Information and Communication Technology: A Literature Review of its Infrastructure and Application in Higher Education

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Abstract

In the present study, the researcher has reviewed the existing literature from the previous research on Infrastructure and the Application of ICT in Higher Education. The researcher carried out an intensive search on various publications and databases websites and finalized fifteen papers for carrying out the literature review. The literature review reveals that in higher education institutions, ICT Infrastructure is efficient in encouraging the use of web technologies, but inadequate ICT infrastructure is being seen as the main challenge that hinders the implementation of E-learning. Some libraries don't have adequate hardware and software equipment's and don't have sufficient internet nodes & speed. The ICT infrastructure in libraries of the colleges has a significant relation with the ICT library Services. The usage of ICT in libraries has significantly improved the management of libraries. The financial limitations and unavailability of staff who are proficient in using ICT are considered as the main obstacle in delaying the process of ICT implementation in libraries of the colleges. As far as the ICT usage is concerned, there exists a difference in usage of ICT between the students and University teachers in classrooms. The teachers are also facing challenges and obstacles for the availability of facilities for using ICT in the classrooms. The ICT usage by students found to be low but they are having a positive attitude towards its usage. It was further seen that ICT literacy, financial, and organizational culture were the main obstacles for the use of ICT. The majority of the academic staff members use instructor led approach as compared to student led approach.

Key Words- Information and Communication Technology (ICT), ICT Infrastructure, ICT Application, Higher Education

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Introduction

The education system of a country is considered an important tool that always plays a key part in the social and economic growth of a country. The introduction of technological tools and the explosion of knowledge have opened up new vistas in the area of education and the learning processes. In the last five decades, higher education systems have developed at an increasing rate to cater the demands of quality education to everyone. Higher education is considered important for the nation, as it is an important instrument for building 21st Century knowledge-based society. For the growth and advancement of human resources, higher education is a very significant field that is responsible for the economic, socio, and scientific development of the country. India's higher education system has developed remarkably, mainly in the post-independence period to become one of the largest educational systems of its kind in the world (Sirswal, 2016). The people in current times need to have access to knowledge and ICT for keeping pace with the advanced developments (Mondal & Mete, 2012). Information and communication technology (ICT) may be defined as a "diverse set of technological tools and resources used to communicate, create, disseminate, store and manage information'' (Tinio, 2003). According to UNESCO, ICT is a technological, scientific, engineering, and management method used for handling information, its association, and application with cultural, social, and economic matters (Ratheeswari, 2018). ICT has reformed all the aspects of human life which are helping them in their day-to-day activities, in social, public, education, research, and developments. ICT helps in transferring electronic data from one person to another and from one place to another or from one organization or institution to another without any boundaries or restrictions. With the help of ICT, a user can

retrieve, manipulate, store, and transmit or receive information electronically. There are various types of ICT tools that are relevant for the educational system and have been used for different purposes like audio conferencing, teleconferencing, television, radio broadcasts, and CD ROMs, etc. (Bhattacharya and Sharma, 2007). The technological tools like Computers, the internet, broadcasting technologies such as radio, television, and telephony are all examples of an ICT system. Integrating technology into the curriculum helps in bringing reforms towards the learning process. Bringing forward ICT into the education system and amplifying its use has resulted in breaking the boundaries of colleges and universities within the four walls of a learning concept. The students can learn irrespective of place and time and can access resources and information according to their convenience. ICTs in higher education have reflected inferences in dealing with the key issues of equity, access, management, pedagogy and efficiency, and quality about the whole educational process (Mondal & Mete, 2012). For addressing these key issues, it is important to provide maximum ICT infrastructure for educational institutions to overcome these issues.

Infrastructure of ICT and Its Usage

ICT Infrastructure refers to the hardware or equipment, software applications, and services associated with ICTs, including telecommunication and electricity, grid networks (Gesci 2007). According to Akinsola et al. (2005), ICT infrastructure could be categorized into Hardware which comprises telephones, computers, LAN network, hub, printer, scanner, television set, fax, codec camera, projector, radio, video, CD, audiotape players, and microphone. The software part of ICT infrastructure includes Windows & MS office. This infrastructure consists of "a set of hardware, software, services, procedures, processes, and persons". Infrastructure availability has great importance in preparing for the effective use of ICT in education. Its adoption and usage of ICT have a positive influence on learning, teaching as well as in research. Infrastructure plays an important role in the development of ICT. It is considered as a vital aspect like the essential infrastructure electricity and transportation (McCredie, 2003). Even for inclusion, ICT plays a major role in achieving the educational goal of Inclusion where it allows sustainable and affordable access to ICT (Wessels 2006). The infrastructure should be highly subsidized for at least several years so that the investment costs are not passed on to the end-users (Mijumbi, 2002).

