

Digital Transformation in Higher Education Institutions – An Overview

R.B. Ravi Varma^{1*}, I M Umesh¹, Nagesh Y N², Kumara Swamy K S³

¹Dept. of Information Science and Engineering, R V College of Engineering®, Bengaluru

²Dept. of Computer Science and Engineering, R V College of Engineering®, Bengaluru

³Dept. of MCA, R V College of Engineering®, Bengaluru

Abstract

Since the emergence of higher education institutions, they are the places where students gather to learn. Over time, higher education institutions have grown and become complex. In order to meet customers' requirements, the institutions are adopting technology. These technologies are capable of changing the conception of a higher education institution. Technologies are reshaping the higher education by altering the daily operations and expanding the missions of the institutes. It can be observed that, nowadays, higher education institutes are quick to adopt new technologies even before their educational value has been proven. Technology has the potential to change the way the institution works.

Technologies like Big Data analytics, Internet of Things, Cloud Computing, Cyber Security, and Artificial Intelligence are being adopted by educational institutions for improved service delivery. Big Data Analytics can be used by educators to understand where and how improvements can be made. IoT enables the creation of smarter lesson plans, optimized use of critical resources, design safer campuses etc. Institutions can make use of cloud services to upgrade learning systems with optimum investment for resources. Students bring more than one device and cloud technology enables them to use the devices seamlessly across institutes IT backbone. Cyber-attacks may happen to educational institutions with a goal of stealing the information like personal information, research data, confidential information like marks and grades. Applications of Artificial Intelligence include personalized learning, customized ways to deliver courses to students etc.

This paper discusses the uses of adopting various technologies for the benefit of educational institutions. Each of the technologies has been discussed briefly and its significance is mentioned.

Keywords: Big Data Analytics, Internet of Things, Cloud Computing, Artificial Intelligence, Cyber Security.

1. INTRODUCTION

Today's enrolments for higher education institutions count into several thousands. Because of this, institutions cannot function in the traditional methods. There is also tough

competition among higher education institutions to satisfy their stakeholders. In order to achieve improvements in better service, institutions have started using technologies long back. Institutions have automated their routine administrative tasks. Now, it is time to look beyond it. Technologies like Big Data analytics, Internet of Things, Cloud Computing, Cyber Security and Artificial Intelligence can change the way the institution works. These technologies can be used for customizing the educational plans, boosting their enrolments, improve educational experience, retention of students etc.,

Big Data helps in maintaining and improving students' performance as well as have an insight into institutional resources usage trends. The activities like identifying the best student considering the performance in co-curricular and extra-curricular activities can be eased using Big Data analytics. IoT technology helps in building smart campus with a focus on optimal resource utilization. As more and more learning resources are stored digitally now, cyber security is gaining importance. Institutions have confidential information like student marks, grades and question papers stored in their local servers. It is a high priority task for any institution to safeguard such confidential digital records. Institutions also may have automated systems for routine administrative tasks like payroll processing or library works. Such systems are to be protected by using secured measures. Cloud systems have become the norm nowadays in higher educational institutions where each facility can be delivered as a service. The students can use software installed in cloud which avoids installation in their local laptops. Other uses of Cloud systems include sharing of assignments by students which the professor can access anywhere. Artificial Intelligence plays significant role as the need of the hour is customized courses, student behavior pattern analysis etc. Higher education institution might become outdated if they do not adopt emerging technologies and trends to teach their students [1].

In this paper, the benefits of using these technologies in higher education institutes are discussed.

2. TECHNOLOGY TRENDS IN INSTITUTIONS

Education institutes use ERP tools and cloud-based technologies to reduce costs and achieve operational efficiency. In current scenario, the institutes need to go beyond these technologies in order to keep up to date and remain competitive in the field.

