proceedings. Further thesis, dissertation related to Digital Education and allied topics viz. Online Education, E-Learning, and Educational Technology have also been analyzed and reported for the preparation of this work.

ICT, Education and Digital Education, and Educational Technology: Foundation and Trends

Information and Communication Technology is the broader version of Information Technology in which Communication Technology or Networking plays an important role in sharing, developing, and interacting using the internet, advanced and wireless networks, software, middle-ware and video-conferencing, social networking, etc. This is popularly known as ICT dedicated in accessing, retrieving, storing, transferring, and manipulating data and information in electronic form^{[10][17]}. ICT uses various media technologies, convergence tools, and advanced networks for information transformation and sharing. It is important to note that there is no universally accepted definition of ICT. However, it may be considered as a field of practice and a field of study ‘both’ as many universities worldwide offer ICT as educational programs and degrees. Another word, ‘**Education**’ denotes the act or process which is required for the purpose of getting basic knowledge or enhancing a skill set or power of reasoning including judgment. It is also helpful in preparing oneself for an intellectual and mature life. In other words, Education is *the action or simply it is the process of educating or simply it is being educated*.

Another word ‘**Educational technology**’ is an integration of Education and Information Technology. It is treated as a field of study as well as ethical practice for facilitating learning as well as improving performance. Education Technology is being used for the purpose of creation, uses as well as managing technological systems for educational

products, tools, and systems. In other words, educational technology is a kind of systematic application in the process of teaching, learning, research, and instructions, as well as tracking the performance of the students. Digital Education integrates all these concepts, and thoughts for its realization^{[3],[13],[30]}.

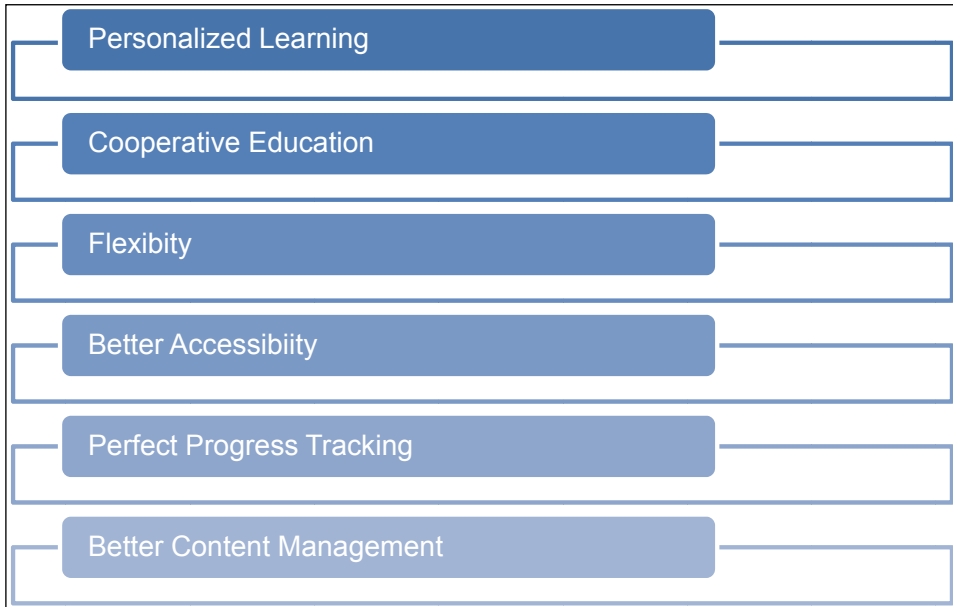


Fig. 1: Some of the important benefits of Digital Education

There are a number of technologies being used in Education Technology for Digital Education practice, but basic and broad technologies are as follows—

- ☛ Software Technologies.
- ☛ Networking Technologies.
- ☛ Web Technologies.
- ☛ Database Technologies.
- ☛ Multimedia Technologies.
- ☛ Security Technologies, etc.

And as far as the latest or sub-fields are concerned, some of the latest are depicted as follows in the context of Education or Digital Education.

