

AR/VR AND VIRTUAL LABORATORY IN EDUCATION

Rafiqova Mubina Abdulaziz qizi
Rafiqova Madina Abdulxapiz qizi

Andijan Branch of Kokand University The Faculty of Social Humanities and Pedegogy
students: Email: mubinarafiqova9@gmail.com Tel:+998971055855

Annotation: *In the 21st century, the digitization of education has revolutionized traditional learning methods, offering new opportunities for both educators and learners. This transformation is driven by digital platforms, innovative technologies, and artificial intelligence (AI), which collectively enhance the accessibility, efficiency, and personalization of education. Educational platforms such as Learning Management Systems (LMS), Massive Open Online Courses (MOOCs), and virtual classrooms have made education more accessible across the globe. Innovative technologies, including Virtual Reality (VR), Augmented Reality (AR), and cloud-based applications, create immersive and interactive learning environments. Meanwhile, AI plays a crucial role in automating administrative tasks, providing personalized learning experiences, and developing intelligent tutoring systems. A virtual laboratory is a software and complex experiments conducted without direct or complete contact with a real installation. In the first case, we are dealing with a laboratory installation via a remote control, for which it is necessary to control the installation and digitization of a real laboratory, including software and equipment, and the data received, as well as communication facilities. In this case, all processes are simulated using a computer. In the second, both types of laboratories are often called virtual, although this definition is only suitable for the second. This article analyzes the impact of virtual labs and AR/VR on education and highlights their advantages and challenges.*

Key words: *Education, methods, platforms, VR, AR, learn, knowledge, science, researchers, country.*

Аннотация: *В XXI веке цифровизация образования произвела революцию в традиционных методах обучения, открыв новые возможности как для педагогов, так и для учащихся. Эта трансформация обусловлена цифровыми платформами, инновационными технологиями и искусственным интеллектом (ИИ), которые в совокупности повышают доступность, эффективность и персонализацию образования. Образовательные платформы, такие как системы управления обучением (LMS), массовые открытые онлайн-курсы (MOOC) и виртуальные классы, сделали образование более доступным во всем мире. Инновационные технологии, включая виртуальную реальность (VR), дополненную реальность (AR) и облачные приложения, создают захватывающие и интерактивные среды обучения. Между тем, ИИ играет решающую роль в автоматизации административных задач, обеспечении персонализированного обучения и разработке интеллектуальных систем обучения. Виртуальная лаборатория — это программное обеспечение и сложные эксперименты, проводимые без прямого или полного контакта с реальной*

установкой. В первом случае речь идёт о лабораторной установке с удалённым управлением, для чего необходимо контролировать установку и оцифровку реальной лаборатории, включая программное обеспечение и оборудование, получаемые данные и средства связи. В этом случае все процессы моделируются с помощью компьютера. Во втором случае оба типа лабораторий часто называют виртуальными, хотя это определение подходит только для второго типа. В данной статье анализируется влияние виртуальных лабораторий и дополненной и виртуальной реальности на образование, а также выделяются их преимущества и проблемы.

Ключевые слова: Образование, методы, платформы, VR, AR, обучение, знания, наука, исследователи, страна.

