

Role and importance of Information Communication Technology (ICT) and Internet of Things (IOT) in Higher Education

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Abstract- Technology, including the Internet of Things (IoT), plays a pivotal role in the development of individuals and various sectors, including higher education. The adoption of Information and Communication Technology (ICT) and the integration of IoT devices in higher education have transformed the learning and teaching process, creating an innovative and enhanced learning environment. Many universities have embraced the integration of technologies, recognizing the benefits it brings.

Technology plays the most important role in the development of an individual as well as for any sector or economy. The adoption of ICT is the process of transforming higher education and provide students, academicians an innovative learning environment to enhance the learning and teaching process. The integration of technologies into education system has been encouraged by several universities. There are many students who can't afford higher education due to high fees structure of universities so technologies help them to get higher education through e-learning. As technologies change the scenario of higher education, mostly students and academicians shifted offline to online mode. Awareness level of ICT and continuous development of the ICT tools for educational implementation is must for the ICT enabled learning to grow in higher education. Educators are required to be aware of the effective use of ICT which ensures the high level of mental development of the students so that their mental growth is not disturbed because it is easy to represent the content applying visual technology but that does not let the student run his mind for conceptualization. That is why proper training programs focusing especially on these issues are required to be conducted by the respective authorities. The research article mainly focuses upon all these issues and challenges and proposes effective solutions.

Index Terms— Information Communication Technology (ICT), Higher education, Internet of Things (IoT) and Development.

I. INTRODUCTION

ICT in education is a dynamic mode that harnesses information and communications technology to effectively support, enhance, and optimize the delivery of information and knowledge, enabling a more engaging and efficient learning experience.

The advancement of education technologies and the development of digital content tools have revolutionized the landscape of higher education, making personalized learning accessible to a wider audience. The integration of Information and Communication Technologies (ICTs) in learning has demonstrated several advantages, as supported by research and practical evidence (source: <https://blog.linways.com/role-of-ict-in-higher-education-in-the-21st-century/>).

One significant advantage of technology, including IoT, in higher education is the opportunity it provides for students who may not be able to afford traditional higher education due to high fees. Technologies like e-learning platforms and IoT-enabled educational tools enable these students to access higher education remotely, breaking down financial barriers and promoting inclusivity.

As technology, including IoT, continues to shape the landscape of higher education, there has been a shift from offline to online modes of learning. This transformation calls for a high level of awareness and continuous development of ICT tools and IoT-enabled solutions to ensure effective implementation in

education. Educators need to be well-versed in the use of ICT and IoT to facilitate the mental development of students. While visual technology and IoT devices aid in content representation and interactive learning, it is important to encourage students to engage in conceptualization and critical thinking.

To address these challenges and ensure effective implementation, it is crucial for relevant authorities to conduct training programs focused on ICT integration, IoT utilization, and addressing related issues. This research article aims to highlight these issues, challenges, and propose effective solutions for the successful integration of technology, including IoT, in higher education. By doing so, it aims to contribute to the ongoing development and enhancement of ICT-enabled and IoT-enhanced learning in higher education.

In India, the higher education system has witnessed significant growth and has become one of the largest in the world, with over 14.6 million students enrolled in more than 31,000 institutions. The number of institutions has shown a Compound Annual Growth Rate (CAGR) of 11%. Recognizing the importance of education for the growth and prosperity of the nation and society, higher education plays a pivotal role in development and transformation. It serves as a key instrument for preparing future leaders in various domains of life, including social, economic, political, cultural, scientific, and technological aspects.

According to the UNESCO Report on Education in the 21st century, higher education is essential in bridging the knowledge gap between countries and communities. It fosters enriching dialogues, facilitates international connections, and promotes networking of ideas, research, and technologies (source: <https://apayts.com/business-practice/>). Higher education equips individuals with the necessary competencies required in diverse fields of human activity, ranging from administration, agriculture, business, and industry to health, communication, arts, and culture.

