


DOI: <https://doi.org/10.46502/issn.1856-7576/2024.18.02.10>

Cómo citar:


Zinchenko, V., Lazirko, N., Manko, R., Huda, O., & Ivanyshyn, M. (2024). Perspectives of using vr to increase accessibility in distance education. *Revista Eduweb*, 18(2), 141-151. <https://doi.org/10.46502/issn.1856-7576/2024.18.02.10>

Perspectives of using vr to increase accessibility in distance education


Perspectivas del uso de la realidad virtual para aumentar la accesibilidad en la educación a distancia

Volodymyr Zinchenko <https://orcid.org/0000-0002-2101-903X>

PhD in Pedagogy, Associate Professor, Department of Pedagogy, Psychology, Social Work, and Management, Educational and Scientific Institute of Pedagogy and Psychology, Oleksandr Dovzhenko Hlukhiv National Pedagogical University, Hlukhiv, Ukraine.

Nataliia Lazirko <https://orcid.org/0000-0001-8043-3946>

PhD in Philology, Associate Professor, Associate Professor of the Department of the Foreign Literature and Polonistics, Faculty of Ukrainian and Foreign Philology, Drohobych Ivan Franko State Pedagogical University, Drohobych, Ukraine.

Ruslana Manko <https://orcid.org/0000-0003-1004-9441>

Senior Lecturer, The Department of the Foreign Literature and Polonistics Faculty of Ukrainian and Foreign Philology, Drohobych Ivan Franko State Pedagogical University, Drohobych, Ukraine.

Oksana Huda <https://orcid.org/0000-0002-3602-7892>

PhD in Engineering, Associate Professor, Associate Professor of Department of Physics and Higher Mathematics, Faculty of Transport and Mechanical Engineering, Lutsk National Technical University, Lutsk, Ukraine.

Myroslava Ivanyshyn <https://orcid.org/0000-0002-4219-104X>

PhD in Philology, Associate Professor Approved at the meeting of the Department of the Foreign Literature and Polonistics, Department of World Literature and Slavonic Faculty of Ukrainian and Foreign Philology, Drohobych Ivan Franko State Pedagogical University, Drohobych, Ukraine.

Recibido: 20/04/24

Aceptado: 05/06/24

Abstract

The article is devoted to the study of the prospects of using virtual reality technologies in the organisation of the educational process. The main concepts and technologies that formed the basis for the development of this innovative technology are considered. The article also analyses the advantages and disadvantages of immersive education, virtual reality technologies, and their application in modern economic conditions. A comprehensive analysis of the use of VR technology in education is carried out, including an analysis of empirical and theoretical studies on the prospects for the use of virtual reality technologies in reforming the education system. The article summarises the practices of VR development and provides information on proposals for the development of



immersive technologies in education. Further research should focus on the practical aspects of integrating virtual reality technologies into the educational process. Attention should also be paid to the peculiarities of using these technologies.

Keywords: innovations, immersive education, educational environment, higher education, information technologies.

Resumen

El artículo está dedicado al estudio de las perspectivas de uso de las tecnologías de realidad virtual en la organización del proceso educativo. El artículo también analiza las ventajas e inconvenientes de la educación inmersiva, las tecnologías de realidad virtual y su aplicación en las condiciones económicas modernas. Se lleva a cabo un análisis exhaustivo del uso de la tecnología de RV en la educación, que incluye un análisis de los estudios empíricos y teóricos sobre las perspectivas del uso de las tecnologías de realidad virtual en la reforma del sistema educativo. El artículo resume las prácticas de desarrollo de la RV y ofrece información sobre propuestas para el desarrollo de tecnologías inmersivas en educación. Las investigaciones futuras deberían centrarse en los aspectos prácticos de la integración de las tecnologías de realidad virtual en el proceso educativo. También debería prestarse atención a las peculiaridades del uso de estas tecnologías.

Palabras clave: innovaciones, educación inmersiva, entorno educativo, educación superior, tecnologías de la información.

Introduction

Educational institutions are complex pedagogical systems that integrate various social and technological components. They shape the knowledge of the younger generation and cannot exist without modern information technology (IT). These technologies are an integral part of society, including education and science, and make a significant contribution to the formation of the personality of the younger generation.