Augmented Reality and **Simulation** is one of the emerging technologies within Computing and Information Technology dedicated to the betterment of educational practices. This is helpful in creating a virtual environment and is responsible for developing the imagination in a realistic manner. Further Augmented Reality is dedicated to improving the learning process. In Online Education, a blended mode of education and a real understanding of difficult theories Augmented Reality is playing

an important role^{[11],[12],[40]}. **Adaptive Learning** is another important technology and works upon the needs and behavior of the students. Identification of students interests and their perceptions are considered as important in Adopting Learning. Here proper computer algorithms are considered to be important in interacting with the learner similar to artificial intelligence. This system is offered customized resources and also healthy learning activities for effective teaching operations as well^{[2][8]}.

Artificial Intelligence and **Machine Learning** is one of the important and alarming technologies dedicated to automation and making systems, organizations, and procedures with intelligent systems. AI and allied fields are dedicated to modern, advanced educational systems for on-campus educational systems and also for the promotion of digital and online education. It helps in the identification, and sharing of the right contents and is sharable to the right person.

5th Generation Network or 5G is dedicated to advancing communication of various contents, information, and other messages. It offers higher speed with a low amount of latency therefore campus-based education, and at the same time online education becomes easy which purely depends on quality network and communication systems. In automatic content sharing, faster and higher amount of video delivery become easy with 5G. The scheduled lecture also depends on 5th Generation Networks.

Learning Analytics is another way of communication and effective Information Technology sub-components dedicated in managing good amount of records and resources. It is being used for the efficient tracking and analyzing of the students interest and behaviors. In tracking and keeping learning rates, analyzing learning environment also Learning Analytics is impactful and required.

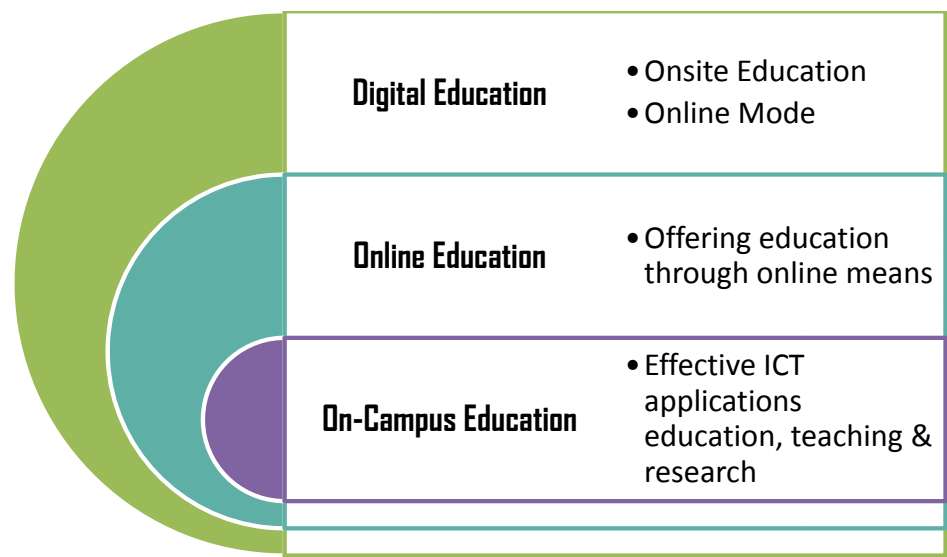


Fig. 2: Two core composition of Digital Education

Issues, Challenges, and Concern in Indian Context

Digital Education is about the technological applications, implications in the field of education including general teaching-learning, research and educational operation and administration. There is a misconception about Digital Education that it is synonym of the Online Education. However, it is broader and not only restricted in Online Education, rather it is about ICT applications in Education, E-Learning, Corporate Education, and so on. The integration of ICT is not new, after the development of the ICT and Computing the Education Sector became technology-centric^{[9],[19],[31]}. COVID-19 has drastically changed the entire educational system including traditional On-Campus education. Many people during the lockdown have been *accustomed to Online Education and even post-COVID-19 also many people are habituated to Online Educational Systems. Today people are using simultaneous educational mode based on requirements or depending upon the situation, place, and other important concerns. Many EdTech (Educational Technology) companies have started their services of their own or assisting traditional institutions for the delivery of knowledge and better educational operations. People are in favour of 'Online Education' and at the same time against or not preferable status as well. Many surveys show that people have negative experiences on Online Education and they always prefer Face-to-Face Education rather than online. It is also to be noted that 'Digital Education' not mean Online Education, it is the applications of ICT in Education and including Online Education. Therefore, many issues are there regarding Digital Education and some of them are as follows^{[14],[28],[41]}. The following are some of the issues and concerns in regard to Digital Education (also refer Fig. 3).*