With the rapid advancements in technology and the proliferation of online learning platforms, higher education in India has witnessed a transformation in delivery methods. E-learning platforms, Massive Open Online Courses (MOOCs), and virtual classrooms have expanded access to education, enabling learners to pursue courses from reputable institutions worldwide. The flexibility and

convenience offered by these digital platforms have made it easier for individuals to acquire new skills and knowledge, even while balancing work and personal commitments.

Additionally, the integration of ICTs in higher education has facilitated the creation and dissemination of digital content, providing students with interactive learning resources, multimedia materials, and virtual simulations. These tools enhance the learning experience, making it more engaging, interactive, and tailored to individual needs. Moreover, ICTs have facilitated communication and collaboration among students and educators, breaking down geographical barriers and fostering global learning communities.

<https://www.thehighereducationreview.com/news/growing-opportunities-for-private-participation-in-indian-higher-education--nid-195.html>.

Education has been an important instrument for social and economic transformation in India. Presently, higher education in India is experiencing a major transformation in terms of access, equity and quality (Behera H (2020)). This transition is highly influenced by the swift developments in Information and Communication technology (ICT) all over the world. Introduction of ICT in higher education has profound implications for the education process especially in dealing with key issues of access, equity, management, efficiency, pedagogy and quality of teaching (Kumar S & Dinesh N (2019)). At the same time, Optimal utilization of opportunities arising due to diffusion of ICT in higher education system presents a profound challenge for institutions. Quality education ushers in a lifetime of opportunity, which helps build a strong and diverse citizenry to work and live in an increasingly competitive world. Higher education provides the competencies that are required in different spheres of human activity (Kumar P & Mishra S (2020)).

Society expects more and more of higher education each year. This stems partly from the continuing expansion of knowledge, and therefore of what must be included in courses and curricula, and partly from growing cognitive challenges and diversity. (<https://damdamacollege.edu.in/ict/>).

To address these challenges and ensure effective implementation, it is crucial for relevant authorities to conduct training programs focused on ICT integration and addressing related issues. This research article

aims to highlight these issues, challenges, and propose effective solutions for the successful integration of technology in higher education. By doing so, it aims to contribute to the ongoing development and enhancement of ICT-enabled learning in higher education.

Progress, convergence, and integration in information technology have driven fundamental change in the information technology faculty, students, colleges, and universities have or might be expected to acquire. <https://cegr.in/Role-of-ICT-in-Improving-Quality-of-Higher-Education.php/>. It has implications in almost all the fields including education. But education which is itself referred to as a communication process is yet to adapt to the highest possible and optimal level of Information and Communication Technologies. Especially, higher education where concepts are to be developed in-depth and visualization are necessary. This research article mainly discusses the issues, challenges and solutions for the advanced development of ICT for educational implications at a higher level.

METHODOLOGY OF THE STUDY

This paper presents a comprehensive analysis of higher education in India, drawing upon an extensive review of secondary sources and incorporating personal experiences and observations. By synthesizing a wide range of information, the paper provides a well-rounded perspective on the state of higher education in the country.

The review of secondary sources encompasses scholarly articles, reports, and studies from reputable institutions and organizations. These sources offer valuable insights into various aspects of higher education, including enrollment trends, institutional growth, pedagogical approaches, challenges, and emerging opportunities. Additionally, personal experiences and observations further contribute to the understanding of the nuances and realities of the higher education landscape in India.

LITERATURE REVIEW

Impact of technology is almost on every nook and corner of education sector starting from learning, teaching to analysis of data. (Yusuf, 2005). A big pile

of data analyzed has proved the benefits of ICT to the standard of education. (Al-Ansari, 2006).

K. Matyokurehwa (2013). A team of experts should be constituted which keep analyzing the current curriculum framework from ICT perspectives constantly and give their recommendations to the respective authorities. Local language development organizations should be framed inside and outside the educational institutions and second/foreign language development skills should be geared up.

