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OVERVIEW OF THE NEW TECHNOLOGIES IMPACTING HIGHER EDUCATION¹

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ABSTRACT

Universities, and the role they play in society, are under threat from the impact of the ongoing pandemic. To improve the teaching and learning process and to deliver quality education, there are numerous promising technologies for higher education. As these are complex and expensive technologies, a decision for their use must be based not on technological hype but scientifically validated outcomes. One of the biggest benefits of integrating technologies in education has been the increase in accessibility for students. Today, more people than ever before have access to learning material and the latest curriculum due to the advent of cheap internet and smartphones. Technologies made learning available to everyone, everywhere, and all the time and enabled teaching to occur in a variety of formats, including massive open online course, webinars, and standard online degree programs. This paper provides an overview of these new technologies that have considerable developments and noticeable impact on higher education moving forward.

KEY WORDS: new technologies, higher education.

INTRODUCTION

New technologies continue to emerge and bring with them the promise to reform and revitalize today's higher education system. Keeping up with

¹ review scientific paper

the emerging technology trends can have a major impact on the way education is being presented in universities today. They are focused on social equity, accessible teaching and learning formats, effective data use and help students with latest opportunities and unique learning experiences that they need and deserve. Advancement of technologies and unlimited expectation of students from higher education enforces higher education institutions to support teaching and learning process with advanced technologies. So, the integration of an innovative educational technology to enhance quality education must be the responsibility of higher education. This paper provides an overview of new learning technologies, including exemplars, benefits and changes in higher education due to their application. These technologies allow students to become active participants in the acquisition of knowledge.

RELATED WORKS

For many decades, the education sector has experienced continuous technological advances which improve the education sector's ability. The AI technology has positioned itself positively in the minds of students as per the study (Dhawan & Batra, 2021). It has a great potential to be applied in higher education to help students, professors and other members of faculty staff and there is still little research in this direction compared to its potential (Romanov et al., 2020). AI can be used as a tool in teaching and learning, knowledge management and skills development; as a skill that higher-education institutions need to teach along with human skills; possible curriculum changes; and jobs and workforce in an AI world (Taneri, 2020). The adoption of the IoT in universities has a positive influence on intra- and extra-university connectivity and results in challenges related to data security and integrity, but the effect of this influence is rather low (Mircea et al., 2021). By comparing the data from available devices such as smart wristbands (watches) and eye tracking technology, i.e., using existing technical solutions and methods that rely on the application of sensors, a correlation between eye tracking, heart rate, and student attention and how it all impacts their learning outcomes can be observed (Francisti et al., 2020). IoT can be implemented as a tool for the digitalization of remote learning in higher education. A new IoT framework collects detailed information, facilitates the choice of the most appropriate learning materials and eliminates cheating during tests and examinations (Ilieva & Yankova, 2020). To synthesize research within cybersecurity risk by reviewing existing literature of known assets, threat events, threat

actors, and vulnerabilities in higher education Comprehensive Literature Review Model is applied (Ulven & Wangen, 2021). With a plethora of connected devices and increased utilization of the Internet, higher educational institutions are exposed to risks that impact their information and data security, which are referred to as cyber-threats. The security measures need to be implemented in the higher education sector, which is incredibly critical, as the hackers can steal and misuse the information assets collected by the institutes (Singar & Akhilesh, 2020). Research in the area of blockchain aimed at the development of concepts related with the application of blockchain in organizing Higher Education Institutions (Raimundo & Rosário, 2021). Blockchain technology shows significant potential for learners and teachers for the design and implementation of learning activities, conducting formative evaluation and tracking the entire learning processes (Awaji et al., 2020). Its implementation changes the concept of interaction between students and their professors, which makes education more accessible and personalized and provides resources necessary for lifelong education realization (Petrovna Fedorova & Skobleva, 2020). AR technologies have great potential in many application fields for education (Iatsyshyn and al., 2020). A study conducted by Nurbekova and Baigusheva (2020) shows the effectiveness of the application of AR and notes the diverse advantages in education: an increase of the interest towards learning and laboratory work, high level of comprehension and permanency in learning, high learning achievements, laboratory skills improvements, effective improvement of visual thinking skills, and a greater students' enthusiasm. Guntur et al. (2020) offer another perspective. The use of AR technology in-class learning has the potential to improve learning outcomes of spatial abilities, student motivation, problem-solving abilities, and student achievement. Other articles present the possibilities of using augmented reality in the study of mathematics, anatomy, physics, chemistry, architecture, as well as in other fields. Researchers face challenges to 5G revolution on education that takes 4G LTE (Long Term Evolution) and makes it better, faster and more reliable. Educators must be prepared in the course of the 4.0 industry revolution by leveraging on the fifth generation mobile technology or 5G which will be commercially used by 2021 (Mokhtar & Ahmad, 2020). According to Xue & Mao (2021), with the new generation of communication technology 5G the future teaching is prospected from the aspects of AI teaching, holographic interactive classroom, and virtual technology teaching. Xu et al., (2020) look forward to the prospect brought by the combination of 5G communication technology and state that with its fast transmission, low

