ORIGINAL

Next-Generation Educational Technologies in University Settings

Tecnologías educativas de nueva generación en el entorno universitario

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ABSTRACT

Introduction: in view of digitalisation, use of modern technology in education has become necessary as education is aiming at quality. For teachers and facilitator, the impact of technology namely e-learning, blended learning, mobile learning and AI on learners and the learning outcomes has to be explored.
Methods: systematic analysis, comparative analysis, modelling, and classification of educational technologies were used in the study. The purpose of these methods was to discover main features of modern educational technologies and to appraise their role in the teaching and learning processes in higher education.
Results: results suggest that modern learning technologies help make education much better and student performance significantly improves with the integration of modern learning technologies. Blended learning and AI application leverage flexible, personalized learning, which is offered in multiple modes of delivery, texts, videos, audio, and more. Technological aspects are shown to be essential for promoting such competences in students.
Conclusions: new technologies like AI and cloud based apps give you the ability to transform your course design with personalisation, collaboration, and direct communication between teachers and students. These improvements serve to highlight that well defined guidelines need to be combined with practical tools to optimise the integration of modern technologies into educational processes to promote the professional growth and activity of students.

Keywords: Learning; Blended Learning; Modern Technologies; Higher Education; Mobile Learning; Cloud Technologies; Artificial Intelligence; Personalised Learning; Educational Process; Professional Competences.

RESUMEN

Introducción: el uso de las tecnologías modernas ya no puede ignorarse. Esto es cierto a medida que la sociedad hace frente a la actual tendencia hacia la digitalización y se esfuerza por mejorar la calidad de la educación. Los profesores y facilitadores deben comprender cómo la tecnología en entornos de aprendizaje como el eLearning, el aprendizaje combinado, el aprendizaje móvil y la IA afectan a los alumnos y a otros resultados del aprendizaje.
Método: este estudio pretende analizar los retos y las estrategias que emplean las universidades en relación con la tecnología. Por lo tanto, se ocupa del diseño, el desarrollo y la evaluación de nuevos sistemas

educativos pedagógicos que utilizan tecnologías digitales en el proceso de enseñanza y aprendizaje.
Resultados: durante el estudio se emplearon varias estrategias, como el análisis de la información ya disponible, la comparación de diversas tecnologías, la modelización del proceso educativo y la clasificación de la tecnología por características más importantes y ámbito de uso. El estudio estableció que la adopción de tecnologías modernas de aprendizaje tiene un efecto general sobre la calidad de la educación, el rendimiento de los estudiantes y el desarrollo de competencias profesionales. Los estudiantes pueden aprender dónde y cuándo quieran gracias a los múltiples modos de entrega de textos, vídeos, diapositivas, audio y películas del aprendizaje combinado.
Conclusiones: la IA, como los chatbots, puede añadir otra capa al diseño del curso personalizando la experiencia de aprendizaje para cada estudiante. El desarrollo de una aplicación basada en la nube permite a los estudiantes seguir colaborando y acceder fácilmente a los materiales de estudio, al tiempo que facilita el vínculo entre estudiantes y profesores. El valor aplicado de los resultados de la investigación reside en la formulación de las directrices para las herramientas prácticas de la enseñanza sobre el uso de ayudas y técnicas contemporáneas para los procesos educativos y la actividad profesional de los estudiantes.

Palabras clave: Aprendizaje; Aprendizaje Combinado; Tecnologías Modernas; Educación Superior; Aprendizaje Móvil; Tecnologías en la Nube; Inteligencia Artificial; Aprendizaje Personalizado; Proceso Educativo; Competencias Profesionales.

INTRODUCTION

The increased growth rate of technology worldwide affects all areas of life, including education. In the case of higher education, this relationship strengthens the argument for investing in the latest advanced technological learning systems, thus providing higher standards of education, enabling wider access to knowledge, and increasing the students' professional skills and competences. These changes highlight the need to research and evaluate the contemporary technologies employed in the context of higher education institutions and their effectiveness in enhancing the quality of education. A current trend in research advocates for using technology in higher education. For instance, Amenduni and Ligorio[1] investigate the socio-political contexts of using blended learning in education and how this enhances student learning by encouraging the use of many learning formats. Mirajkar[2] strongly opposes the blended learning model, stressing that its application in higher learning increases students' interest and study retention.