Virtual reality (VR) technology is an innovative and promising area of education that provides a multidimensional representation of a subject area. Virtual reality is a technology that provides contactless information interaction through complex multimedia operating environments. It creates the illusion of direct entry and presence in a stereoscopically presented "virtual world", while providing tactile sensations when the user interacts with virtual objects (Scavarelli, Arya, & Teather, 2021).

The above-mentioned technology allows users to fully immerse themselves in the virtual space and feel like a part of the environment created by the developers. This feature of VR provides an interesting and visually appealing learning experience, demonstrating various phenomena and processes with any degree of detail. VR technology can improve educational curricula by providing enhanced opportunities to interact with objects and create a sense of presence.

Visually appealing lectures, seminars, and workshops made possible by VR provide a comprehensive understanding of real-world objects and processes, improving the quality and efficiency of educational processes while reducing costs. Visual information is the main source of memorisation, and combining it with other activities significantly improves information retention. Virtual reality systems have clear advantages over other learning tools in this regard (Mystakidis, Berki, & Valtanen, 2021).

1. VR systems allow users to visualise objects of different sizes, which makes it possible to study objects in both the micro and macro worlds. This feature is particularly useful in teaching biology, astronomy, and physics.
2. The VR systems can be used to create models of processes that cannot be directly observed by human senses. This allows you to clearly demonstrate phenomena in an accessible and understandable form.



For example, the distribution of heat in space or matter can be modelled by highlighting areas with different temperatures with different colours and gradients.

3. VR technologies allow you to create objects that do not exist in the real world and visualise abstract models, which is especially important in mathematics. Virtual reality technology allows you to accurately simulate direct interaction with an object, modelling its behaviour in a real environment with high accuracy.
4. This technology makes it possible to create a highly detailed simulated reality that can significantly affect the emotional states of the subject, thereby further enhancing the simulation of his or her behaviour in a real environment (Alalwan et al., 2020).

Theoretical Framework or Literature Review

Theoretical foundations of research on the use of VR in education

Although there is no universally accepted and unambiguous definition, the term “virtual reality” was coined by Jaron Lanier, a pioneer in VR development, in 1989, initially defining VR as a computer illusion. VR is a professional and scientific term that has gained widespread use and refers to a three-dimensional computer simulation that creates a realistic effect without its physical reality.

Scavarelli, Arya and Teather (2021) distinguish two main meanings of the term VR. In a broad sense, it is the entire information environment created with the help of digital technologies. In a narrow sense, VR is defined as the highest programming product related to the modelling of the external and internal world of a person, using immersive 3D information environments that are the pinnacle of modern programming and electronics.

The created digital world is a model of real-world objects, such as buildings or plants, or the topology of human internal organs. A human operator can perceive the environment as if it were part of the real world using visual, auditory, or tactile devices. VR can be a model of an abstract world that is not directly represented in reality, such as a chemical molecule or a set of parameters. Or it can be an environment from a completely fictional science fiction world.

According to some authors, VR is a uniquely powerful computer application through which people can interact. Virtual reality is, first and foremost, a digital environment that simulates real life experience and engages all the senses to achieve certain goals. Figure 1 shows a diagram of VR features.