Technological & Computing Issues and Concerns

Lack of Proper Electrification

Digital Education needs electrics as all the devices viz. computers, laptops, servers, or even mobile or smartphones run with the power supply. Electrification in India is still far away, as many rural areas and remote villages are not yet under the benefit of electrification or power system. In Digital Education project proper electrification is required by both sides, i.e., education providers i.e., educational institutions, and at the same time knowledge seekers including students, learners, or users. The government of India and State specific Governments, Ministries, and various organizations are doing their best for hundred percent electrification and when such work will over there will be no question on Digital Education implementation and development^{[15],[21]}. Therefore, though there is no such big issue in conventional or traditional education but in the promotion of Digital Education electrification is a major issue.

Infrastructural Problems

In traditional educational systems infrastructure is a big matter and their physical infrastructure is important including buildings, rooms, seminar rooms, labs, libraries, archives, experimental labs, conference hall, etc. Thus, it needs time, money, and other kind of investment. But Digital Education depends on Digital tools, techniques, and

technologies. Therefore, from the root level planning it requires investment in advanced internet with proper speed and broadband, servers and digital setups, lot of computers and other peripherals and in many situations, such infrastructure development and building become difficult or treated as an important issue^{[4],[16],[29]}. Further from the user's perspective also it need investment in digital tools, technologies, and devices to use Digital Education including online education. If it uses of ICT in Education in a traditional setting even such a context also requires technologies and devices. Developed countries like USA, Germany, Japan, and France are already matured in different contexts but in India and other developing countries Infrastructure development and management are no doubt an important issue.

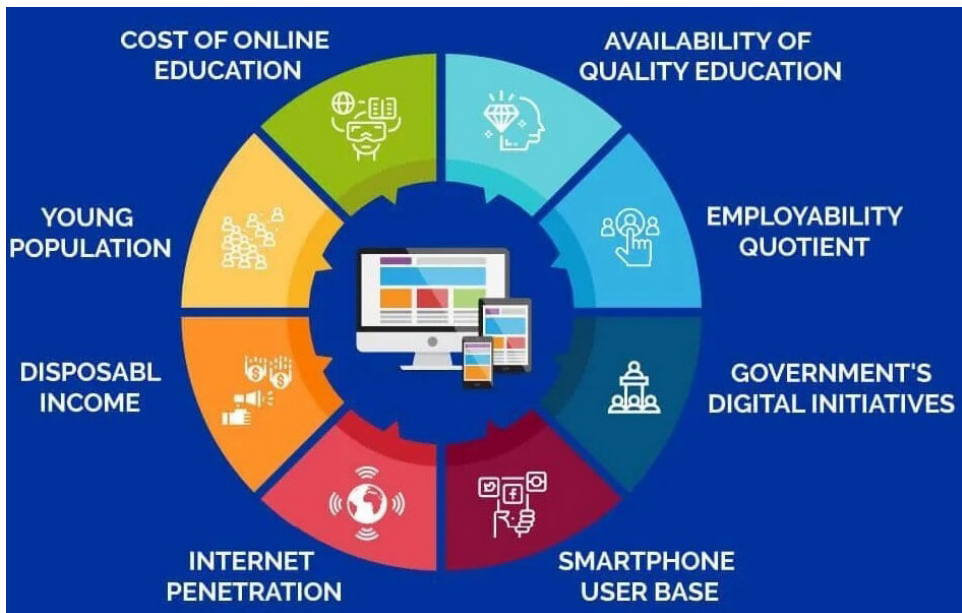


Fig. 3: Some of the issues in Digital Education specially for Online Education

Digital Literacy and Technical Issues

Digital Education is digitally equipped and it needs technologies, devices, systems, and other accessories for proper and real implementation. Further knowledge of different technologies is required from the end of educators-teachers, educational administrators & planners, and off-course students. Everyone of each stakeholder needs literacy on Hardware, Software, Network related literacy at least for its operation and move. Online skill sets, operational knowledge and technical skill sets are important in Digital Education development. In a purely online or face-to-face mode where ICT uses are there, both corners need Digital literacy.