Pegu (2014) in his study “Information and Communication Technology in Higher Education in India: Challenges and Opportunities” examined the role of ICT in higher education in India. The study reported poor penetration of ICT programs in higher education and also due to the lingual diversities there are needs to create content in local/regional languages. Further, there are tremendous opportunities as these programs have high potential to achieve expected learning outcomes efficiently.

According to the United Nation Development Program, “ICTs are basically information-handling tools - a varied set of goods, applications and services that are used to produce, store, process, distribute and exchange information.” (UNDP cited in).

Chandha (2015) in her study titled “ICT & Present Classroom Scenario” presented her opinion on technological learning tools for learning. She described various ways to incorporate ICTs to the mainstream of classroom teaching and tried to ensure a positive approach towards the successful implementation of ICTs and suggested practical ideas to do so.

Sandhu (2015) in her study titled “Integration of ICT in Teacher Education” [24] focused on the issues and concerns related to the integration of ICT in teacher education program. She arose a major issue that making teachers comfortable with innovative technologies is one of the major concerns to be considered as their comfortability will help integrate ICTs to the classroom teaching. For this purpose, teacher education should be transformed in order to prepare the teachers for changing scenarios.

Girish & Sureshkumar (2017) in their study “ICT in Teaching-Learning Process for Higher Education: Challenges and Opportunities” focused on the challenges and opportunities for implementing ICT in the classroom for teaching and learning process. They also concentrated on the circumstances which are

needed to be converted in order to achieve the full potential of ICT programs for better teaching-learning. They found various challenges such as expensive cost, lack of essential infrastructure required for the complex operation of ICT enabled tools for learning, and unfulfillment of basic needs like electric supply, etc. But ultimately there are opportunities for implementation of ICTs as the learning outcomes with their help have improved significantly.

Presently, the number of higher education institutions is increasing rapidly. As per the UGC figures (2018), there were total 851 universities/institutions and 244 institutions/universities eligible for central assistance in March 2018 including central, state, state private universities and institutions established through state legislation, and deemed to be universities institutions as figured below (from UGC annual report 2017-18).

In a report prepared by NITI Ayog 2019 various benefits of the ICT have been identified which are: instant access to the knowledge for the development of wide sense of understanding, helpful in the customization of the teaching material as per the needs of the students, awakening of the motivation to learn, respecting individual differences, capturing the attention of the students for a longer span of time, formation of a disciplined classroom-environment, etc. Phutela and Dwivedi (2019) in their study found that elearning enhances the interest towards and speed of students' learning. Students' become eager to learn especially in a group task

Kundu et al. (2018).also list some of the very essential issues in their study which are: lack of trained teachers, lack of knowledge for the integration of ICT with school and higher education curriculum, poor administrative support, financial issues, time management related problems, lack of the required infrastructure etc.

Students should be provided proper training for the basic knowledge of ICTs and these pieces of training should be properly reviewed time to time and the curriculum of these pieces of training must be compatible as per the modern needs. They should have a basic introduction not only to the operation of the computer but to the other concepts such as e-business, e-marketing, e-commerce, e-library etc.

Teachers and educators' training are needed to be done in a special manner. Making them technically aware and training them for effective content delivery, developing the brains of the students are essential. An

attitude test must be conducted so to analyse their attitude towards innovative approaches.

HIGHER EDUCATION SCENARIO IN INDIA

India boasts one of the world's largest higher education systems, comprising over 651 universities, as reported by the University Grants Commission (UGC) in 2013. Additionally, the country is home to 31,324 colleges offering higher education, according to the Higher Education in the 12th Five-Year Plan Report (2012-17) released in August 2011. These figures highlight the vast scale and diversity of the higher education sector in India.