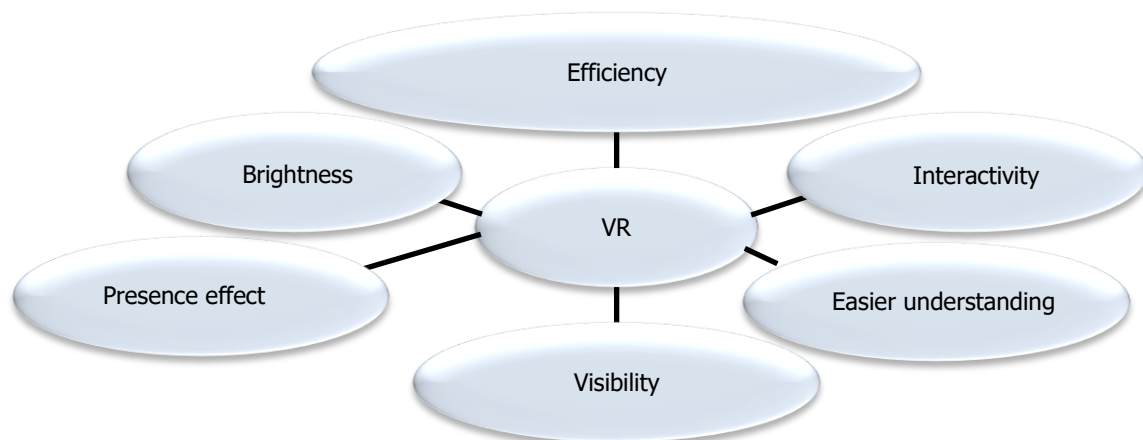


Figure 1. Key Features of Virtual Reality in Enhancing User Experience.

Source: Prepared by the authors

VR is a construct that combines philosophical and natural science views on human cognitive abilities and their support. The following properties of VR can be distinguished: performance in relation to the real objective world, relevance when directly observed in real time, autonomy with unique patterns and spatial and temporal constraints, interactivity with other realities.

The authors refer to the primary level as traditional works of art and products of the imagination, such as mythological characters, fairy tales and epics. In addition, altered states of consciousness include clinical psychotic states and hypnotic trance states. The secondary level consists of artificial reality created by humans using digital technologies with a low degree of interactivity and animation. This includes information space such as the Internet and personal computer software. Finally, the third level is artificial information reality, created to imitate ordinary reality as closely as possible with the help of digital technologies. It is characterised by high animation and interactivity.

Methodology

Design

The effectiveness of this study is assessed using qualitative and quantitative indicators. During the observations, these indicators are measured, compared and analysed, and the data are then interpreted. The study went through several stages, as shown in Table 1.

Table 1.
Stages of the study

Nº	Stage	Period of implementation	Content of the research stage
1	Stating	February 2023	Defining the purpose and objectives of the study. Formation of control and experimental groups of students. Selection of research tools and methods. Conducting primary testing.
2	Formative	September 2023 - March 2024	Implementation of pedagogical conditions using VR technology (for the experimental group) and traditional teaching methods (for the control group). Study of attitudes towards the educational environment. Conducting statistical processing of the results. Drawing conclusions based on the results.
3	Summarising	April 2024	Processing the research results. Summarising the results.

Source: Prepared by authors

Participants

The experimental work was conducted on the basis of the National Pedagogical Dragomanov University (Kyiv). The study involved 100 second- and third-year students studying in the field of "Teacher Education" with a bachelor's degree at the Faculty of Teacher Education. Students of 6 academic groups were divided into experimental (EG) and control (CG) groups. All respondents were warned about the need for an honest and unbiased attitude to the survey. The study was conducted in accordance with general ethical standards and rules. All respondents agreed to the processing of their personal data and the use of the research results for the publication of the article.

Data collection

1. The Educational Environment Trust Scale (EETS). This test was developed by researchers at the University of Illinois. The EETS contains 18 statements that assess the level of trust students have in their teachers, peers, and the educational environment in general.
2. Monitoring of academic performance. The method allows for an objective assessment of the effectiveness of the implemented technology.

Analysis of data

The following formula is used to determine the standard deviation (SD) for each group:

$$S = \sqrt{\frac{\sum(X_i - \bar{X})^2}{N-1}}; \quad (1)$$

where X_i is the value of each level, \bar{X} is the average value, N is the number of observations.

2. χ^2 criterion is calculated using the formula:

$$\chi^2 = N \cdot \left[\sum_{j=1}^m \left(\sum_{i=1}^n \frac{x_{ij}^2}{Q_i \cdot R_j} \right) - 1 \right], \quad (2)$$

where N is the total number of students who participated in the formative stage of the pedagogical experiment;

m – is the number of possible values of the first feature; n is the number of possible values of the second feature;

x_{ij} – is the number of combinations of the i -th value of the first feature with the j -th value of the second feature;

Q_i – is the total number of observations of the i -th value of the first feature;

R_j – is the total number of observations of the j -th value of the second feature.