Similarly, Stepanova[3] is concerned with introducing the blended learning model in universities and analysing its pros and cons. Due to the emergence of AI and machine learning, understanding the appropriate educational resources for different learners becomes easy because lessons can be designed for specific learners. That is why the introduction of new learning technologies and their application in education should be good for higher institutions that aim to improve the effectiveness, availability, and individualisation of the education process.

The higher education system is changing in the context of widespread technological development and its successful application in different areas of human activity. A cultural shift in learning patterns solely based on the traditional model will have to occur. This calls for enhancing the learning environment, which means new and relevant curriculum designs considering students' changing needs. In this regard, new technologies like e-learning, blended learning, mobile learning, MOOCs, gamification, virtual and augmented reality technologies, artificial intelligence and cloud technologies are now considered an exceptional means of improving the educational process. However, introducing these technologies has disadvantages; significant investments, teacher training, and changes to the curriculum are all pre-conditions followed by technical challenges. The question is that many analysts point out the contemporary challenge, which is the use of modern technologies in higher education, which has great potential, but to utilise this potential requires thorough consideration, preparation and evaluation. There is a need to assess which technologies can be best incorporated into the education process, the impact on the learners' achievements, their acquisition of professional skills, and the limitations and dangers accompanying such technology. In this regard, it becomes necessary to investigate and evaluate the present-day teaching technologies in universities and their influence on the education process.

The aim of the paper is to study the teaching technologies that are already used and can be applied in higher educational institutions, concentrating on the quality of education and professional competences of the students.

Literature review

Blended learning technology enhances teaching practice by integrating online technologies into pedagogical activities. Amenduni and Ligorio[1] perceive the international context of blended learning as an accent on the need to combine different modes of instruction to enhance learning. Mirajkar[2] has pointed out the flexibility and self-directedness that blended learning offers, seeing the need for it in higher education.

A report of a multi-country study by Stepanova[3] investigates the challenges and advantages of using a blend of teaching and more orthodox learning methods in tertiary institutions. A technology model of professional competence acquisition via blended learning for the master's level is presented by Batsurovska[4] . Nearly the same issues were grounds for Horbatiuk[5] to study the focus of internationalisation of learning in higher educational institutions. A case study of blended learning in vocational education and training is critically evaluated by Reigeluth[6] to demonstrate how the technology may ease the current higher education quagmire. The impact of AI and ML tools on personalised education in the context of blended learning is stated by Bilow[7] to constitute a new trend. Blended learning offers numerous opportunities to enhance the standard and quality of higher education concerning traditional and new changes.[8,9]

The integration of mobile technologies in education. Mobile technologies have their advantages; one is enhancing access and interaction for the viewers. El-Sofany and El-Haggar[10] assessed its effectiveness in higher education, stressing that the learning outcomes of the mobile learning programme were significantly improved. In this regard, Kustandi et al.[11] have reported on virtual reality in online education and mobile devices. Ullah et al.[12] studied the influence of mobile technologies on e-learning processes within higher education. Sokhina et al.[13] imagined the prospects of using cloud computing to serve higher education institutions explicitly focusing on mobility. Tayirova[14] examined the potential of cloud computing in higher education, emphasising its use with portable devices. Al Masarweh and Afandi[15] analysed the factors affecting distance education participants' mobile learning adoption. Swiontek et al.[16] discussed mobile applications and the machine learning paradigm in the context of higher education. Horbatiuk[5] looked at mobile learning technologies as one of the interactive learning technologies. Implementing mobile technology appears to be a prevailing trend in seeking to achieve the goals and objectives of higher education because it helps make the education process more accessible and interactive.

The incorporation of AI and ML techniques has minimised the educational process into efficient and highly optimised content suited to their respective students. Bilow[7] analysed advancement of the blended learning. Stepanova[3] extended this definition to the blended learning approaches that include AI technologies. Swiontek et al.[16] also examined the application of machine learning in higher education, focusing on its application in adaptive learning. Vergara et al.[17] also studied gamification, and together, the two spoke about AI applications in higher education. Soloviev et al.[18] disagreed with the previous researchers and advocated for the development of laboratory work integrating AI and 3D models. Sokhina et al.[13] have made this possible by cloud technologies. Reigeluth[6], on the contrary, did not underestimate MOOCs; he believed that for the fast-growing difficulties in the higher education system, these resources must be seen as tools regarding this challenge, with AI being one. The application of various AI and machine learning strategies provides for the time and realities of advanced forms of providing personalised education services.