Internet & Technological Issues

Digital Education, if the sided on online or blended mode then obviously it depends on the Internet. Proper Digital Education needs not only the Internet rather it seeks Internet

services with higher bandwidth, speed, and security. Uninterrupted services are also important for smooth online education, blended education, and better technological system development in traditional educational systems^{[10],[18],[20]}. Many areas in India are not under the coverage of the Internet and in many areas, mobile data is the only way for the Internet. And live-streaming classes, conferences, workshops, and hands-on training (online) are difficult in such cases without proper and required internet services. The development of the Internet in the school or educational institutions is not enough it requires all-round development of proper Internet system installation and services from all corners.

Technological changes

Digital Education fully depends on technologies, tools, and various electronic platforms, and as far as need is concerned such technologies and platforms are always changeable depending upon the requirement. The changes in software including various updates, and modified versions are always an issue in Digital Education. E-Learning platforms, web-based platforms are important in many contexts. Thus, institutions and also students engaged in Digital Education (both physical and online) need a look at such changes and need to be updated based on the requirement.

Lack of EdTech Organizations, and Special Students Demand

Different Educational Technology companies are highly required and important in developing and continuing Digital Education. Such companies are basically responsible and dedicated in designing, developing, and maintaining Digital Education Systems for each institution or client based on need or deal, or agreement. It is also important to note that Digital Education development also depends on the availability of proper, dependable service providers. And in a country like India, this is an issue, as there are limited EduTechfirms to develop and run the system. One more issue is the availability of specialized Digital Education service providers for special students or physically challenged students.

Educational Methodologies, Social & Psychological Issues, and Concerns

Like Infrastructure and Technology-related issues as discussed and observed above, herewith issues related to Social and Educational concerns are mentioned.

Lack of Motivation in Students

For teaching a student lot of teaching methodologies are available and teachers and educators are always engaged to offer knowledge using such methodology. Online learning, which is an important part of Digital Education is highly sensitive in regard to design and developing newer methods of teaching. But still, it is difficult to manage or motivate students upon requirements. General teaching, Question & Answer Session, Quizzes, and Learning Assignments are needed to arrange for better Digital Education practice. But still, the concern of lack of motivation is a crucial issue^{[26],[36]}. As physical interaction is always offering a greater amount of collaboration and understanding,

therefore managing proper communication, and interaction is a challenge in Digital Education especially in Online Mode.

Lack of In-person Interaction

Psychological level is an important issue in Online Education. Many students are not properly interacting with Online Education. In the physical/ traditional mode of education, proper and effective communication are always possible. But in Online Mode there are gap in proper communication as many learners are not interested to ask questions to the teachers. And there are ways to interact but still such ways are not being used so much. Therefore, in Online Education such barriers and communication gaps are considered as worthy and impactful. Interaction with the teacher teams, friends/peers, and educational staff is always important in better educational processes and development. The behavior and attitude can be easily identified in in-person mode, whereas finding analyzing behavior and attitude is difficult in the Online mode of education^{[14],[25]}. In physical mode, there is no question of the camera being off mode, but in online this is a reality and thus it increases the lack of in-person interaction.

Course Structure and Quality

Digital Education is differing case to a case basis. If it is In-Person then Course Structure and Quality issue is different, and if it is Online then it differs. In online mode designing course content is always important as it is rather ‘face of the educators’ focused on content and accessories. Therefore, while preparing courses such aspects must need to follow-up. There are companies and institutions that offer online or other Digital programs viz. Blended Programs and here the concern of proper course structure, module, credit, and timing must be looked into in order to offer the knowledge effectively. There are free platforms like Youtube, Facebook but especially education providers always need to focus on such facets.