Typically, critical values are given for different levels of significance. The probability of error associated with rejecting or not rejecting the null hypothesis is called the significance level. This means that the probability of considering differences to be significant when they are actually random is determined by the significance level. In pedagogical research, a significance level (denoted by α) of 0.05 is usually used, which indicates that the possibility of error should not exceed 5%. This is the level of significance used in this study.

Results and Discussion

Features of educational VR

In recent years, there has been a growing interest in the use of VR for educational purposes around the world (Alzahrani, 2020). Educational virtual reality is a separate and effective area of digital technology application that facilitates the learning process, expands knowledge, and is based on reliable information. It can be integrated with other teaching methods and is intended for participants in the educational process, including teachers and students.

Learning using educational virtual reality is significantly different from traditional methods. Unlike traditional education, which often requires a high degree of personal interest, responsibility and hard work,



often in conditions of personal autonomy, with conventional sources of information that often require additional clarification, education in the context of educational VR allows you to simulate a complex visual-spatial-auditory environment (Joo et al., 2018).

VR creates an effective didactic environment with wide possibilities that produce qualitatively new properties that are not inherent in traditional methods. Educational VR is a system of sequential actions that requires technological interfaces to provide an immersive experience. It is not a rigid algorithm of actions and prescriptions, but rather a flexible learning technology that can be adapted to achieve the desired educational goals (Saab et al., 2021).

There are three types of main interfaces that support learning objectives:

- VR, which provides a sensory immersion environment, the illusion of body presence and an experience of intense participation;
- Multiuser VR (MUVE), which provides mental presence in the created environment indirectly by personal avatars, without sensory stimulation, with the ability to interact with other avatars;
- Mixed, or augmented, reality, where digitally generated information enriches, shapes, accelerates or slows down real-life situations (Anderson & Rivera Vargas, 2020).

Table 2.

Characteristics of educational VR presented in the review by P. Axel

VR type	Features
VR that creates a simulated environment with spatial and visual logic	- The student can take on the roles of observer, participant and creator.
VR that creates challenging circumstances	- It provides opportunities for immersion and understanding, multisensory experience, social interaction and collaboration.
VR interconnected with physical reality (PR)	- Subtractive FR (sociocultural situations and experiences that are difficult or impossible to access physically or mentally). - Additive and/or augmented FR (illustrative or merging with physical reality). - Concretising FR (representing objects of physical reality that can be accessed only in an abstract way, with creative participation in this, for example, controlling the work of neurons or getting to know political processes). - Independent FR (creation of an alternative to reality, imaginary, fictional).
VR that reduces or eliminates potential physical and mental effects	- Removes the burden of responsibility for the performance of activities in the simulated environment, thereby creating the possibility of a safe and secure experience. - It has the ability to increase the burden of responsibility (without the ability to control the person being influenced) in order to enhance the cognitive aspect of responsibility (an environment saturated with specific stimuli).

Source: Prepared by Aczél (2017)

It should be noted that the highest level of VR can be achieved with the help of several types of technological products. The first type includes widely available computer monitors that display highly animated images containing 3D models of real objects (for example, created using the Unity multi-platform tool). The second type is portable VR headsets or glasses (HMD - Head Mounted Display). There are three types of HMD systems: those that display only computer-generated images, those that display real video images, and those that display a combination of computer-generated and real video images.

This type is augmented virtual reality, which differs from traditional virtual reality in that it projects additional objects that are not in the field of view simultaneously with the demonstration of a real situation.

Selivanov's CAVE reality projects specially shaped virtual objects onto multiple screens, using motion parallax to create the illusion of three-dimensional objects for the user. This technology allows for the modelling of a wide range of complex dynamic virtual scenes. CAVE systems provide a much more immersive virtual environment than HMD technology (Jang et al., 2021). The CAVE system adapts to the user's parameters, providing interactive interaction with virtual objects. In addition, the user can touch and manipulate virtual objects using special devices called pens.