Annotatsiya: XXI asrda ta'limni raqamlashtirish an'anaviy ta'lim usullarini tubdan o'zgartirib, o'qituvchilar va o'quvchilar uchun yangi imkoniyatlar yaratmoqda. Ushbu o'zgarishlar raqamli platformalar, innovatsion texnologiyalar va sun'iy intellekt (SI) yordamida amalga oshmoqda. Ta'lim platformalari, jumladan, Ta'limni boshqarish tizimlari (LMS), Ommaviy ochiq onlayn kurslar (MOOC) va virtual sinflar, ta'limning global miqyosda keng tarqalishiga yordam bermoqda. Virtual reallik (VR), kengaytirilgan reallik (AR) va bulut texnologiyalari kabi innovatsion texnologiyalar o'quvchilar uchun interaktiv va qiziqarli ta'lim muhitini yaratadi. Shu bilan birga, sun'iy intellekt ma'muriy jarayonlarni avtomatlashtirish, shaxsiylashtirilgan ta'limni taqdim etish va aqlli repetitorlik tizimlarini ishlab chiqishda muhim rol o'ynaydi. Virtual laboratoriya – bu dasturiy ta'minot va kompleks eksperimentlarni haqiqiy o'rnatish bilan bevosita aloqasiz yoki umuman yo'q bo'lganda o'tkazishdir. Birinchi holda, biz masofadan boshqarish pulti orqali laboratoriya o'rnatilishi bilan shug'ullanamiz, buning uchun haqiqiy laboratoriya, dasturiy ta'minot va jihozlarni o'z ichiga olgan va olingan ma'lumotlarni, shuningdek aloqa vositalarini o'rnatish va raqamlashtirishni boshqarish lozim. Bunday holda, barcha jarayonlar kompyuter yordamida simulyatsiya qilinadi. Ikkinchisida amalda bo'lishiga qaramay har ikkala turdagi laboratoriyalar ko'pincha virtual deb nomlanadi, bunday ta'rif faqat ikkinchisiga mos keladi. Ushbu maqolada virtual laboratoriyalar va AR/VR larni ta'lim sohasiga ta'siri tahlil qilinadi hamda ularning afzalliklari va muammolari yoritiladi.

Kalit so'zlar: Ta'lim, metodlar, platformalar, VR, AR, o'rganish, bilim, fan, tadqiqotchilar, davlatlar.

It is known from history that the progress of countries is determined by the extent to which the peoples in it have mastered the newest knowledge of their time. In other words, if the inhabitants of any country or region have mastered the most advanced knowledge of their time or are presenting it to others, science, material lifestyle and well-being of people have increased in that place, and on the contrary, in which place the citizens do not acquire the most advanced knowledge of their time, even if those places are materially prosperous now, they will inevitably face a crisis in the near future. there are many examples. Since the 20th century, the inhabitants of that time experienced

many such changes times. Science and technology development in the 20th century compared to previous centuries. It has progressed several times; perhaps such progress is in history it could be said that it was not. Most of the civilizations known to us

history has not yet seen such a development and coverage of very large areas, or even the entire earth, on such a scale. In this century, human knowledge has become a more valuable resource than all other material natural resources, and because of this reason, we see the emergence of countries that are backward and underdeveloped in economic development despite the abundance of natural resources, but on the other hand, despite their small territory and lack of natural resources, they have progressed in harmony with civilization and are highly developed. It is the civic duty of every person to contribute to the development of his country as much as he can, and at the same time, it is his human duty to acquire the most advanced knowledge of his time and leave knowledge worth mentioning with positive qualities for the future generation.

Due to the special attention of the leadership of our country to the development of information and communication technologies (ICT), especially digital technologies, this field is developing day by day in our country. It is not science fiction to think that the next generation of students may prefer distance learning to face-to-face learning. Since the advent of COVID-19, we have had to make major changes to the way we work and communicate with each other. The rise of online education is part of that. Many people took advantage of the opportunity to learn new knowledge and acquire new skills. There are excellent study programs and websites available to engage students, encourage reading materials, and help when needed. Also, the most advanced AR (augmented reality), VR (virtual reality), MR (mixed reality), Flipped Classroom, Blended Learning technologies of modern education are also developing at different speeds. By applying high technologies to our lives, today we can expand our perception and use these technologies to build worlds other than our physical world in virtual reality. It is also possible to combine mixed reality, which combines reality and virtuality, in every area of the modern world.

The main goal of using virtual reality technology in education and training is to increase efficiency and change the way people learn by making it more interesting. We have seen many startups and established education companies offering packaged products and services for schools. VR systems are used for learning and teaching in several fields, including history, geography, biology, medicine, and transportation management. They are used for children, teens, and adults in grades K-12. Virtual education is already popular among K-12, higher education, and vocational education, and we can see virtual reality expanding even further in the future. Higher education, which is expected to receive a large share of revenue, has key VR applications such as student recruitment, immersive learning and fundraising. It has become inevitable that the future of VR will merge with artificial intelligence (AI). This synthesis has shown its effectiveness in many ways in the business sector, including increasing productivity and

streamlining workflow processes, but developers and researchers are looking for more useful opportunities.