Lack of Accredited Programs and Degrees

Digital Education is today very emerging in both ‘in-support’ of Face-to-Face Education, and also in Online Education. Many universities and Higher Educational institutions are offering educational programs and degrees which are not accredited properly and not-recognized. Therefore, such degrees are invalid in job market and also in other institutions. And such situation is damaging reputation of Online Education is some context. Educational service providers, accreditation bodies, and Government all such stakeholder joint initiatives are highly important and required.

Abundant Distractions, Lack of Discipline

Due to the issues of the technology, tools, network, and proper internet issues not only students but also teachers are sometimes feeling bored in Online platforms. Lack of class interaction, and discussion, therefore, creates loneliness, and mentally unfit in many contexts.

Resistance to change

As Digital Education fully depends on Technologies, Computing, Devices, and platforms therefore each and every stakeholder of Digital Education needs proper attention in upgrading skill sets and tasks to do again and again. And in the teaching community, many persons including teachers are not interested to change themselves^{[12],[34]}.

Lack of interest and fear from the end of parents

As far as India is concerned, Digital Education comes with an issue called a Lack of Interest or fear from the end of Parents. As many Indians are not enough knowledgeable in mobile phone or smartphone operation, therefore, they are not feeling comfortable in sharing the devices with their children due to misuse of the phones for other purposes, and this becomes a reality and a true fact in many senses. Many parents are always in fear regarding the use of non-preferred content from mobile and thus led a lack of interest in online or digital education in some contexts.

Experienced teachers and online classrooms

As far as the experience of the teachers is concerned in the case of Digital Education two important issues have been observed, and among these first one is Enhancing ICT in Education for On-Campus and traditional classroom teaching-learning process. For many teachers who are aged is convenient to traditional chalk-board or whiteboard way of teaching-learning. Whereas in other content many teachers are not interested in offering teaching if it is an online mode of study^{[10],[27]}. Therefore, in some cases even if there is availability of qualified and skilled teachers but offering true quality education becomes difficult. Therefore, proper mindset changes and rigorous training to teach the students are highly appreciated.

Lack of observation in online education

In a country like India, many parents are first-generation users of education and they may not be familiar with the proper uses of mobile phones or smartphones. Therefore, students during class or during the time of home tasks may be engaged in playing, watching videos, opening different apps, and other unnecessary content which is completely unknown or far away from the parents. Moreover, long-term uses of smartphones for online classes or watching recorded (offline) videos are responsible for the creation of eye-related problems and sometimes serious psychological disorders.

Unfriendly atmosphere at homes

In most cases in a country like India particularly in remote or rural India many families are not having multiple number of rooms in their homes. Therefore, the ambiance at home is not at par with the requirement for study or teaching-learning purposes. Another issue is the place required for a computer or study desk etc. and therefore in Digital Education particularly in Online Education this can be considered as important issue.

Evaluation, and Economical Issues and Concerns

Digital Education is a new form of education and at the same time, it is a new way of advancing traditional education. It has many opportunities which have been discussed in the earlier section. But the issues and challenges are crucial as discussed in some of the contexts here above^{[12],[23]}. Regarding evaluation, and economic aspects Digital Education has many challenges and issues and some of them are mentioned below.

Issues on Exam Management

There are different concerns on Examination related aspects of Digital Education particularly for the Online form. There are alarming aspects of cheating and duplicating in online mode. Though it is worth it that, educational providers and educational institutions are taking newer initiatives and plans for a neat and clear examination process. Some of the new approaches are—

- ☛ Sharing of the screen.
- ☛ Use of the Hi-tech devices
- ☛ Use of the microphones
- ☛ Use of Audio questions, etc.

Many institutions are using multiple-choice questions, use of audio questions, and use of mathematical and chemical questions in order to reduce issues related to the exam-related issues but for many institutions conducting the examination with such models is really difficult^{[6],[37]}.

Fund for Technologies

As far as financial aspects are concerned Digital Education has many issues including designing, developing, and managing digital systems, devices, and infrastructure. Most of the technologies are costly and organizations need such investment during the primary stage, and also continuously for the purpose of running Online Education, ICT in Traditional Mode of Education. Moreover, funds are also required for the purpose of purchasing technologies, applications and updating newer versions, etc.