In his review, P. Ackzel identifies three groups of educational VR products, each of which has its advantages and disadvantages. The advantage of the programme is that it clearly meets the learning objectives. Akzel notes that the disadvantage is that it can be difficult for the user to determine its educational focus, which can reduce motivation to learn. The first group includes educational VR products developed exclusively for educational purposes (for example, Quest Atlantis and Rome). The second group includes educational VR products that simulate communicative social situations and entertainment, as well as include educational features such as virtual online museum tours and Jump Start. The second group includes educational VR products that create simulated social situations and entertainment and include educational features such as virtual online museum tours and Jump Start. However, such products are not recommended for group online sessions due to safety concerns and the high likelihood of encountering unknown online players or participants. The third group includes immersive virtual products designed primarily for gaming, but can also be used for educational purposes, such as the development of VR content (e.g. Minecraft or Second Life) (Aczél, 2017).

Axel highlights several problems that other researchers have noted that customers of educational VR products may face when developing VR content. Developers may have difficulty setting precise goals, lack competence, or lack innovative intentions, which can lead to cognitive overload and/or low motivation for the user. It is important to note that educational VR is mainly targeted at users aged 10 to 15, while older users, including adults, prefer virtual spaces suitable for creating their own content (Aczél, 2017).

The study tested students' satisfaction with the learning environment. The results of the study are presented in Table 3.

Table 3.

Results of the Educational Environment Trust Scale (EETS) test for CG and EG

Group	n	Average value	Standard deviation	t-test (p-value)
CG	50	72,5	9,4	-2,34 (0,021)
EG	50	68,2	11,3	

Source: Prepared by authors

The results show that the control group (CG) has a mean of 72.5 with a standard deviation of 9.4, while the experimental group (EG) has a mean of 68.2 with a standard deviation of 11.3. The t-test value is -2.34 and the p-value is 0.021. This indicates a statistically significant difference between the groups, where the CG has a higher mean, which may indicate the impact of the experiment. We also monitored students' academic performance, the results of which are presented in Table 4.

Table 4.

Results of monitoring the dynamics of students' academic performance for CG and EG

Group	n	Average value	Standard deviation	t-test (p-value)	Chi-square (p-value)
EG	50	78,5	9,2	-2,45 (0,018)	12,7 (0,002)
KG	50	72,1	11,5		

Source: Prepared by authors

The EG shows a mean academic performance value of 78.5 with a standard deviation of 9.2, while the CG has a mean value of 72.1 with a standard deviation of 11.5. The t-test value (-2.45) and p-value (0.018) indicate a statistically significant difference between the groups, and the chi-square (12.7) with p-value (0.002) confirms this significance. The results indicate that the EG achieved higher academic performance compared to the CG, which did not use VR technologies.

Learning models that use VR technology

P. Akzal formulated theoretical concepts of learning based on three approaches in a review of educational VR technologies that use complex immersive environments for interactive user learning. They are formed on the basis of three approaches in a review of educational VR technologies that use complex immersive environments for interactive user learning (Aczél, 2017). For example, the author recommends a constructivist approach based on Piaget's theoretical model of the evolution of mental models in children's cognitive development as one of the first approaches to the use of educational virtual reality. Akzal has formulated theoretical concepts of learning based on three approaches in a review of educational VR technologies that use complex immersive environments for interactive user learning. In his research, P. Akzal relied on the constructive approach. It allows students to actively and creatively accumulate knowledge, discover, define, and identify relationships, and teachers to creatively generate new knowledge.

Educational virtual reality presents students with a problem in a specific context for which they must develop an individual or collective solution. Thus, it is not standardised or universal, but there is always an opportunity to analyse the effectiveness of learning in the process of solving the problem. VR undoubtedly enhances the learning process by providing high motivation and engagement through sensory stimulation, creating individual or group activities that have a positive impact (Bower, DeWitt, & Lai, 2020).

The second approach is experiential learning. Here, the subject creates meanings and acquires knowledge outside the standard dissemination of knowledge from expert to layperson. The knowledge is based on individual and/or collective experience, gained empirically through insights that reduce criticism in the interpretation of experience. Individually and in groups, experience is interpreted in accordance with socio-cultural attitudes. This interpretation leads to reflective active behaviour. Educational methods associated with this approach are a cyclical process consisting of several stages and elements (Shevchenko, Dubiaha, & Fefilova, 2021).

The cyclical process acquires new knowledge through observation, reflection and action (Smolych & Zavadskaya, 2021).