First of all, it should be remembered that VR technology optimizes development tools for rapid creation, generation and calculation of elements on a low-demand device. Another advantage of AI for VR is that we can create systems that automatically generate the various objects needed to develop VR applications, so the whole process can be simplified and take less time. Experts predict that this will eventually lead to the development of highly interactive workspaces and advanced image recognition tools. Using VR technologies to enhance the learning process has a number of advantages and disadvantages. Analyzing examples of modern educational VR applications will help you understand what they are.

K-12 education is of great importance in the formation of children's characteristic abilities and thinking styles, because active participation in the educational environment plays a large role in achieving educational results.

There are thousands of calculation-based e-learning materials available for every stage of primary education, and researchers have evaluated the effectiveness of well-designed examples. One example cited is computer or smartphone-based VR that teaches pedestrian safety to students. Empirical studies have shown that children learn safe street crossing procedures and transfer their knowledge to real life, and students' self-efficacy increases after a computer-based VR learning process. Students of the fourth stage were shown the lunar system. According to the results of the study, the experimental group achieved better results than the control group.

A computer-based 3D digital museum for general secondary school students was developed by researchers to overcome the limitations of actual museum visits. The results of the study showed that the average quality of education of digital museum visitors is higher than that of real visitors. Participants noted that the digital museum's learning resources were more effective and easier to use. The researchers used problem-based learning strategies in a computer-based 3D VR environment to solve different biodiversity scenarios. The results of the students showed improved cooperation skills and self-management skills.

There are several AR apps for elementary school students. The researchers developed an LMS-integrated desktop AR application to teach ten different topics of varying complexity in the natural and social sciences. T-test results between pre-test and post-test showed the intrinsic motivational effect of AR, which increased the competence, interest and general effort of elementary school students. Another AR tool was developed to teach astronomy to elementary school students, but the program was only evaluated by teachers. A marker-based AR was developed to teach primary school students about the human digestive and circulatory systems. 3D visualization and audio content were used for the digital representation of markers.

AR environment was tested by 39 4th year students using computer and web camera systems. The results of the experimental study showed that AR was not only

useful for motivating students, but also made it easier for children to acquire and retain knowledge. A SMART app was developed to teach sophomores fundamental concepts about animals and transportation. Data from 54 students showed that SMART had a positive motivational effect and improved the learning performance of participants, especially for disadvantaged students. Researchers have developed an AR application for primary school students to improve their knowledge of Taiwan's marine ecology and water resources. The results showed that AR had a positive effect on participants' confidence, satisfaction and knowledge acquisition, especially for those with lower educational levels. Another group of researchers developed an AR application to teach English vocabulary. A virtual laboratory is a software and complex experiments conducted without direct or complete contact with a real installation.

In the first case, we are dealing with a laboratory installation via a remote control, for which it is necessary to control the installation and digitization of the data received, including a real laboratory, software, and equipment, as well as communication facilities. In this case, all processes are simulated using a computer. In the second, despite the fact that in practice both types of laboratories are often called virtual, such a definition is suitable only for the second. They will be considered below.

The need to create virtual laboratories in education arose due to difficulties. The following advantages of virtual laboratories can be highlighted. There is no need to purchase expensive equipment and reagents.

The reason is that many laboratories lack sufficient funds, old equipment is installed, the results of experiments are uncertain and dangerous for students. In addition, in areas such as chemistry, equipment, and consumables (reagents), is exceptionally expensive. Of course, computer hardware and software are not cheap, but the versatility of computer technology and its wide distribution compensate for this deficiency.

The ability to simulate processes that are impossible in laboratory conditions is possible. It allows modern computer technologies to observe processes that are difficult to implement in real conditions due to the small size of the observed particles.

In some works, further processing of sufficiently large arrays is required, then the digital data, which is then processed on a computer through a series of experiments, is performed. The weak point of this sequence of actions when using a real laboratory is the input of the obtained data into a computer. In a virtual laboratory, this step is absent, since the data can be entered directly into the results table by the experimenter or automatically when conducting experiments.