Fund for Tools for the Students

Along with organizations in many cases, students also need to purchase digital tools and devices in order to get education, skills, and training. Sometimes they also need to get rented technologies. For the students of developing countries therefore such technologies are become crucial in many contexts.

Possible Solutions and Requirements

This section depicts different suggestions in respect of issues mentioned in respect of proper Digital Education implementation.

In Managing a Lack of Motivation

In regard to motivating the students some of the possible steps may be offering a certificate of appreciation to the students who are actively engaged in the class or session. Further for motivating students, it is possible to divide long classes into small sessions depending upon area and topics or sub-topics, organize quizzes, and hold polls whenever required. Organizing discussion forums, and interactive sessions including video animations for motivating students/ learners and users can also be a good way to manage the lack of motivation. Case-to-case basis discussion can be a good decision and alternative in regard to motivating students.

In Managing the lack of Infrastructure related concern

As there are issues with the infrastructure therefore possible solutions may be establishing and offering digital infrastructure for students, poor candidates, and needy students. Further private organizations and educational institutions may reduce the program fees or offer scholarships to interested candidates for their encouragement. NGOs may offer infrastructure including public computers or device facilities to their establishments and in local community centres. Educational institutions and local authorities may establish and offer devices in order to enhance the infrastructure-related issue.

In Digital Literacy Related Problem

Digital Education as depends on technological support therefore it depends on various technologies, and all such technologies need proper literacy from the teachers, staff, and students. For solving Digital Literacy related matters technical support may be provided by the concerned educational institutes or EduTech companies. Training programs (onsite and online), tutorials, and sessions may be organized by educational institutions. Schools and universities may also offer online learning platforms depending upon need. Senior students or skilled students can be part of the Digital Literacy drive in order to solve the Digital Literacy drive.

Solving Education Technology related Problems

Digital Education is online then tools and platforms need to be prepared according to the requirement of the students. And here it is better to prepare customized learning plans, and preparation of the content as per the need, abilities, and disabilities of the students, and depending upon the need voice recognition may be used. A variety of applications can be used to solve education technology related problems. Training to the teachers may be offered by the EdTech companies based on students need and demand^{[11],[36]}.

Solving and Suggestion on Lack of Disciplines

Problems like lack of discipline, and lack of collaborative learning are possible to manage using breakout rooms, and whiteboards, for better communication video projects, and online polls management is also better move in proper communication.

It is also important to ensure by the teachers and parents during the classes that the electronic devices are not being used for other purposes. Offering incentives, rewards and awards may be helpful in timely attending classes, active participation, more attendance, etc.

Solving Accreditation Related Problems

In Digital Education trust is very important and many courses and programs are non-accreditation based. Therefore Government, other agencies, bodies, and institutions need to establish proper planning, and policies in regard to accreditation of the courses, programs, and platforms. Proper designing of the courses is required for a better educational experience.

Solving Lack of In-Person Experience and Interaction

Problem related to the lack of interaction in ICT based environment (in-person) may be solved by organizing proper training programs, workshops, seminars, etc. Regarding virtual classes, the big classroom may be managed and split into smaller groups. Interactive exercises and projects may be organized for better experience development^{[12],[35]}. If there is sufficient infrastructure, then a virtual reality related mechanism may be developed.

Entertaining Course Structure, Educational Module, and Hands-on training

It is very essential to create and offer courses that are very much interactive practical and hands-on based. More knowledge of practical skills may be offered in order to establish sophisticated and advanced educational modules. More flexible course structure development is also important in order to offer an advanced learning process^{[4],[38]}. Quality content is essential to ensure an interactive educational process including audio-video content whenever required.

Concluding Remarks

Digital Education is the combination and utilization of different Information Technology tools, techniques, and systems for educational and teaching-learning matters. Technology is advancing throughout and as far as Computing and ICT is concerned it has an impact on the Ongoing in-person educational process. Today not only in Developed countries but also in developing countries the concept and emergence of Digital Education is noticeable. The issues related to the technologies, and applications are really an important concern including financial and economic aspects. There are many opportunities that exist in Digital Education; both for the on-campus and online systems, and overcoming some issues can render a healthy and advanced Educational System. India has a lot of educational institutions of different categories and all these institutions are doing their best in offering ICT-enabled educational services including teaching-learning, educational management and administration, research and innovation, etc., and proving remedies to the existing challenges may bring sophisticated and advanced education systems.