The main impact of ICT infrastructure lay in its usage. Various researches have revealed that the proper usage of ICTs can accelerate paradigm change for both pedagogy and content that is considered as the heart of the reforms in education in the 21st century. In the educational sector, the usage of ICT not only improves and enhances classroom teaching but also offers various facilities for E-learning. In the educational sector, the most widely used ICT includes

the internet, computers, and online delivery systems like televisions, projectors, radios, and many others also. Hence, the ICT tools i.e., radio, television, and the emergence of newly introduced digital technologies like the internet and the use of computers were recognized as the most prevailing equipment for changing and bringing more reforms in the educational system. The application of ICT tools appropriately and effectively increased access to education strengthening the importance of education and have increased the educational quality by making teaching and learning an active process connecting to real life. Further, the usage of ICT includes computers, interactive media, CD ROMS, satellites, modems, teleconferencing, and other technological resources to support learning (Tileston, 2004). ICT usage increases access to information/knowledge and this information/knowledge helps the people to work more productively as well as with new opportunities. In India, there is a dire need of improving the quality of education in the higher education system by using Information technology. Various initiatives have been taken by the government of India for delivering content and to promote education for the students by using ICT. Educational programs like Gyan darshan, Gyanvani, and also the Doordarshan national channel was launched for broadcasting programs for school students, university students, and adults in a digital mode every day. Introducing ICT in higher education has changed the way education is conducted. ICT is mostly dependent on the technological infrastructure and providing access to all technology means the availability of infrastructure of ICT will increase. This is the key to why ICT infrastructure is a key component in many organizations.

Research Reviews on Infrastructural facilities of ICT in Higher Education

ICT Infrastructure which plays a major role in higher education institutions is affected by various factors. These factors were analysed by (Miseviciene et al., 2019) in his study. The factors like growing needs among learners, the price of education, the introduction of new technologies, and making it in line with the environment were the factors that affect ICT infrastructure. The study by Miseviciene et al. (2019) further aimed at determining how e-service of the university can fulfill the student's demands which aimed at investigating how user's demands have influenced the ICT Infrastructure for higher Education. The research reveals that some of the e-services provided by Kaunas University of Technology (KUT) fulfill only the specific demands of the students, whereas the others are general and universally applicable. While examining, it was concluded that the arising demand is not fulfilled by the e-services in the university but only particular information is being provided. When we talk about the efficiency and productivity of ICT Infrastructure, there has been a vast growth in ICT in recent years in various countries. This development has been possible

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by the transformational power that ultimately favors efficiency and productivity. The efficiency and productivity can be increased if there are investments by the governments. The investment will develop the overall aspects of an education system (Oyerinde & Bankole, 2019). The researchers in their study investigated the effectiveness and productivity of ICT Infrastructure Usage in Education and revealed that ICT infrastructure is being relatively utilized efficiently there has been a little increase in the productivity for the region as well.

In libraries, ICT provides value-added information services and provides access to a lot of digital information to its users. The libraries are making use of the latest ICT equipment to automate the functions, implement effective and efficient library cooperation, and share resources over networks. In a related study conducted by (Mishra, 2018) carried out in the Central Library of "Amity University Kolkata" to know the usage of electronic resources, the researcher revealed that the library lacks adequate hardware and software facilities and does not have sufficient internet nodes and speed. The university campus LAN has not been completely updated for the maximum benefit of digital technology. The ICT infrastructure is considered an important element for the usage and adoption of Collaborative Web Technologies (CWT). The CWT refers to various tools and systems that are designed for facilitating group work. In a related study by (Pima et al., 2016) that aimed at evaluating the ICT Infrastructure available in institutions of Higher Education in Tanzania, the researcher revealed that in higher education institutions, ICT Infrastructure is efficient in encouraging the use of web technologies in Tanzania. The ICT has provided students with collaborative technologies like Web 2.0 which can offer various kinds of tools and other utilities for online learning (Rossi, 2019). E-learning nowadays has gained a lot of popularity, particularly after COVID19. The popularity is due to the flexibility, convenience, and reducing the cost of learning. In a related by Mwangi, 2015 where the researcher investigated the ICT Infrastructure readiness for implementation of E-learning in Kenyan universities, the researcher revealed that the availability of insufficient ICT infrastructure is considered as a major challenge for implementing E-learning. The researcher further suggests that institutions need proper strategy for ICT infrastructure for properly implementing E-learning.