This significantly saves time and reduces the percentage of possible errors. Finally, a separate and important advantage is the possibility of using a virtual laboratory in distance learning, which is convenient when the possibility of working in university laboratories is not available in principle.

Some of these advantages are also inherent in the installation of a laboratory with a remote control. Unfortunately, the number of virtual laboratories currently available,

which are used in the educational process, is very small. This is primarily due to their high cost of development, which leads to the following consequences.

1. Virtual laboratories developed by professional programmers, designers, and specialists in the simulated field are very expensive, which prevents their widespread use.

On the other hand, the low potential for diffusion does not create much incentive for their production.

2. The creation of virtual laboratories by ordinary people can lead to satisfactory results only when modeling a narrow class of phenomena. Their low diffusion is associated with the cost and the fact that there are practically no alternatives.

Virtual laboratories, of course, have some disadvantages. The main one is the lack of direct contact with the research object, instruments, and equipment. Experience in working with real devices is necessary; therefore, a rational solution would be to combine the use of real and virtual laboratories in the educational process, taking into account their specific advantages and disadvantages.

For example, when working with dangerous objects, it is necessary to use virtual laboratories precisely and only after acquiring the necessary skills; if necessary, go to work with real objects. Thus, real and virtual laboratories provide the highest efficiency of the educational process, combined with low financial costs.

Virtual laboratories, of course, have some disadvantages. The main one is the lack of direct contact with the research object, instruments and equipment. Real devices are needed for experimental work, so a rational solution is to combine real and virtual laboratories. The use of virtual ones, taking into account their specific advantages and disadvantages, will be combined. When working with dangerous objects in the educational process, virtual laboratories should be used precisely and only after acquiring the necessary skills. Thus, real and virtual laboratories provide the highest efficiency of the educational process.

The results of an experimental study showed that the motivation and academic success of 130 undergraduate students from various disciplines increased. Digitization has no doubt changed our education system, but we cannot say that it has diminished the value of our old-time classroom learning. Neither do we want something so priceless to turn into dust.

The best part about the digitization of education in the 21st century is that it is combined with the aspects of both; classroom learning and online learning methods.

Walking hand in hand, both act as a support system to each other, which gives a stronghold to our modern students. Digitization in education has also proved to be the right method for saving resources. Online examination platforms have restricted the frivolous use of paper, directly reducing the need to cut down trees.

This way, the digitization of the education industry in the 21st century proves to be a boon to our society.

Digitization in education is here to stay and will continue to revolutionize how we learn and teach. It has already made a huge impact on the way we learn by providing us with new opportunities for collaboration between teachers and students, as well as enabling us to access educational materials from anywhere around the world.

As technology continues to develop at an unprecedented rate, we can expect even more exciting changes in the future.

REFERENCE:

1. Мулаидинов Ф., Солиджонов Д. Virtual va to'ldirilgan reallik texnologiyalari. – Тошкент: [nashriyot ko'rsatilmagan], 2022. – 219 б.
2. Ainslee J. Digitization of Education in the 21st Century. – London: Routledge, 2021. – 154 p.
3. Roberts S. C. What is Digitization in Education? // Medium. – 2021. – URL: <https://medium.com/@everlynsalt/what-is-digitization-in-education-6b697bcfb38b> (дата обращения: 12.09.2025).
4. Таълимда виртуал лабораториялардан фойдаланиш // ResearchGate. – 2022. – URL: https://www.researchgate.net/publication/358649951_Ta'limda_virtual_laboratoriyalar_dan_foydalanish (дата обращения: 12.09.2025).
5. Рафиқова М. Modern Education System in Cities. – Самарқанд: SamDU нашриёти, 2023. – 98 б.
6. Жахонгирова Т. Эволюция негативных эмоций в английской литературе: семантический анализ // Ta'limning zamonaviy transformatsiyasi. – 2024. – Т. 11. – № 2. – С. 18–20.
7. Jakhongirova T. The Role of Input Frequency in Early Language Acquisition // Xalqaro ilmiy-amaliy konferensiyalar materiallari. – 2024. – Т. 1. – № 1. – С. 462–464.