Over the years, there has been a steady increase in student enrolment in both universities and colleges. As of the beginning of the academic year 2009-10, the total student enrolment reached a significant milestone of 13.642 million. Among this figure, 1.669 million students (12.24%) were enrolled in university departments, while 11.973 million students (87.76%) were enrolled in affiliated colleges, as indicated in the Ministry of Human Resource Development (MHRD) Annual Report for 2009-10. This growth in student enrolment reflects the growing demand for higher education in the country.

The substantial number of universities and colleges, coupled with the increasing student enrollment, demonstrates the significant role of higher education in India's education landscape. It provides a wide range of opportunities for students to pursue undergraduate, postgraduate, and doctoral programs, contributing to the overall development and progress of the nation.

Table 1: Type-wise classification of Universities in India.

S.No	Type of Institution	No. of Institution (As on 2006)	No. of Institution (As on 2013)	No. of Institution (As on 2022)
1	Central Universities	20	44	54
2	State Universities	217	310	445
3	Private Universities	8	168	421
4	Institutions Deemed to be Universities	104	129	130
	Total	349	651	1050

Source:

- 1.UGC excluding institutions of national importance
- 2.<https://university.careers360.com/articles/central-universities-in-india>
- 3.https://en.wikipedia.org/wiki/List_of_state_universities_in_India

The higher education system in India continues to suffer due to inadequate access to technology and inequity. However, the application of ICT in higher education has not only brought about diversification in higher education but has also fostered new avenues for international mobility of traditional and non-traditional students (Kirsebom, 1998). While it is believed that ICT can transform the educational scenario in the country, it should address the needs and perform multiple roles in higher education to benefit all stakeholders. This sense of urgency and the continuous implementation of ICT in higher education has led many universities and colleges into a more action-oriented adaptation approach (Schmidtlein& Taylor 2000).

HIGHER EDUCATION IN CHHATTISGARH

Chhattisgarh is a state in central India that has made significant progress in the field of higher education. The state government has taken various initiatives to improve access to quality education and establish institutions of higher learning. Here are some key points about higher education in Chhattisgarh:

Chhattisgarh is home to several universities that offer a wide range of undergraduate, postgraduate, and doctoral programs. Some prominent universities in the state include Pt. Ravishankar Shukla University, Bilaspur University, Guru Ghasidas Vishwavidyalaya, Indira Gandhi Krishi Vishwavidyalaya, and Chhattisgarh Swami Vivekanand Technical University, Chhattisgarh Swami Vivekanand Technical University (CSVTU), Indira Gandhi Krishi Vishwavidyalaya (IGKV) Guru Ghasidas Vishwavidyalaya, and Dr. C.V. Raman University .

There are 285 government colleges and 25 universities including private universities. The Gross Enrollment Ratio (GER) in the State is around 13 per cent, far behind the national average of GER which is around 22. Certain measures have been taken by the Chhattisgarh Government to equate the GER of the State with that of the national average.

The most important of those measures is the implementation of

RashtriyaUchchatarShikshaAbhiyan (RUSA). RUSA is a Centrally Sponsored Scheme (CSS), launched in 2013, with an aim to provide strategic funding to eligible higher educational institutions of different states. The scheme focuses on three major aspects: Access to education, equity among children and providing quality education.

Four new universities are being opened by the state government in districts like Jagdalpur, Bilaspur, Durg and Ambikapur to provide higher education to the youth in the state of Chhattisgarh. Under RUSA, grant of 20 crore has been sanctioned for the construction of each new university.

(<https://digitallearning.eletsonline.com/2017/09/reforming-higher-education-landscape-in-chhattisgarh-holistically>).