ICT is being considered as a cost-effective opportunity for equalizing the educational system. Its Usage promotes equity in higher education. For bringing the quality, the usage of ICT equipment is necessary and the users need to have a positive attitude towards it. In a study conducted by Kamei (2013), the researcher has looked at the ICT Infrastructure resources at the University of Hyderabad. The study investigated the level of ICT usage by students for educational purposes. In addition to it, the researcher also contributed towards the level of

ICT practices and the student's attitude towards ICT for educational purposes. The responses were covered based on five groups of technologies. Cyber Infrastructure, Data storage resources and management, High-Performance computing, advanced network infrastructure, and resources for collaboration with virtual communities. After analysing the data, the findings of the study reveal that the level of ICT usage by students was found to be low, but they are having a positive attitude towards the usage of ICT. The ICT infrastructure comprises various digital tools which help in disseminating the data among users. The availability of ICT infrastructure is an essential component of an educational institution. The institutions in India require ICT infrastructure and at the same time require the human resource for operating it. In a similar study conducted by Walmiki and Ramakrishnegowda (2009), the researcher surveyed the ICT infrastructure of Karnataka University libraries and found that most libraries in Karnataka are lagging due to the unavailability of ICT infrastructure. The universities have not installed proper LAN facilities for uninterrupted internet access. In yet another study by Dattatraya & Subhash (2017), the researcher selected 40 colleges in Maharashtra to study the ICT infrastructure in Agricultural College Libraries. From the analysis, it was revealed that the educational institutions don't possess the necessary ICT infrastructure in the institution. This hampers the user's access to ICT e-resources.

Table 1: Summary of Studies on ICT Infrastructure

Year	Author	Country	Title/ Study
2019	Miseviciene et al.	Lithuania	"Factors That Influence ICT Infrastructure in Higher Education"
2019	Oyerinde & Bankole	South Africa	"Measuring Efficiency and productivity of ICT Infrastructure Utilization"
2018	Mishra	India	"ICT infrastructure and information services provided by the Amity University Kolkata central library: a study"
2017	Dattatraya and Subhash	India	"ICT Infrastructure Facility in Agricultural College Libraries in Maharashtra"
2016	Pima et al.	Africa	"Assessing the available ICT infrastructure for collaborative web technologies in a blended learning environment in Tanzania: A mixed methods research"

2015	Mwangi	Kenya	"ICT Infrastructure Preparedness for E-Learning Implementation in Kenyan Universities"
2013	Kamei	India	"ICT Infrastructure Resources and Practices in University of Hyderabad"
2009	Walmiki and Ramakrishnegowda	India	"ICT infrastructure in university libraries of Karnataka."

Research Reviews on Usage of ICT in Higher Education

The application of ICT is being considered an important aspect when it pertains to the development of a nation technologically, economically, and culturally. The major aim of ICT is to ensure quality, transparency, and efficiency in education. It helps the local standards of education to be in line with the international standards. In a related study conducted by Rzayev and Suleymanov (2018), where the researcher has conducted a case study and investigated the application of ICT in teaching, learning, and management in different areas of ICT Application, regarding the obstacles and benefits of using ICT. The study findings reveal that ICT literacy, financial, and organizational culture were the main obstacles for the application of ICT. The usage of ICT has resulted in improving quality, better transparency, quality control, and cost savings in teaching and learning. ICT can play a major role in libraries by ensuring its effective usage with highly qualified and skilled manpower. The use of ICT has provided a boost to library services as it is now helping its library services to reach its users. ICT helps in automating different functions of the library like circulation, cataloguing, and acquisition (Adebayo et al., 2018). In a related study, the researcher investigated the use of ICT in the college libraries situated in Assam. The study revealed that the ICT infrastructure in libraries of the colleges has a significant relation with the ICT library Services.

ICT has empowered teaching and learning and its role towards bringing inclusiveness and improving the teaching and learning process cannot be ignored. But the current problem like its ineffective implementation is considered a global issue. However, there is evidence where it has been seen that faculties are integrating ICT in their teaching and making proper usage of it. In a study conducted by Dintoe (2018) the researcher explored the difficulties faced by the academic staff members of Botswana University in using different pedagogies with the help of technology. A qualitative case study was conducted by the researcher and it was found

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that the majority of the academic staff members use an instructor-led approach as compared to a student-led approach and they are using subject-specific technologies suitable to their instructional methods. The technologies as mandated by distance education and University system depicted very low usage due to its unavailability.