The Implementation of Cloud Technologies in the Sphere of Higher Education. Cloud technologies are an excellent tool for storing, sharing, and accessing learning materials in higher education institutions. Sokhina et al.[13] consider the areas of development of cloud technologies in higher education, stressing the collaboration prospects. Tayirova[14] reveals the usage of cloud technologies within the higher education system, including their role in distance education. Soloviev et al.[18] discuss implementing 3D models in the laboratory due to the cloud-based applications. Parusheva et al.[19] highlight the contribution of higher education institutions to the improvement of sustainable development with a specific focus on the frameworks of cloud technologies. In his study, Poliak[20] examines how mobile information gadgets, including clouds, are employed in higher institutions to teach and learn. Riznyk[21] analyses the importance of distance education delivery technologies in specific aspects of the activity in every higher education institution, providing relevant cloud-based multimedia technologies. Pyzh and Halenko[22] look at the perspectives of distance education in higher education institutions under conditions of distant cloud services. El-Sofany and El-Haggar[10] focus on the assessment of the achievements of students in higher education programmes with the help of cloud learning technologies. Cloud technologies are increasingly seen as an integral part of the contemporary educational activity of higher educational institutions, which improves and expands the reach of educational materials.

METHOD

Systematising and analysing are two methods that understand the same tasks, albeit with a slightly different approach. These processes consist of dividing broader phenomena into little parts analysis and then reconstructing or combining the parts into a raw whole synthesis. Within the scope of this research, the collocation of this statement helps determine the principal elements and characteristics of modern educational technologies such as e-learning, blended learning, and mobile learning, among others. Synthesis is simply the reverse; it takes the particularised data and studies the relationships of interdependence along broader parameters around these variables and depicts the role played by these technologies to the educational processes in the institutions of higher learning.

This article presents a comparative analysis of the ways in which e-learning supports students' effectiveness,

motivates learners, and facilitates the provision of educational materials. Ultimately, this method provides a comprehensive understanding of the relative merits and demerits of various technologies, depending on the educational level. The comparative analysis results will reveal the most efficient and effective learning technologies.

This article uses modelling to determine the possible advancement effects of specific technologies on educational processes. This system approach provides insight into the interdependencies of the different elements that make up the education system. Furthermore, these models assist in formulating actions for the efficient and effective utilisation of existing technologies.

In this research, the focus of classification is in the context of the information about the learning technologies of the 21st century, the basic features and the relevant fields of use. This technique is important as it explains the broader range of technologies and their application in higher education institutions. The outcomes of this classification can help formulate syllabuses and design and use these technologies in education systems.

RESULTS

Recent learning technologies have been an important factor in changing the educational process in colleges and universities. They assist в education quality enhancement, its coverage and the individual approach to the student. It is also necessary to mention the most important one: Internet-based learning. Lecture intervention methods involve using online resources, including audio-visual resources, digital tools, and multimedia, to give lectures, quizzes, assessments, and feedback. For instance, Alnemrat et al.[23] note that Moodle and Blackboard allow instructors to upload content with interaction, meaning learning can be done at a self-paced pace.

Blended Learning View refers to the approach in which traditional instruction in class is combined with components delivered online. Students can learn the theoretical aspect of the course through online lectures and later participate in practical sessions in the classroom under the supervision of a teacher. This technique ensures that students grasp a better understanding of the subject.

Mobile Learning (m-learning) refers to teaching and learning using mobile devices such as smartphones or tablets to access course materials, do assignments, and communicate with lecturers or students. This teaching technique is quite flexible, allowing learning to be done wherever and whenever needed, which is helpful to students whose studying is accompanied by working.

Massive Open Online Courses mean that courses offered by recognised top universities across the globe are opened up for all to access for free. Through Coursera, edX, and FutureLearn, students can learn various courses and acquire certificates, improving their employment chances.[24]

According to educational experts[25], game-based learning (or simply gamification) refers to a learning approach that integrates points, levels, and rewards into the learning process. Through game-based platforms such as Kahoot and Quizlet, learning becomes engaging and more interactive than before.[26,27]

Virtual and augmented reality (V/AR) technologies make it possible to visualise information through a 3D interactive model or simulation in which students are actively involved. These technologies are convenient, especially in training areas such as medicine, engineering, and architecture, where practical work is highly emphasised.