latency and high capacity technology, 5G is poised to lead and change the medical education. The usage of cloud computing is needed for educational sector, especially in universities to ease all of administration and learning access to everyone (Wigati et al., 2021). Cloud computing can also motivate the students by following an experiential education approach, using unique gaming techniques or collaborative e-learning platforms (Agrawal, 2021). Moving toward cloud computing in educational institutions will decrease the cost of IT infrastructure, release the stress in the Computer Centres, and help in adapting and installing any new technology in less time and effort (Muhairat et al., 2020).

NEW TECHNOLOGIES IMPACTING HIGHER EDUCATION

New technologies continue to emerge and bring the promise to reform and revitalize today's higher education system. Following technologies are impacting higher education:

ARTIFICIAL INTELLIGENCE (AI)

AI in education is being felt, and the traditional methods are changing drastically. Some of the major applications and use cases of AI in higher education are:

AI-Enabled Administrative Task Automation

AI's advents have automated much of the administrative tasks that have consequently provided teachers more time to communicate with students, plan for a class, or concentrate on other essential activities. The technology has allowed the automation of paperwork classification and processing.

AI for Improved Grading System

Using AI, teachers can automate grading for multiple-choice and fill-in-the-blank tests of almost all kinds. Such technology can evaluate the knowledge of students, analyze their answers, and provide helpful input and help teachers develop customized student training plans.

AI-Enabled Smart Content

The traditional syllabuses were enabled to create customized textbooks through AI. Such textbooks are being digitized, creating new learning interfaces to help students of all academic grades.

AI-Enabled Smart Tutorials

A smart tutoring system allows customized online tutoring that is tailored to the students' learning styles and preferences. Such programs operate according to the student's needs by putting greater emphasis on those topics, students have not learned.

Personalized Learning by AI

AI-powered apps allow students to customize learning where their teachers give personalized and tailored responses. Teachers can also break down the lessons into smart study guides and flashcards to make it easier for students to understand.

Worldwide Learning

AI has made it easier for the world to learn any course from anywhere around the globe. Students can use the benefits of convenient learning from anywhere in the world at any time through AI systems, software, and support.

INTERNET OF THINGS (IoT)

IoT can completely change how we teach and learn in the coming times by connecting teachers, learners with rich multimedia content, and performance analytics. Applications of IoT for the education domain would be:

Strong Networking

IoT facilitates the global networking between students, mentors, educators, and parents through connected devices. As poster boards convert into ‘intelligent’ IoT-enabled boards, and digital highlighters are available, students can easily interact with peers and instructors while sitting in the comfort of their home or classroom.

Attendance Monitoring

IoT can make both data collection and analysis easy. With an advanced attendance gadget, there is no need for manual attendance. Teachers can add the records necessary and send an email to parents regarding the student’s presence.

Interactive Devices

Interactive devices promote collaboration and communication. Even in a group project, students can readily share valuable data and collaborate in a better way. Smart boards enable lecturers to explain everything in an interactive way using displays and films.

Efficient Management

IoT solutions can streamline the day-to-day operations and automate tasks. It saves a lot of time and efforts for the management and teachers. As a result, teachers can focus more on teaching, and the management team can concentrate on other productive tasks.

Higher Campus Safety

Digital IDs and wristbands can be used to give access to visitors, employees, and students. Training areas, classrooms, and other locations can be made safe using emergency indicators, wi-fi clocks, and other connected devices.

'Anywhere' Learning

These days, textbooks contain QR codes to simplify their downloads on smart devices. It offers the facility of anywhere and anytime learning. IoT also allows a 24/7 communication between the students and their mentors. Safety and privacy protection are two other characteristics of IoT-based learning.