2.1 BIG DATA ANALYTICS

Steady inflow of massive amounts of data and the decision making driven by data in the diverse sectors of industries across the world, the education sector also forays into the newer dimensions of technology, breaking through the age-old traditional boundaries by incorporating big data analytics in their work ethos anticipating the desired outcomes in terms of improved students pass percentages and starting new customized programs. Different stakeholders are expecting higher education institutions to respond to their demands in a timely manner [2].

Data Sources includes admission data, faculty data, course curriculum, assessment data, learning resource, Infrastructure data, procurement data and financial data.



Fig. 1. Big Data Analytics. Source [3]

The educational institutions depending on their requirements can implement ground-breaking big data analytics applications. Few of domains where big data plays an important role are discussed by the authors in this paper which can be leveraged by the institutions.

- In India there is a mushrooming of educational institutions by both public and private sectors. With the entry of the multinationals into this sector there will be aggressive competition among the institutions. In such a scenario it is very essential to help the institutes and students to exercise their right choice. Data Analytics plays an important role facilitating the right connect between the institutions and the students, process accuracy and saving a whole lot of time.
- Improved learning experience greatly depend on student centric. In such a scenario this can be achieved only through analyzing the trail of data every student leaves behind and incorporating the outcomes of the analytics into the course curriculum will have a bright chances of higher adoption rate as they are tailored to individual objectives of the students.
- In order to reduce the drop-out rates, application of sentiment analysis and predictive analytics on different student profiles will yield break through information about a student's derailment from the ideal path thereby the respective counsellors can guide their wards resulting in higher retention rate.

Particularly in India with the increased monitoring by several statutory bodies, it is obvious for the institutions to keep the institutional analytical information in terms of student strength, human resource, infrastructure, learning resources, research & innovation, resource allocation and financial data to enhance their operational efficiency and adhere to the stringent guidelines and compliance.

There is a dire need for comprehensive and interactive support systems that supports in data management (cleansing of data), visualization (interactive charts & dash boards) & Analytics (access to all kinds of reports) that help the decision makers in predictive and proactive in terms of providing solutions to the problems that might arise in the future.

With the increasing onslaught by hackers, it poses a challenge for the institutions to protect their sensitive & confidential data. Hence there an urgent need for essential data security systems in place supplemented with obvious user control policies to prevent data thefts.

2.2 INTERNET OF THINGS

Current world depends on several things/objects. IoT enables the smartness between those objects and connects those objects (smart phones, laptop and appliances) with other objects with unique addresses. Application developments involve automatic control of the devices/ objects / Things over the Internet. In education domain, IoT Application help to create smart Institutions, SmartCampus, Smart city, Security Systems, and connected Systems. Collecting data through IoT Devices can also help campuses to become "smarter," which in turn can make them serve students better and make more cost-effective decisions and save the money.

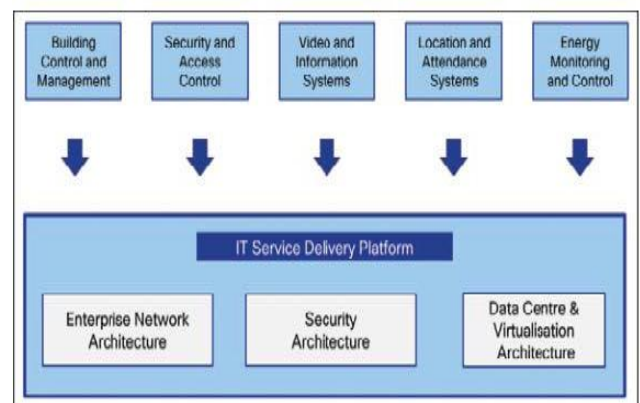


Fig. 2. Applications of Internet of Things in Education. Source [4]

The educational institutions have been impacted by Internet of Things (IoT) massively. IoT technology enables internet-based communication between sensors, controllers and physical objects. Various parameters of the education environment can be captured and analyzed by embedding sensors in objects. The integration can also be done with cloud computing, wearable technologies, augmented reality etc. The

IoT technology has also facilitated a new type of interaction between people and education environment. The learning outcomes can be enhanced by delivering more affluent learning experience and improved operational efficiency. This helps in providing real-time, actionable insight into student performance. This technology has huge potential in educational institutions to transform the way they are working.