Experiential learning methods are designed to empirically create new knowledge by overcoming obstacles, unlike everyday life experiences, which are not always conducive to acquiring new knowledge, as P. Axel notes. Real-world experiences can be classified as primary (direct) or secondary (indirect). VR creates an effective hybrid of mediated experience that can be used in education.

It is important to note that secondary experiences are also spatially, temporally, culturally and contextually distant. For example, receiving news in the form of a text or multimedia message is a secondary experience (Radziewska et al., 2022).

Virtual reality offers a unique advantage over real-life secondary experiences by providing a physically tangible presence of media technologies, such as a display or VR helmet, a rope or a treadmill, as well as their physical effects, such as sweating. This direct impact on the user's senses provides a powerful and immersive experience, even though it is indirect and reflexive. Virtual reality (VR) is a highly effective tool

for experiential learning. It creates a realistic perception and facilitates the entire cycle of comprehension, thinking, action, and reflection. This contrasts with traditional school assignments that are presented in the form of text or verbal instructions from the teacher (Elshami et al., 2021).

Context-aware learning is a third approach that emphasises the importance of presence, engagement with the context of the situation, and a type of learning that can be more intensive, depending on the degree of integration into the situation (Bhandari, 2023).

The situation requires exploration and interpretation of changes in the context, active participation, interactive communication, situational engagement, and thus immersion. These methods make it possible to implement metacognitive learning, which involves asking reflective questions that contribute to the acquisition of new knowledge. It is important to note, however, that contextual learning requires additional human and economic resources and much more time, for example, for travelling, visiting companies, internships, etc.

VR allows the use of media resources that can be compared to real-life situations, depending on the intensity and subtle variability of the situational context. When developing educational VR content, the constructivist approach can be based on knowledge generation, the empirical approach on experience, and the situational approach on the situational context. When developing educational VR content, the constructivist approach can be based on knowledge generation, the empirical approach on experience, and the situational approach on the situational context (Al Rawashdeh et al., 2021)

SNKC describes a clear multi-step process for VR newcomers to become part of a social network. The learner starts out as a neophyte, but with dedication and effort, they can progress to become a mentor who not only contributes to the reality they create, but also controls it.

Training methodology using VR technologies

Virtual reality can support a number of different types of learning. The first type is observation-based learning, which provides students with sensory experiences through cutting-edge media resources that allow them to transcend physical boundaries. For example, virtual campuses, museums, historical sites, works of art and natural formations. The benefits of learning through virtual reality should be emphasised, as it offers multiple perspectives without requiring additional physical or economic resources, as demonstrated in the context of learning (Nambiar, 2020).

The second approach is activity-based learning, which involves active participation and experiencing the consequences in a virtual reality environment. Education aims not only to understand complex concepts, but also to test existing knowledge, such as physical and mathematical laws, language rules, and social norms. Through trial and error with feedback, education provides valuable experience without physical or social consequences, similar to experiential learning (Soliman et al., 2021).

Social learning is the third type of learning. It enables collaboration in solving problems and overcoming physical barriers, as demonstrated by the Harvard HBX Live virtual online project. The potential of interaction on newly created technological platforms should be emphasised and represents a new method of learning called "pyragogy" (Turchyn et al., 2023). Learning is based on joint research, the presence of another student, active critical feedback and high responsibility. The key elements of learning are knowledge sharing, co-presence, interaction and collaboration (in the context of learning).

Experiential learning - the fourth type - involves the design of learning materials and the study of areas that are either inaccessible to human senses or too complex to perceive (Di Natale et al., 2020). Modelling is used to create a tangible reality that allows us to evaluate phenomena that were previously understood



only at an abstract level. For example, nanoparticles and democratic institutions of society can be better understood through the use of VR.

The fifth type is future-oriented learning, which contributes to the development of sustainable skills of a promising personality. The authors call this approach the "Homo-perspective" social person. According to the authors, human perception, memory, and emotions are future-oriented, not primarily related to the present or past. In other words, people do not understand, store, or experience through knowledge, evaluation, and emotions, but rather represent and predict (Nambiar, 2020).