The students' information on their levels of understanding determines the AI and machine learning used in formulating adaptive learning systems. Better still, this trend of personalisation of learning supports the development of personalised learning experiences and makes the assessment more sophisticated.

Cloud technology has made it better for sharing, storing information, and brokering documents through online software, applications, and education resources. The frequently used tools include Google Drive, Dropbox, and OneDrive, among others, supporting this process.[28] Learning in colleges and universities becomes easier and more collaborative using these technologies; therefore, educational standards are improved, and universities prepare students for professional work. The perspective of List 1 is focused on the advantages and disadvantages of several teaching technologies in higher education (table 1).

Table 1. Advantages and disadvantages of different learning technologies in higher education		
Learning technology	**Advantages**	**Disadvantages**
Electronic learning (e-learning)	availability, flexibility, cost-effectiveness	technical problems, motivation, limited communication
Blended learning	integration of best practice, in-depth understanding	the complexity of the organisation, double workload
Mobile learning (m-learning)	convenience, interactivity	limited capabilities of devices, distractions
Massive open online courses (MOOCs)	wide access, diversity	low completeness, less personalisation
Game-based learning (gamification)	increased motivation, improved memorisation	distractions, different interests

Virtual and augmented reality (VR/AR)	realism, interactivity	cost, technical difficulties
Artificial intelligence (AI) and machine learning	personalisation, efficiency	data dependency, ethical issues
Cloud technologies	cooperation, accessibility	security, dependence on the Internet

Contemporary cellular, computer, and other devices are substantially changing the educational process in higher education institutions and making teaching and learning more effective. Educational technologies have been aptly named as the innovations that most effectively redefine the methodological aspect of learning. However, it is always important to consider the implementation of new technologies into the educational process from several defeating perspectives. In such competition as higher education has entered in recent years, for most institutions of higher education, the key is to adapt the teaching process and turn the weaknesses of information technology into substantial benefits.[29] Introducing advanced technologies within a framework of integrated education promotes more interaction and individualised instruction, ultimately increasing students' practical involvement in the learning process. E-learning and mobile apps can also contribute towards enabling students to have more liberty in their learning time and use good course material. Figure 1 shows the propensity and statistics of the modernisation of the higher education sector from 2018 to 2023.
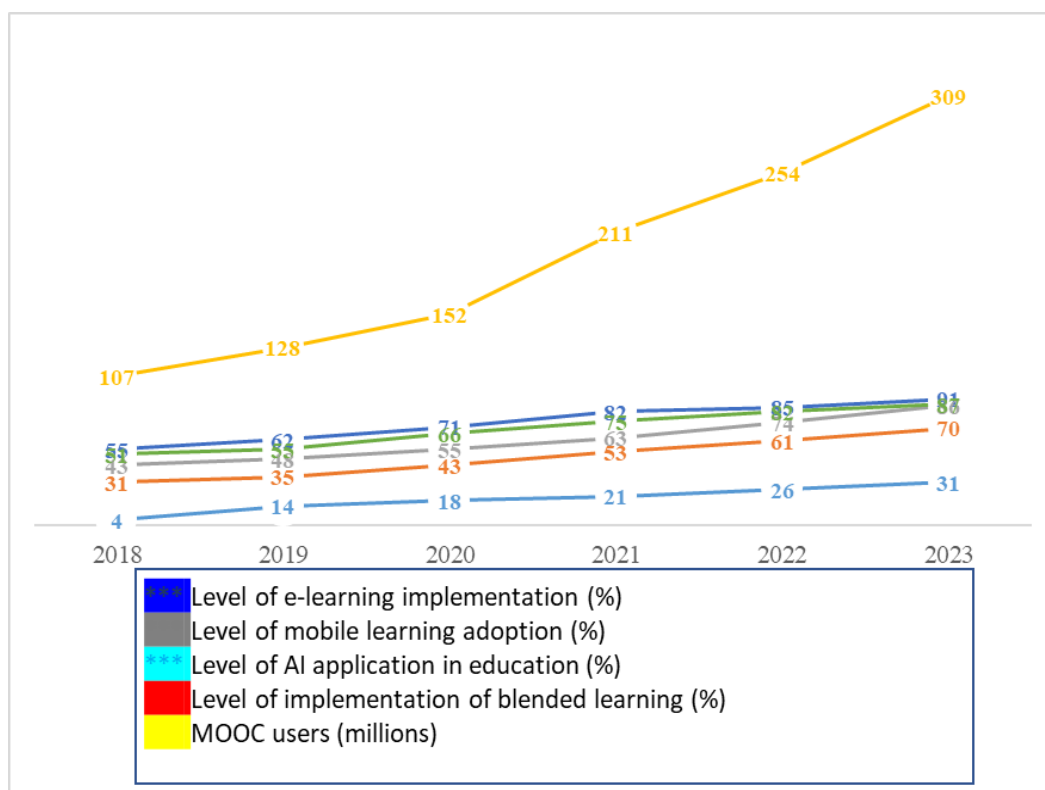