2.3 CLOUD COMPUTING

Traditional methods are unable to address the needs of higher education [5]. In modern day computing, the term cloud computing has become the standard. Cloud computing has significantly changed the way the institutions are managing their online resources. In higher education institutions, cloud technology saves both time and money. It eliminates the need for specialized hardware and software on computing nodes. Because of this, there will be flexibility in terms of access and scale. Some of the examples of how the stake holders are benefitted from this technology are; students can access information stored on cloud from wherever they are. Professors can receive submissions even when they are out of the campus. Resource optimization is also possible as educational institutions can scale back its resources when they are no longer required. Purchase of equipment's can be reduced with cloud-based subscriptions.

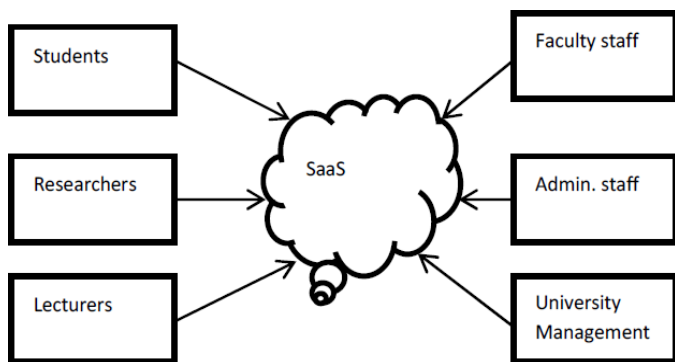


Fig. 3. Use of SaaS in Higher Education. Source [6]

Recent studies (A Survey of IT and library leads, UK) shows that 80% of respondents are currently using cloud technology to support student needs. 45% of the surveyed higher education institutions were using cloud technology for purposes like payroll processing and management software.

Cloud technology can be used in institutions for virtual class rooms, provisioning learning materials, online usage of tools for assignments and virtual labs. Using virtual class rooms, teachers can have face to face interaction with students who are present geographically in different locations. This provides an opportunity to enroll students from diverse population. Video materials and e-books can be shared in cloud systems for access by students. Using virtual labs, students can learn from instructor-led sessions in online labs that are safe, convenient and accessible from anywhere.

There exist immense benefits by cloud technology, but managing cloud in educational institutions has certain issues. Lack of trained staff in implementation or inefficient utilization of resources. For instance, virtual lab left open after usage may add costs. As cyber-attacks on education institutes are in rise, security is of paramount importance. In 2017, a Russian hacker breached cyber data in 63 Universities of US. Data compliance is another issue that needs to be addressed in educational institutions.

2.4 ARTIFICIAL INTELLIGENCE

Advances in artificial intelligence open to new possibilities and challenges for teaching and learning in higher education [7]. In January 2019, the *Wall Street Journal* published an article with a very provocative title: "Colleges Mine Data on Their Applicants". Institutions use machine learning to assess the interest level of the students in joining their Institutions. This article threw light on higher education institutions using Artificial Intelligence. Artificial intelligence in higher education includes various kinds of applications as shown in figure 1. Institutional use means relying on algorithms for promoting their institute to prospective students, curricula planning, class size estimation and financial resource allocation.