References

- [1] Bax, S. 2011. Digital education: Beyond the “wow” factor. *Digital education: Opportunities for Social Collaboration*, pp. 239-256.
- [2] Blikstein, P. 2013. Digital fabrication and ‘making’ in education: The democratization of invention.” *FabLabs: of Machines, Makers and Inventors*, **4**(1): 1-21.
- [3] Buchanan, R. 2011. Paradox, Promise and Public Pedagogy: Implications of the Federal Government’s Digital Education Revolution. *Australian Journal of Teacher Education*, **36**(2): 67-78.
- [4] Decuypere, M., Grimaldi, E. and Landri, P. 2021. Introduction: Critical studies of digital education platforms. *Critical Studies in Education*, **62**(1): 1-16.
- [5] Dillenbourg, P. 2016. The evolution of research on digital education. *International Journal of Artificial Intelligence in Education*, **26**: 544-560.
- [6] Dillenbourg, P. 2016. The evolution of research on digital education. *International Journal of Artificial Intelligence in Education*, **26**(2): 544-560.
- [7] Dunleavy, G. Nikolaou, C.K., Nifakos, S., Atun, R., Law, G.C.Y. and Car, L.T. 2019. Mobile digital education for health professions: systematic review and meta-analysis by the Digital Health Education Collaboration. *Journal of Medical Internet Research*, **21**(2): 1-17.
- [8] Edwards, R. 2015. Software and the hidden curriculum in digital education. *Pedagogy, Culture & Society*, **23**(2): 265-279.
- [9] Edwards, R. 2015. Software and the hidden curriculum in digital education”. *Pedagogy, Culture & Society*, **23**(2): 265-279.
- [10] Elboubekri, A. 2017. The intercultural communicative competence and digital education: The case of Moroccan University students of English in Oujda. *Journal of Educational Technology Systems*, **45**(4): 520-545.
- [11] Gibson, D., Ostashewski, N., Flintoff, K., Grant, S. and Knight, E. 2015. Digital badges in education”. *Education and Information Technologies*, **20**(2): 403-410.
- [12] Gond, R. and Gupta, R. 2017. A study on digital education in India: scope and challenges of an indian society. *Anveshana’s International Journal of Research in Regional Studies, Law. Soc. Sc. J. Manag. Prac.*, **2**(3): 12-18.
- [13] Halili, S.H. 2019. Technological advancements in education 4.0. *The Online Journal of Distance Education and e-Learning*, **7**(1): 63-69.
- [14] Hanna, D.E. 1998. Higher education in an era of digital competition: Emerging organizational models”. *Journal of Asynchronous Learning Networks*, **2**(1): 66-95
- [15] Heller, L., Parker, P. A., Youssef, A. and Miller, M.J. 2008. Interactive digital education aid in breast reconstruction”. *Plastic and Reconstructive Surgery*, **122**(3): (2008): 717-724.
- [16] Hiltz, S.R. and Turoff, M. 2005. Education goes digital: The evolution of online learning and the revolution in higher education. *Communications of the ACM*, **48**(10): 59-64.
- [17] Huang, Z. *et al.* 2019. Digital health professions education on diabetes management: systematic review by the Digital Health Education Collaboration. *Journal of Medical Internet Research*, **21**(2).
- [18] Hussin, A.A. 2018. Education 4.0 made simple: Ideas for teaching. *International Journal of Education and Literacy Studies*, **6**(3): 92-98.
- [19] Jindal, A. and Chahal, B.P.S. 2018. Challenges and opportunities for online education in India. *Pramana Research Journal*, **8**(4): 99-106.