Disability Accommodation

IoT may prove helpful for students who identify as disabled. Hearing-impaired students may utilize a system of connected gloves and a tablet to translate from sign language to verbal speech, converting sound into written language.

CYBERSECURITY

Higher education is an especially attractive target for cybercriminals because institutions possess large amounts of personal identifiable data, medical records, and advanced research project information. This brings along the following changes in the field of education:

Keeping Up to Date

Now, as cyber threats keep growing bigger, educational facilities have to keep up to date with the rapidly changing environment more than ever.

Faculty Training

With the growing awareness of cybersecurity, more and more educational facilities start taking proactive steps to protect themselves from a threat and one of the most widely used approaches is staff training.

Access Control

Although the educational environment is supposed to be easy to access, the growing cyber risks force facilities to apply stricter access control. Now, educational facilities are doing their best to ensure the security of their websites.

Introducing New Faculties

Since cybersecurity is a big thing today, many educational facilities introduce new academic programs to educate new specialists in the field of cybersecurity.

Spreading Awareness among Students

Educational facilities organize various workshops, seminars, and cybersecurity projects for students to spread awareness about pupils and educate them on how to protect themselves.

BLOCKCHAIN

New ways to apply blockchain technology in the higher education sector are emerging all the time. The different applications of blockchain in education are:

Improve record keeping

Blockchain technology transforms record keeping of certificates and student credentials in learning institutions. There is no need for an intermediary in verifying degrees, certificates, diplomas, and other academic papers with blockchain technology.

Records of education achievements

Blockchain-based university diplomas are a great leap forward, but perhaps the ultimate use case is the creation of a virtual transcript or record of all educational achievements throughout one's entire lifetime.

Seamless payments

Blockchain will allow students to store their cryptocurrency funds – which should be usable over time to pay for their higher education fees.

Protection from Copyright and Digital Rights Violation

The blockchain technology will ensure all people can store academic information in a safe and secure chain with advanced encryption. The owners of learning materials can track, verify access, and allow usage of their digital content.

Creating Better Learning Platforms

Blockchain technology will be useful in the development of better online learning platforms. Using the education concept, access and sharing of study materials can be enhanced. Users buy internal tokens to ask for feedback from standby online tutors.

VR AND AR TECHNOLOGIES

VR and AR allow users to interact with computer-simulated environments, real or imagined. VR also enables users to experience visual, auditory, tactile, smell, and taste inputs in a three-dimensional space. The use of VR and AR helps address some of the fundamental issues in modern education:

Better student engagement

VR/AR in education help students become more interested in learning about a topic, thanks to the use of interactive 3D models. It can visualize the information so that it can be better understood; it can also offer challenges that will motivate the learner to engage with the content.

Better understanding of advanced concepts

The process of understanding the taught topic is different for every student. VR/AR in education acts as a tool for gaining an accurate picture of unobservable and hard-to-understand ideas.

Aid learning by doing

Virtual reality in education and training can assist in practical learning by simulating real-world environments. Besides headsets and software, virtual reality makes use of haptic (touch-based) devices, resembling real-world objects, that can provide real-time feedback.

Emotional reactions

Learning is a multi-dimensional experience involving our senses, our power of thought, and our ability to form memories and feel emotions. Virtual reality helps by sparking specific emotional reactions in students, adding a new layer to the lessons and making them more memorable.

Improving creativity

In addition to content consumption, VR/AR in education is useful for boosting creativity.

Personalizing education

Incorporating virtual reality education in the classroom allows teachers to tailor lessons to the needs of the individual student. The application of VR/AR can make the learning experience a uniquely individual one.

Creating a learning community

Educators can help their students connect to a learning community in which they can help each other work through difficult concepts with the assistance of software applications.

Contribute to inclusivity

Some models of VR and AR are specifically designed for different types of disabilities and are enabling students to simply regulate their devices and blend in the classes.

 5G TECHNOLOGY

Advancement in technology, especially the introduction of 5G technology brings several benefits to higher education:

Connectivity to more devices

While 4G technology can only support a couple of thousand devices at once with a few minor delays, 5G has the ability to support a million devices without any delays.

High-quality lessons in VR and AR

By using 5G instead of 4G technology, students will have a seamless experience while they are learning. Educators can give students to visit other planets or even take a tour of the human torso thanks to VR.