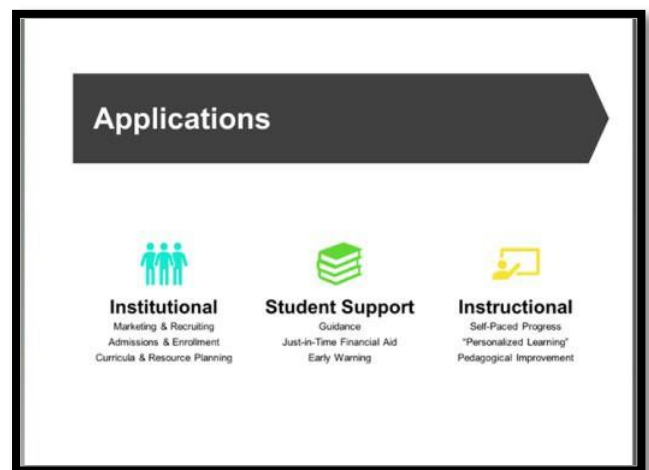


Fig. 4. Artificial Intelligence in Higher Education. Source [8]

Institutions are using machine learning for student guidance. Using this technology, students can automatically schedule their course load. Some other applications recommend courses, career paths which were traditionally done by guidance counsellors. The recommendations are based on how students with similar data profiles performed. The AI can be used to analyze a wide variety of data like academic, operational to predict the students who are at a risk of failing or dropping or have any other issues. These systems make use of more granular patterns of information and behavior of the student for real-time assessment of student risk. Data like when a student stops visiting cafeteria, when a student visits library or a gym can be captured and analyzed for better decision making.

Institution can apply artificial intelligence in instruction. The systems respond to individual student’s pace and progress. These systems are capable of assessing the progress of the students, recommend and deliver specific parts of a course. These are commonly termed as “personalized learning” platforms. Some of the specific uses of artificial intelligence in educations are discussed here.

- Institutions will be able to provide customizable experiences for students
- Institutions will be able to create student retention plans that can predict rather react to student’s difficulties.
- Creation of intervention strategies to increase their enrolment numbers.

By using AI platforms to deliver time-intensive tasks and improving efficiency in problem-solving, decision makers can re-focus their efforts to improve reputation of the institute.

2.5 CYBER SECURITY

Cyber-attacks on educational institutions are growing [9]. In order to improve the service delivery, many institutions are building cyberspaces. Cyber Security becomes very critical as it plays a central role in information technology and to meet the ever-increasing expectations of customer. Compared to other public sector organizations, higher education institutions are more targeted by cyber- attacks as shown in figure 2. The attacks are characterized as cyber stalking, theft of identity, data interception, data exfiltration, denial of service attacks etc. Higher education institutions incur heavy economical and service delivery mislay. Cyber-attacks are done to modify certain data like student’s fees balances and modification of student grades.

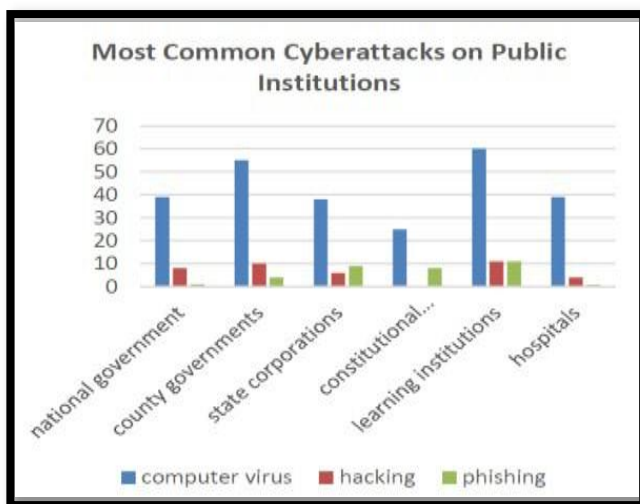


Fig. 5. Public Sector ICT Survey Report 2016 Source [10]

Many institutes have adopted cloud computing services that enable them to create a virtual repository of data. This

increases the risk for data breaches like financial and operational data if the data is stored in third party servers that are accessible over internet. It is common nowadays for the institutes to be hosts of bring-your-own-everything (BYOE) environments with all stake holders like students, staff, faculty and visitors bringing their devices. This poses a threat as their devices may be unsecure leading to the vulnerability of institute’s network. The challenges to be faced by education institutes are overwhelming, but there exist several ways to protect IT networks. Ensuring the safety of the immense volume of information that the institutes may have should be one of the top priorities. The mechanisms like access control, continuous monitoring of data bases can help to achieve cyber security goals.