Figure 1. Statistical data on the introduction of modern technologies in higher education (2018-2023)
Source: Built based on[1,7,10,13,30]

The graph depicts the changes in the pattern of using modern technological tools within the context of education between 2018 and 2023. During this period, user statistics increased from 107 million in 2018 to 309 million in 2023, indicating increased demand and popularity of online courses. Also, there has been a gradual increase in e-learning adoption from 4 % in 2018 to 31 % in 2023, further pointing out the growing trend of online education. The most preferred model of e-learning during that time was blended learning. Its popularity grew from 31 % in 2018 to 70 % in 2023 as it was traditional face-to-face lessons supplemented with online content. So, without a doubt, mobile learning also increased along with the boost of mobile technologies, which led to a growth from 43 % in 2018 to 61 % in 2023. In addition, artificial intelligence in education was gradually finding its place, with usage increasing from 14 % in 2019 to 31 % in 2023, demonstrating how AI is reshaping the educational landscape. In addition, there was also an increase in the use of cloud technologies, with the figures going from 55 % in 2018 to 85 % in 2023, which is now essential in modern education systems.

The graph marks the improvement in the adoption of technological innovations within education systems, further suggesting that education systems are dynamic about technology adoption. The increasing adoption

of MOOCs, cloud technologies, and artificial intelligence in educational processes indicates how these tools change how people learn. These trends resonate with the ongoing changes that higher education is undergoing, all of which are enabled by these technologies. It is also worth considering the application of these technologies in the best institutions worldwide.

An important instance is blended learning, which integrates conventional educational practices with Internet instruments.

Several high-ranking universities employ this method:

1. Xuezheng University combines distance and onsite learning, improving students' learning experience.

2. Stanford University employs m-learning so that the students can take part in courses from anywhere and at any time due to the portability of the devices.

3. The National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" uses advanced distance education technologies to extend educational opportunities and make teaching learning more a wide range of students.

"Distance education" is there to support students during their studies, using AI and machine learning algorithms to allow for better results during education and make it more pleasant for every person:

– Carnegie Mellon University supports AI. It consolidated AI use into teaching units to explain why it enables ideas generation and creating unique combinations, let alone adaptive units learning to purposefully meet individual student's needs to make it desirable for courses themselves.

– The University of Cambridge has applied several machine learning algorithms, processes, and tools to academic data to enhance the educational process.

– *Harvard serves as a case study, demonstrating that when all the factors are aligned —including the educational background and the CCA itself—the result is a successful outcome:*

– The University of California, Berkeley, has employed cloud-hosted learning materials to enhance effective collaboration between students and teachers throughout the process.

– V. N. Karazin Kharkiv National University uses cloud technologies for distance learning, allowing for effective communication between students and teachers through cloud services.

According to Sindhu,[31] the newly developed MOOC platform is intended to broaden the teaching and learning of courses offered by reputable universities worldwide. For instance, Yale and Oxford provide courses through Coursera and edX, which enables students from many parts of the world to receive the sought-after education.