5G helps educators save time when they are teaching

With the help of 5G technology and IoT educators have the ability to log in with ease as soon as they enter their respective classrooms. Small administrative jobs can be automated to be done via 5G and students can receive feedback digitally.

Videos can be downloaded quicker

Educators who use YouTube to teach their students will definitely benefit from the strength of 5G tech because videos will be downloaded in minutes not hours.

Students with special needs can learn better with 5G

Learning can be challenging for a student with learning difficulties or special needs. They need to be assisted more than other students and thanks to 5G, robot apps can be implemented in the classroom to aid them to deal with various problems.

Opens the door to make lessons more flexible

Students can carry on learning even when they are outside the classroom thanks to 5G technology because they will be able to get the same responsiveness as well as speed on their tablets, PCs, and smartphones.

5G technology makes learning fun

5G technology allows students to download apps that can make studying more engaging and fun.

CLOUD COMPUTING

By implementing cloud computing, it becomes possible to bring teachers and learners together on a single, unified platform. Additionally, they can always be sure about their resources being secure on the cloud. The extensive benefits of cloud computing in the field of education are:

Strong virtual classroom environments

With cloud-based software, it becomes possible for educational organizations to have virtual classrooms for the students. The concept reduces the infrastructural costs to a considerable extent. Students can even appear for virtual exams, saving their time and expenses effectively.

Ease of accessibility

Users can easily access the course content, applications, and data anytime and anywhere. The barriers of place and time no longer exist, the cloud always ensures seamless delivery of content.

Secure data storage

Cloud computing also serves the benefit of secure data storage. Organizations that deliver learning through the cloud can adopt a VPN for ensuring data security. This means that the learning content can be easily transferred to the users without compromising its integrity.

Scalability

Cloud Computing enables educational facilities to handle an increasing number of students and to manage the usage peaks and traffic spikes caused due to events like training registrations and assignment submissions.

Agility and innovation

Learning providers can innovate to create better learning experiences for the students. This becomes possible because new tools and features can be developed, tested, and deployed in the applications to make them better than before.

Greater reach for the students

Cloud computing works wonders for students who want to opt for remote learning or even pursue courses overseas. Working professionals who are unable to attend conventional classes but want to upgrade their skills can also take virtual classes.

Extensive cost-savings

Another benefit of cloud computing is extensive cost savings. Students need not invest in expensive books and applications as these learning resources are available on the cloud.

Minimal hardware requirements

With cloud-based applications, the requirements of hardware resources are minimal. These applications can operate seamlessly on internet browsers, both on desktops and mobile devices.

CONCLUSION

In the future, technology will influence the learning experience in many ways. To make education interesting, relevant and practical higher education institutions must focus on changing trends and start adapting to new technologies. Adaption of innovative trends will not only help the educational institutions to improve the quality of education but also help the students to grasp better, recall quickly and retain the knowledge for longer duration. Step by step approach of adopting those technologies can help a long way for improving higher education integration with the industry-relevant knowledge base. Students who learn through technology acquire the skills they need to survive in a complex, highly technological knowledge-based economy that will help them throughout their future careers.

REFERENCES

1. Agrawal, S. (2021). A Survey on Recent Applications of Cloud Computing in Education: COVID-19 Perspective. *Journal of Physics: Conference Series*; Bristol Vol. 1828, Iss. 1, (Feb 2021). DOI:10.1088/1742-6596/1828/1/012076.
2. Awaji, B., Solaiman, E., & Albshri, A. (2020). Blockchain-Based Applications in Higher Education: A Systematic Mapping Study. *Proceedings of the 5th International Conference on Information and Education Innovations*, pp. 96–104. Published by ACM, <https://dl.acm.org/doi/10.1145/3411681.3411688>.
3. Dhawan, S., Batra, G., Artificial Intelligence in Higher Education: Promises, Perils, and Perspective, *Journal: OJAS-Expanding Knowledge Horizon* (Vol.9, No. 2), 2020, pp. 11-22, <https://jaipuria.edu.in/pgdm/wp-content/uploads/2021/01/Ojas-July-Dec-2020-Issue.pdf#page=15>
4. Fedorova, E. P., & Skobleva, E. I. (2020). Application of Blockchain Technology in Higher Education. *European Journal of Contemporary Education*, 9(3), 552-571, http://ejournal1.com/journals_n/1599673646.pdf