The use of ICT in libraries has significantly improved the management of libraries. There is a need to regularly upgrade the services of ICT infrastructure in libraries of the colleges (Mahanta & Das, 2019). The development and upgrading of ICT infrastructure will have a positive impact on its success in libraries. In today's fast-changing technological environment, implementing, and using new technologies in libraries is no longer a matter of choice rather a requirement for survival. In a related study, the researcher conducted a pilot study to know the availability of ICT infrastructure facilities and the application of modern technologies in Cachar district, Assam. The researcher adopted a survey method for the study. The study reveals that most of the college libraries are in the developing stage in terms of ICT infrastructure and its implementation. The financial limitations and unavailability of staff who are proficient in using ICT are considered as the main obstacles in delaying the process of ICT implementation in libraries of the colleges (Choudhary & Sarmah, 2017).

The usage of ICT has importance at all levels of education. The e-teaching and e-learning are the reality of higher education institutions nowadays. These two modes of education have proven effective amid COVID19 which disrupted face-to-face education. The knowledge of computers has a significant impact on carrier opportunities. In a related study, the researcher examined the challenges and gaps in the usage of ICT in University Education in Nigeria. The researcher used a descriptive survey design for the study and the findings revealed that there exists a difference in usage of ICT between the students and University teachers in classrooms. The teachers are also facing some challenges and obstacles for the availability of facilities for using ICT in the classrooms and the solution of the proper usage of ICT in classrooms includes the provision of facilities, funding, and technical expertise in Universities of Nigeria (Ajegbelen, 2016). The availability of infrastructure of ICT is mandatory for increasing its usage among teachers and students. The infrastructure can play an important role in boosting the research output of an educational institution. There exists a strong relationship between libraries and researchers. With the advancement of ICT, researchers have the access to online journals. It helps researchers to make it easier than ever to access, manage, integrate, assess, create, and communicate data. In a related study, the researcher aimed at investigating the usage of ICT products and services for research by the research scholars at the Faculty of Social Sciences, Aligarh Muslim University. The results of the

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study reveal that a variety of products and services were used by the researchers for their research purpose and hence these products have been proved very helpful in finding the required information easily and quickly (Ahmad & Fatima, 2009). The usage of computer as was discussed earlier have increased the research output but at the same time has increased our dependency on the internet for knowledge and information. As a reason for dependence, there has been a lot of explosions of information which has compelled libraries to adopt the new way of storing, retrieving, and disseminating information. In a related study, the researcher examined the ICT in libraries of Kerala. The study found that the libraries have software, hardware, and communication facilities but its benefit is not reaching the needy students. The main tool for communication was email. The libraries were possessing OPAC facilities for running the services (Haneefa, 2007).

Table 2: Summary of Reviews on Usage of ICT

Year	Author	Country	Title
2019	Mahanta & Das	India	"Application of ICT in College Libraries of Assam"
2018	Rzayey and Suleymanov	Europe	"Application of ICTs in Teaching, Learning, and Management at State University in Azerbaijan Case of Azerbaijan State University of Economics."
2018	Dintoe	Canada	Information and communication technology use in higher education
2017	Choudhary & Sarmah	India	"An Evaluation of ICT Infrastructure and Application in Selected College Libraries of Assam"
2016	Ajegbelen	Nigeria	"The Use of ICT to enhance University Education in Nigeria"
2009	Ahmad & Fatima	India	"Usage of ICT Products and Services for Research in Social Sciences at Aligarh Muslim University"
2007	Haneefa	India	"Application of information and communication technologies in special libraries in Kerala"

Conclusion

The study is a small-scale literature review where the researcher carried out a literature review on the Infrastructure of ICT and its usage. The researched used online databases for retrieving the studies on the topic. Based on the analyses, the researcher can conclude that

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there is a need to develop the infrastructure of the educational institutions and encourage the students and faculties to utilize it to a great extent. The ICT infrastructure is considered an important element for the use and adoption of Collaborative Web Technologies. For the availability of facilities of ICT, the government needs to play a key role. The education institutions must organize workshops on ICT so that the faculties become skilled to use ICT. The needs of the students need to be seen and need to be addressed. The libraries of the institutions need to be equipped with the latest technical types of equipment so that they can benefit the students in every aspect. The faculties need to be skilled for optimum use of ICT in classrooms or during the class. ICT can increase access, enhance efficiency and upgrade the quality of higher education. The ICT infrastructure is helping in transforming the teaching, learning, and assessment practices in higher education institutions. At a time, when we are proceeding towards digital education, there exists a lack of training and technical knowledge on the use of ICT which can only be achieved by spreading awareness among students and faculty.

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