There exist maturing VR/AR technologies that are employed for the setting up of interactive models and simulations:

– Students from Imperial College London can make use of VR for medical education and interact with patients in a virtual setting

– The National University of Life and Environmental Sciences of Ukraine students use VR to undertake AR simulations of natural processes in engineering education.[32]

The examples of some of the significant components of contemporary educational models adopted by some leading universities provide adequate evidence supporting the claim about the impact of modern technologies in enhancing the quality of education and professional competences of students. Their collision, however, alters the educational processes and their comprehension, increasing flexibility, interactivity and ease of learning. Properly implemented blended learning, mobile technologies, artificial intelligence, cloud computing, MOOCs, VR/AR, and other educational technologies improve learning and students' knowledge. Table 2 presents belief items with suggestions on how to apply and adapt modern learning technologies.

Table 2. Recommendations for the optimal implementation and use of modern learning technologies	
Recommendation	**Detailed description**
Assessment of needs and opportunities	The first step to attaining goals is to study the educators' and students' particular requirements. It also evaluate the institution's present financial soundness and capacity to absorb new trends in technology.
Planning and strategy development	It is also essential to devise a coherent plan explaining how the technology will be implemented, along with short—and long-term goals. This plan could also provide a complete information guide on the specific initiative.
Training and support for teachers	Conduct strategic development initiatives related to the practice of translators and educators so that there could be workshops and training. Implement an aid centre to help with both technical and methodological issues.
Pilot projects and feedback	Start by testing the required new technologies through pilot schemes. They analyse the feedback received and make the necessary changes to improve the initiative.

Integrating technology into the learning process	Use modern methods of employing the required information technology to improve the existing strategies. Apply a mixed teaching method by incorporating both online and offline methods.
Personalisation of training	Introduce AI-supported teaching methods that allow personalising the process of education. Create individualised education pathways for each student.
Developing mobile learning	Construction and reconstruction are now accessible physically and virtually through mobile applications and platforms. Encourage students to use mobile devices as a component of the learning process.
Use of virtual and augmented reality (VR/AR)	Use AR/VR techniques to produce virtual and augmented training content and simulations that require practical work.
Gamification of the learning process	Gamification could increase participation and performance. Tools like Kahoot! and Quizlet could incorporate fun into the learning process.
Cloud technologies for collaboration	Use cloud-based tools to store and shift teaching materials. Encourage students to work as a team, using the Cloud to reinforce collaboration.
Evaluating and monitoring performance	Continually assess the effectiveness of the introduced technologies based on student outcomes and teacher input. Modify the strategy based on the information gathered.

Technology use in higher education significantly improves and universalises the learning process. Nevertheless, careful preparation, teacher training, and embedding of technologies in the learning process make it possible to achieve the goal of effectively targeting digital tools. However, it is paramount to analyse the advantages and drawbacks of employing new technologies. The implementation evaluation and modification processes will allow educational activities to be relevant to the ongoing changes in students' and teachers' requirements.

The use of mixed approaches to incorporating modern technologies into the educational practices of higher education institutions is a complex issue that can not be approached in isolation. Different technologies can bring some benefits and disadvantages, which should be carefully evaluated before the technology is utilised.

DISCUSSION

Blended learning is arguably one of the most talked about features, as it integrates conventional teaching and learning with the web in multiple instances. A study by Amenduni and Ligorio[1] notes that blended learning helps increase the efficiency of the learning process because it is more flexible and available. Mirajkar[2] points out that using this technology involves some organisational changes that require substantial resources and could be a barrier to some organisations.

Mobile technology is also interesting in the context of higher education. El-Sofany and El-Haggar[10] emphasise further that mobile learning enhances students' performance as a result of engaging them by being able to provide instructional materials anytime and anywhere. However, Kustandi et al.[11] discuss the effectiveness of mobile devices in terms of other developments that could quickly distract students from where they are meant to pay attention.

Utilising artificial intelligence (AI) and machine learning can help create new methods to customise learning methods. According to Bilow,[7] even though those systems are recommended, digital transformation processes can only be successful with them. Stepanova[3] cautions about ethical and legal concerns associated with education AI, for example, privacy and fairness of algorithms.

The availability of these technologies over the cloud allows learners and instructors to interact better and have easier access to learning resources. As Sokhina et al.[13] put it, cloud-based technology enhances group work and information dissemination, an essential feature of contemporary education. On the contrary, Tayirova[14] emphasises the dangers of internet penetration and data privacy that can prevent the application of these technologies in some countries.