Table 2: Type-wise classification of Universities and colleges in Chhattisgarh

S.No	Type of Institution	No. of Institution (As on 2022)
1	Central Universities	01
2	State Universities	09
3	Private Universities	15
4	Institutions Deemed to be Universities	01
5.	Govt. College	285
6.	Private College	264

IMPACT OF ICT ON LEARNING

ICT has created a paradigm shift in pedagogy (methods and practice of teaching) and education content. ICT focused education mainly promotes the lifelong learning for students and improves their knowledge skills by encouraging them to explore and discover, instead of just learn and remember. Also, it opens the door of enabling learner-centered pedagogy instead of traditional teacher-centered pedagogy. This not only helps the learners to work better as compared to past, in fact, it also allows teachers to modify their teaching or content-delivery options. ICT-supported learning catalyzes the effective learning process through collaborative, evaluative, creative and integrative learning approach. Therefore, due to this reason, it can be sometimes considered as student-directed learning, whereas conventional methods were more teacher-centric. This is so because, previously, the activities were mostly prescribed by the teachers.

Whereas, ICT allows learners to direct their study related activities themselves. https://en.wikibooks.org/wiki/ICT_in_Education/The_Promise_of_ICTs_in_Education

CHALLENGES AND RISKS OF ICT IN HIGHER EDUCATION

The major barriers were lack of genuine software, inadequate computer in the classroom, low speed internet, lack of motivation from both teacher and student side to use ICT, lack of proper training skills, unavailability of latest ICT equipment, lack of expert technical staff, poor administrative support, poor course curriculum etc. Suggested are made for ongoing professional development of teachers to model new pedagogies and tools for learning with the aim of enhancing the teaching-learning process. It is important for teacher trainers and policy makers to understand the barriers and cost-effectiveness of different approaches to ICT use in teacher training so that training strategies can be appropriately explored to make such changes viable to all.

IMPORTANCE OF ICT IN HIGHER EDUCATION

The Information and Communication Technology (ICT) is an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer, and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. When such technologies are used for educational purposes, namely to support and improve the learning of students and to develop learning environments, ICT can be considered as a subfield of Educational Technology. ICTs in higher education are being used for developing course material; delivering content and sharing content; communication between learners, teachers and the outside world; creation and delivery of presentation and lectures; academic research; administrative support, student enrolment etc. (<https://www.cegr.in/Role-of-ICT-in-Improving-Quality-of-Higher-Education.php>)

ICT plays an important role in higher education as it helps students, faculty as well as administrative staff to achieve excellence in higher education for

improving the teaching process. All over the world students got benefited & also taking advantage of e-learning. Nowadays communications between people of anywhere in world got easier through ICT which saving time and money. Technologies are very developed & enhance communication skills. Many universities conduct online exams using new technologies. Through ICT the quality & variety of education is provided to students with subject experts. In education sector, the adaption of technology helps in enhancing the quality of education and many industries also helps universities to adopt new technology which helps in growth of economy and helps in achieving excellence in higher education. As the technology is changing with the great pace so it is also beneficial for the students and faculties to adapt those changes easily.

INTERNET OF THINGS (IOT) TECHNOLOGY

The Internet of Things (IoT) technology networks have the potential to play a transformative role in higher education and communication technology. IoT refers to the interconnection of physical devices or "things" embedded with sensors, software, and network connectivity, enabling them to collect and exchange data.

In the context of higher education, IoT networks can enhance various aspects of campus life and learning experiences. Smart campuses powered by IoT can automate and streamline administrative processes, such as attendance tracking, resource allocation, and facility management. IoT-enabled devices can facilitate real-time monitoring of classrooms, laboratories, and libraries, optimizing resource utilization and enhancing safety and security measures.

Moreover, IoT devices can enrich the learning environment by providing interactive and immersive experiences. For instance, IoT-based sensors and wearables can be used in scientific experiments, allowing students to collect and analyze data in real-time. Virtual reality (VR) and augmented reality (AR) applications powered by IoT can create simulated environments, enabling students to engage in hands-on learning in various disciplines.