- [20] Keser, H. and Semerci, A. 2019. Technology trends, Education 4.0 and beyond. *Contemporary Educational Researches Journal*, **9**(3): 39-49.
- [21] Knox, J. 2016. Post-humanism and the MOOC: opening the subject of digital education. *Studies in Philosophy and Education*, **35**(3): 305-320.
- [22] Miranda, J. *et al.* 2021. The core components of education 4.0 in higher education: Three case studies in engineering education. *Computers & Electrical Engineering*, **93**: 107278.
- [23] Narciss, S. 2013. Designing and evaluating tutoring feedback strategies for digital learning. *Digital Education Review*, **23**(2): 7-26.
- [24] Nimavat, N., Singh, S., Fichadiya, N., Sharma, P., Patel, N., Kumar, M. ... and Pandit, N. 2021. Online medical education in India—different challenges and probable solutions in the age of COVID-19. *Advances in Medical Education and Practice*, pp. 237-243.
- [25] Norman, G. 2014. Research challenges in digital education. *Perspectives on Medical Education*, **3**: 260-265.
- [26] Ozga, J. 2016. Trust in numbers? Digital education governance and the inspection process. *European Educational Research Journal*, **15**(1): 69-81.
- [27] Paio, A., Eloy, S., Rato, V.M., Resende, R. and de Oliveira, M.J. 2012. Prototyping vitruvius, new challenges: Digital education, research and practice. *Nexus Network Journal*, **14**: 409-429.
- [28] Palvia, S., Aeron, P., Gupta, P., Mahapatra, D., Parida, R., Rosner, R. and Sindhi, S. 2018. Online education: Worldwide status, challenges, trends, and implications. *Journal of Global Information Technology Management*, **21**(4): 233-241.
- [29] Paul, P.K., Sridevi, K.V., Ghosh, M. and Lama, A. 2012. Education Technology: The Transparent Knowledge Delivery through QPN and Cloud Computing. *IJSD-An International Journal*, **12**(2): 455-462
- [30] Paul, P.K. *et al.* 2014. Education Technology: Emphasizing EduNxt Knowledge Transformation Systems of Sikkim Manipal University (SMU), Gangtok, Sikkim, India. *International Journal of Embedded Systems and Computer Engineering*, **4**(2): 109-113.
- [31] Paul, P.K., Bhuimali, A., Kalishankar, T., Aithal, P.S. and Rajesh, R. 2018. Digital Education and Learning: The Growing Trend in Academic and Business Spaces—An International Overview”. *International Journal on Recent Researches in Science, Engineering & Technology*, **6**(5): 11-18.
- [32] Paul, P.K., Dangwal, K.L. and Garg, A.K. 2012. Education Technology and Sophisticated Knowledge Delivery. *Techno-Learn-International Journal of Education Technology*, **2**(2): 169-175.
- [33] Pegu, U.K. 2014. Information and communication technology in higher education in India: Challenges and opportunities. *International Journal of Information and Computation Technology*, **4**(5): 513-518.
- [34] Qureshi, M.I., Khan, N., Raza, H., Imran, A. and Ismail, F. 2021. Digital Technologies in Education 4.0. Does it Enhance the Effectiveness of Learning? A Systematic Literature Review. *International Journal of Interactive Mobile Technologies*, **15**(4): 31-46.
- [35] Reeves, T.C. 2003. Storms clouds on the digital education horizon. *Journal of Computing in Higher Education*, **15**(1): 3-12.
- [36] Robin, B.R. and McNeil, S.G. 2012. What educators should know about teaching digital storytelling”. *Digital Education Review*, **22**: 37-51
- [37] Salmon, G. 2019. May the fourth be with you: Creating Education 4.0. *Journal of Learning for Development*, **6**(2): 95-115.

- [38] Thomas, M. 2011. Digital education: opportunities, challenges and responsibilities. *Digital Education: Opportunities for Social Collaboration*, pp. 1-5.
- [39] Wahabi, H.A. *et al.* 2019. Medical Doctors' Offline Computer-Assisted Digital Education: Systematic Review by the Digital Health Education Collaboration". *Journal of Medical Internet Research*, **21**(3): 1-14.
- [40] Williamson, B., Eynon, R. and Potter, J. 2020. Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. *Learning, Media and Technology*, **45**(2): 107-114.
- [41] Xu, X., Posadzki, P.P., Lee, G.E., Car, J. and Smith, H.E. 2019. Digital education for health professions in the field of dermatology: a systematic review by Digital Health Education Collaboration. *Acta dermato-venereologica*, **99**(1&2): 133-138.