Introducing modern technologies to the higher education sector is a complex process that touches various aspects, including technical, organisational, ethical, and legal. Implementing these systems is very risky. While benefits can be derived from such systems, careful and detailed analysis is required to assess their impact directly on the transformation of the educational environment.

CONCLUSION

Before blending traditional educational methods with more modern online components, mainstream students had little access to quality education. As a result, many students opted to forgo higher education as it slowed their career paths. While attending online classes began to gain traction, COVID-19 fueled its growth further, leading to a massive spike in the number of standard online degrees sought out. However, switching to distance education presents challenges, such as creating efficient digital classrooms, setting up proper communication channels, and ensuring the materials are interactive and engaging. More engagement would result in better information retention, better integration and application of skills. Integrating remote education services would

significantly damage the existing education systems in terms of core functionality and resource use. The future of education, which is already visible in terms of "EdTech. will significantly disrupt the entire higher education market. The "Worth of One Touch" project, if blended with virtual reality and artificial intelligence, will be developed for the future. Although many regulations and guidelines have been issued throughout recent years, most higher educational institutions did not have clearly defined procedures for taking remote education seriously. This created a lack of readiness and preparation when the time came, leading to a disorganised and fragmented approach.

BIBLIOGRAPHIC REFERENCES

1. Amenduni F, Ligorio MB. Blended learning and teaching in higher education: An international perspective. Education Sciences. 2022;12(2:129. https://doi.org/10.3390/educsci12020129

2. Mirajkar R. Blended learning - need of higher education. Zenodo (Cern European Organisation for Nuclear Research). 2021. https://doi.org/10.5281/zenodo.6948841

3. Stepanova EV. The blended learning in higher education. The European Proceedings of Social and Behavioural Sciences. 2020. https://doi.org/10.15405/epsbs.2020.10.03.103

4. Batsurovska I. Technological model of training of masters in electrical engineering to electrical installation and commissioning. Journal of Physics: Conference Series. 2021;1946(1):012015. https://doi.org/10.1088/1742-6596/1946/1/012015

5. Horbatiuk O. Interactive learning technologies in higher education institutions. Pedagogical Education: Theory and Practice. 2022;32:20-30. https://doi.org/10.32626/2309-9763.2022-32.20-30

6. Reigeluth CM. MOOCs in the higher education crisis. Red. Revista de Educación a Distancia. 2019;19. https://doi.org/10.6018/red/resenas/04

7. Bilow SC. AI and machine learning. SMPTE Motion Imaging Journal. 2021;130(3):10-11. https://doi.org/10.5594/jmi.2021.3057688

8. Eker B, Akdogan A. Quality criteria in universities. Journal of International Business and Innovation. 2023;01(02):65-70. https://doi.org/10.61552/JIBI.2023.02.002

9. Abidoye FO, Adeyemi AD. Analysis of secondary school students' performance in biology and chemistry in Nigeria: Influence of ICT. Journal of Education, Management and Information Technology. 2024;02(01):43-48. https://doi.org/10.61552/JEMIT.2024.01.006

10. El-Sofany HF, El-Haggar N. The effectiveness of using mobile learning techniques to improve learning outcomes in higher education. International Journal of Interactive Mobile Technologies. 2020;14(8):4. https://doi.org/10.3991/ijim.v14i08.13125

11. Kustandi C, Fadhillah DN, Situmorang R, Prawiladilaga DM, Hartati S. VR use in online learning for higher education in Indonesia. International Journal of Interactive Mobile Technologies. 2020;14(1):31-47. https://doi.org/10.3991/ijim.v14i01.11337

12. Ullah MW, Razaq N, Iqbal N, Ul Ain Q, Hassan U, Ahmed AH, Noor UA. Effect of E-learning on higher education. Pakistan Journal of Medical and Health Sciences. 2021;15(9):2903-2905. https://doi.org/10.53350/pjmhs211592903

13. Sokhina SI, Malinina ZE, Shevchenko ON. Prospects for cloud technologies in higher education. CTE Workshop Proceedings. 2013;1:12-13. https://doi.org/10.55056/cte.62

14. Tayirova MA. Possibilities of using cloud technologies in the higher education system. Frontline Social Sciences and History Journal. 2023;3(4:19-26. https://doi.org/10.37547/social-fsshj-03-04-04