IoT networks also have the potential to revolutionize communication technology in higher education. Connected devices can facilitate seamless

communication between students, faculty, and staff, regardless of their physical locations. IoT-powered communication systems can support real-time collaboration, remote learning, and virtual meetings. Additionally, IoT-based solutions can optimize connectivity and bandwidth management, ensuring reliable and high-speed internet access for campus communities.

IoT networks can contribute to research and innovation in higher education. By integrating IoT devices into laboratories and research facilities, data collection, analysis, and experimentation can be enhanced. This opens up possibilities for conducting cutting-edge research in fields like environmental monitoring, healthcare, agriculture, and more.

However, while the potential benefits of IoT networks in higher education are substantial, there are also considerations around data privacy, security, and the management of large-scale deployments. Institutions must ensure robust cybersecurity measures and develop policies to safeguard sensitive information.

IoT technology networks have the capacity to revolutionize higher education by transforming campus operations, enriching learning experiences, facilitating seamless communication, and fostering research and innovation. By leveraging the power of IoT, higher education institutions can create a more connected, efficient, and engaging environment for students, faculty, and staff.

IMPORTANCE OF ICT& IOT IN HIGHER EDUCATION

The importance of Information and Communication Technology (ICT) and the Internet of Things (IoT) in higher education cannot be overstated. Here are key reasons why ICT and IoT are crucial in higher education:

Enhanced Learning Experience: ICT and IoT technologies enable interactive and personalized learning experiences, with access to digital resources, online courses, and educational applications. IoT devices provide real-time data collection, simulations, and virtual experiences, making learning more engaging and immersive.

Access to Knowledge: ICT and IoT bridge the gap in access to education by providing remote learning opportunities. Students can participate in online classes, access educational materials, and collaborate

with peers and instructors, overcoming geographical barriers. This is especially beneficial for learners in remote areas or those with physical limitations.

Improved Teaching Methods: ICT and IoT empower educators with innovative teaching methods, utilizing multimedia content, online assessments, and interactive tools to cater to diverse learning styles. IoT devices enable hands-on learning experiences, data analysis, and experimentation, creating dynamic and engaging lessons.

Administrative Efficiency: ICT and IoT streamline administrative tasks in higher education institutions, automating student records, course registrations, grading, and scheduling. IoT-enabled campus infrastructure enhances resource management, energy efficiency, and security, leading to cost savings and improved operational efficiency.

Collaborative Learning and Research: ICT and IoT foster collaboration among students and researchers through online platforms, video conferencing, and discussion forums. They enable communication and knowledge sharing beyond physical classrooms. IoT networks facilitate connected research environments, data sharing, and interdisciplinary collaborations.

Skill Development for Future Careers: ICT and IoT skills are increasingly in demand across industries. Integrating these technologies into higher education helps students develop digital literacy, critical thinking, problem-solving, and communication skills essential for the evolving job market.

Continuous Professional Development: ICT and IoT provide avenues for educators' continuous professional development through online courses, webinars, and digital resources. They enable instructors to stay updated with the latest teaching methodologies, technological advancements, and subject knowledge.

Research and Innovation: ICT and IoT drive research and innovation in higher education. They enable advanced data analytics, IoT sensors, and networked devices for data collection, analysis, and interpretation. This leads to groundbreaking discoveries, advancements in various fields, and the development of smart solutions.

In conclusion, ICT and IoT have revolutionized higher education by enhancing learning experiences, improving administrative efficiency, fostering collaboration, and preparing students for the digital age. Embracing these technologies is crucial for

providing a high-quality education that equips learners with the skills they need for success in the 21st century.

CONCLUSION

ICT and IoT have significantly and fundamentally transformed higher education, revolutionizing learning and teaching approaches, research capabilities, and administrative efficiency. Embracing these technologies and effectively addressing associated challenges are imperative for fostering a dynamic and inclusive educational ecosystem, preparing students to thrive in an ever-evolving digital world. The continuous evolution of ICT and IoT undoubtedly holds the key to shaping the future of higher education, propelling it towards greater heights of innovation and excellence.

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