5. Francisti, J., Balogh, Z. Reichel, J., Magdin, M., Koprda Š., Molnár, G., Application Experiences Using IoT Devices in Education, *Applied Sciences*, 10 (20) (2020), p. 7286, <https://doi.org/10.3390/app10207286>.
6. Grace, U. T., Artificial intelligence & higher education: Towards Customized Teaching and Learning, and Skills for an AI World of Work, *CSHE Research & Occasional Paper Series*, June 2020, pp. 1-13, <https://files.eric.ed.gov/fulltext/ED606654.pdf>.
7. Guntur, M. I. S., Setyaningrum, W., Retnawati, H., and Marsigit, M. (2020). Assessing the Potential of Augmented Reality in Education, 11th International Conference on E-Education, E-Business, E-Management, pp. 93-97.
8. Iatsyshyn, A., V., Kovach V. O., Lyubchak V., O., Zuban Y., O., A. V. Piven., A., G., Sokolyuk., O.M, Iatsyshyn A.V. Popov., O., P., Artemchuk., V., O., Shyshkina M., P., (2020) Application of augmented reality technologies for education projects preparation *CEUR Workshop Proceedings*. pp. 134–160, <http://ceur-ws.org/Vol-2643/paper07.pdf>
9. Ilieva, G., & Yankova, T. (2020). IoT in Distance Learning during the COVID-19 Pandemic. *TEM Journal*, 9(4), <https://doi.org/10.18421/TEM94-45>.
10. Mircea, M., Stoica, M., & Ghilic-Micu, B. (2021). Investigating the Impact of the Internet of Things in Higher Education Environment. *IEEE Access*, 9, 33396–33409, <https://doi.org/10.1109/access.2021.3060964>.
11. Muhairat, M., Abdallah, M., & Althunibat, A. (2019). Cloud computing in higher educational institutions, *An International Journal of Advanced Computer Technology*, 8(12), <https://ijact.in/index.php/ijact/article/view/964>
12. Nurbekova, Z., and Baigusheva, B., (2020). On the Issue of Compliance with Didactic Principles in Learning using Augmented Reality. *International Journal of Emerging Technologies in Learning (iJET)*, 15(15), pp. 121-132, <https://online-journals.org/index.php/i-jet/article/view/14399/7637>
13. Raimundo, R., & Rosário, A. (2021). Blockchain System in the Higher Education. *European Journal of Investigation in Health, Psychology and Education*, 11(1), 276–293. MDPI, <http://dx.doi.org/10.3390/ejihpe11010021>.
14. Romanov, N., Iulian Cluci, M., Anastasiei, I.D., Tugui, A., Artificial Intelligence Applications And Tools In Higher Education: An Overview, *Conference: SESYR Sustainable Education through European Studies for Young Researchers Jean Monnet Module*, Romania, October 2020, pp. 11-29.
15. Singar A.V., Akhilesh K.B. (2020) Role of Cyber-security in Higher Education. In: Akhilesh K., Möller D. (eds) *Smart Technologies*. Springer, Singapore, https://doi.org/10.1007/978-981-13-7139-4_19.
16. Ulven, J. B., & Wangen, G. (2021). A Systematic Review of Cybersecurity Risks in Higher Education, 13(2), 39. MDPI AG, <http://dx.doi.org/10.3390/fi13020039>.
17. Umaimah, M., & Jaidi, B. A. (2020). 5G Communications: Potential Impact On Education Technology In Higher Ed.
18. Wigati, N., Wibisono, A. and Hidayanto, A. (2021). Challenges of Infrastructure in Cloud Computing for Education Field: A Systematic Literature Review. In *Proceedings of the 23rd International Conference on Enterprise Information Systems - Volume 1: ICEIS*, ISBN 978-989-758-509-8, pp. 351-358. DOI: 10.5220/0010522603510358.
19. Xu, J., Cui, Y., Huang, X , Mo, S. , Wang, L., Su, G. and Cheng, Y. (2020). The Prospect of 5G Technology Applied to Distance Medical Education and Clinical Practice. *Creative Education*, 2837-2845, doi [10.4236/ce.2020.1112209](https://doi.org/10.4236/ce.2020.1112209).
20. Xue, J., & Mao, M. (2021). Research on the impact of 5G technology on teaching behavior. *ISBDAS 2021*, IOP Publishing, *Journal of Physics: Conference Series* 1955 (2021), <https://iopscience.iop.org/article/10.1088/1742-6596/1955/1/012117/pdf>.