15. Al Masarweh M, Afandi W. Investigating factors of m-learning acceptance and use for distance learning students in higher education. International Journal of Cognitive Research in Science, Engineering and Education. 2022;10(3:117-128. https://doi.org/10.23947/2334-8496-2022-10-3-117-128

16. Swiontek F, Lawson-Body A, Lawson-Body L. The use of machine learning in higher education. Issues in Information Systems. 2019;20(2:56-61. https://doi.org/10.48009/2_iis_2019_56-61

17. Vergara D, Gómez-Vallecillo AI, Fernández-Arias P, Antón-Sancho Á. Gamification and player profiles in higher education professors. International Journal of Game-Based Learning. 2023;13(1):1-16. https://doi.org/10.4018/ijgbl.323449

18. Soloviev VN, Lytvynova SH, Batsurovska IV, Dotsenko NA, Gorbenko OA, Kim NI, Haleeva AP. Technology of application of 3D models of electrical engineering in the performing laboratory work. In Proceedings of the 9th Workshop on Cloud Technologies in Education (CTE 2021); 2021:323-335.

19. Parusheva S, Bobek S, Zabukovšek SS. Sustainable higher education: From e-learning to smart education. Sustainability. 2023;15(13), 10378. https://doi.org/10.3390/su151310378

20. Poliak O. Modern information mobile tools of training in higher education institutions. Bulletin of Taras Shevchenko National University of Kyiv. Series "Pedagogy. 2019;2(10):48-51. https://doi.org/10.17721/2415-3699.2019.10.13

21. Riznyk N. Use of multimedia technologies during distance learning in higher education institutions. Economic Bulletin of the University. 2021;50:12-17. https://doi.org/10.31470/2306-546x-2021-50-12-17

22. Pyzh N, Halenko T. Creating the implementative conditions of information technologies in higher education institutions. Education. 2021;4:116-121. https://doi.org/10.37472/2617-3107-2021-4-11

23. Alnemrat A, Aldamen H, Al-Deaibes M, Alsharefeen R. E-learning in a Jordanian higher education institution. Frontiers in Psychology. 2023;14. https://doi.org/10.3389/fpsyg.2023.1136142

24. Singha BK, Chaveesuk S, Chaiyasoonthorn W. MOOCs adoption in higher education: A management perspective. Polish Journal of Management Studies. 2021;23(1):239-256. https://doi.org/10.17512/pjms.2021.23.1.15

25. Paľová D, Vejačka M. Implementation of gamification principles in higher education. European Journal of Educational Research. 2022;11(2):763-779. https://doi.org/10.12973/eu-jer.11.2.763

26. Saxena M, Mishra DK. Gamification and Gen Z in higher education. International Journal of Information and Communication Technology Education. 2021;17(4):1-22. https://doi.org/ 10.4018/IJICTE.20211001.oa10

27. Kovácsné KP. Gamification in higher education. Teaching Mathematics and Computer Science. 2021;18(2):87-106. https://doi.org/10.5485/tmcs.2020.0510

28. Nagayev V, Gerliand T, Kyrepin V, Nagayeva G, Sosnytska N, Yablunovska K. Pedagogical technology of management of students' educational and creative activities in the process of professional training of engineers. In IEEE International Conference on Modern Electrical and Energy Systems (MEES); 2021:1-4, https://doi.org/10.1109/MEES52427.2021.9598806

29. Batsurovska I, Dotsenko N, Gorbenko O, Kim N. The Technology of Competencies Acquisition by Bachelors in Higher Education Institutions in the Conditions of the Digital Media Communication Environment. In ICNTLLSC 2021 International Conference on New Trends in Languages, Literature and Social Communications (ICNTLLSC 2021); 2021.

30. Batsurovska I. Massive Open Online Courses in the System of E-learning of Masters in Electrical Engineering. In IEEE International Conference on Modern Electrical and Energy Systems (MEES); 2021:1-4. https://doi.org/10.1109/MEES52427.2021.9598641

31. Sindhu S. Examining higher education students' intention of adopting MOOCs: An empirical study. International Journal of Technology and Human Interaction. 2022;18(1):1-18. https://doi.org/10.4018/ijthi.299358

32. Magomadov VS. Examining the potential of VR and AR technologies for education. Journal of Physics.

2020;1691(1):12160. https://doi.org/10.1088/1742-6596/1691/1/012160

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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