It is difficult for the education institutes to own the tools that the cyber security industry produces as the financial resources are limited. Higher education institutions require a deep look into their cyber security. The institutes need to have a mechanism for minimum level of security. The decision makers in the institute are becoming more aware of the risks as emerging technologies, institutional practices and user expectations collide in a way that does not safe guard resources of the institution. Considering the dangers, the institutes must be ready to have an all-inclusive strategy to counter cyber-attacks to become trustworthy.

3. CONCLUSION

The application of Big data analytics is essential in Higher Education as there exists huge data. Big Data Analytics offers several benefits that would empower the stakeholders to make informed decisions to progress. The impact on the education system is inevitable in this technology driven era. These BDA approaches are proven to be relatively effective in quality improvement process of education and eventually contribute to produce highly skilled professionals. Internet-of-Things has a great potential in eliminating all the barriers to education viz. language, geography, location and economic development. The amalgamation of education and technology leads to quicker and modest learnings, increased levels of knowledge and quality of students. IoT may emerge into the education sectors once the standards are established and functional models are extensively prevailed.

Cloud computing may have significant potential improvements in IT applications and IT infrastructure in higher education institutions. It is advisable to the HEI’s IT Management teams to pursue the right approach in commensurate with the strategic directions of the HEI. The future holds the capacity of producing technologies designed explicitly for teaching & learning by linking Artificial Intelligence with the developments in the domain of robotics and liberal use of sensor devices to monitor the surroundings and actions. Future research may lead to development of systems that provide collaborative learnings with new modalities for interfaces between teachers & learners. Embracing Artificial Intelligence into smart classrooms would lead to generation of vast real time data from sensors and this would result in development of newer models learners’ behavior in the broader environment of the

classroom. The eLearning systems are open, distributed and interconnected. Thus, the Cyber Security is a unique challenge as thousands of users access many systems through hundreds of networks in order to ensure that only authorized users will have access to the right information at the appropriate time and protect from cyber-attacks

REFERENCES:

- [1] <https://www.blog.epravesh.com/education-technology-trends-2020/>
- [2] Ben Daniel, Big Data and analytics in higher education: Opportunities and challenges, *British Journal of Educational Technology* (2014)
- [3] <https://imacimi.wordpress.com/2018/08/28/big-data-in-education-the-need-of-the-hour/>
- [4] Hanan Aldowah et al, Internet of Things in Higher Education: A Study on Future Learning, *Journal of Physics: Conf. Series* 892, 2017, page 1- 10.
- [5] MD. Anwar Hossain Masud et al, Cloud Computing for Higher Education: A Roadmap, *Proceedings of the 2012 IEEE 16th International conference on computer supported cooperative work in design*, page 552-557
- [6] A. O. Akande and J. Van Belle, "Cloud computing in higher education: A snapshot of software as a service," *2014 IEEE 6th International Conference on Adaptive Science & Technology (ICAST)*, Ota, 2014, pp. 1-5.
- [7] Stefan A. D. Popenici and Sharon Kerr, Exploring the impact of artificial intelligence on teaching and learning in higher education, *Research and Practice in Technology enhanced Learning*, 2017, page 1- 13
- [8] <https://er.educause.edu/articles/2019/8/artificial-intelligence-in-higher-education-applications-promise-and-perils-and-ethical-questions>
- [9] <https://www.snapcomms.com/blog/cyber-security-higher-education>
- [10] Mayieka Jared Maranga. Dr. Masese Nelson, Emerging Issues in Cyber Security for Institutions of Higher Education, *International Journal of Computer Science and Network*, Volume 8, Issue 4, August 2019, page 371-379