Conclusion

The main purpose of this paper was to analyse the extent to which virtual reality technologies can be integrated into the educational process. A review of studies conducted in the field of educational VR demonstrates the comprehensive ontological and methodological elaboration of the issues faced by researchers. It can be stated that virtual reality technologies are safe and effective for learning. Modern digital equipment meets the highest standards of environmental safety, including psychological and technical characteristics.

This theoretical study allowed us to identify the types, levels and features of immersion experienced by users of virtual reality products. The experimental studies presented in this article examined the personal characteristics of users and the degree of their influence on academic performance. The article discusses teaching methods and tools to increase learning motivation and improve learning.

Modern digital virtual reality products, despite their effectiveness, can still be expensive and inaccessible. The integration of VR technologies into the educational process requires improvements and changes from both technology developers and participants involved in the learning process. Developers need to provide more convenient and safer equipment, and educators need to develop promising educational programmes that meet the needs of students and are consistent with the nature of these technologies. The future of educational virtual reality depends on the speed with which VR becomes a widely available educational technology. This article explores the potential of higher-level virtual reality technologies in higher education by examining the impact of virtual reality programmes on student characteristics. Didactic VR technologies create an enhanced modern educational environment and expand learning opportunities for students. Virtual reality technologies will revolutionise human interaction with the real world in the next few years, and their potential will be used in various fields.

Bibliographic References

- Aczél, P. (2017). Virtual reality and education - world of teachcraft? *Perspectives of Innovations, Economics and Business*, 17(1), 6-22.
- Al Rawashdeh, A. Z., Mohammed, E. Y., Al Arab, A. R., Alara, M., & Al-Rawashdeh, B. (2021). Advantages and disadvantages of using e-learning in university education: Analysing students' perspectives. *Electronic Journal of E-learning*, 19(3), 107-117. <https://doi.org/10.34190/ejel.19.3.2168>
- Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Alzahrani, A. I., & Sarsam, S. M. (2020). Challenges and prospects of virtual reality and augmented reality utilisation among primary school teachers: A developing country perspective. *Studies in Educational Evaluation*, 66, 100876. <https://doi.org/10.1016/j.stueduc.2020.100876>
- Alzahrani, N. M. (2020). Realidade aumentada: Uma revisão sistemática de seus benefícios e desafios em contextos de e-learning. *Applied Sciences*, 10(16), 5660. <https://doi.org/10.3390/app10165660>
- Anderson, T., & Rivera Vargas, P. (2020). A critical look at educational technology from a distance education perspective. *Digital Education Review*, 2020(37), 208-229. <https://doi.org/10.1344/der.2020.37.208-229>
- Bhandari, M. P. (2023). Past and present of social inequality: Analysing structure and future trends. *Future of Social Sciences*, 1(3), 47-60. <https://doi.org/10.57125/FS.2023.09.20.04>



- Bosa, V., Marieiev, D., Balalaieva, O., Krokmal, A., & Solovei, A. (2024). Implementation of virtual reality in foreign language teaching. *Amazonia Investiga*, 13(73), 187-199. <https://doi.org/10.34069/AI/2024.73.01.15>
- Bower, M., DeWitt, D., & Lai, J. W. (2020). Razões associadas à intenção de professores em serviço de usar a realidade virtual imersiva na educação. *British Journal of Educational Technology*, 51(6), 2215-2233. <https://doi.org/10.1111/bjet.13009>
- Di Natale, A. F., Repetto, C., Riva, G., & Villani, D. (2020). Realidade virtual imersiva na educação K-12 e superior: Uma revisão sistemática de 10 anos de pesquisa empírica. *British Journal of Educational Technology*, 51(6), 2006-2033. <https://doi.org/10.1111/bjet.13030>
- Elshami, W., Taha, M. H., Abuzaid, M., Saravanan, C., Al Kawas, S., & Abdalla, M. E. (2021). Satisfaction with online learning in the new normal: Perspective of students and faculty at medical and health sciences colleges. *Medical Education Online*, 26(1), 1920090. <https://doi.org/10.1080/10872981.2021.1920090>
- Jang, J., Ko, Y., Shin, W. S., & Han, I. (2021). Realidade aumentada e realidade virtual para a aprendizagem: Um exame usando um modelo de aceitação de tecnologia estendido. *IEEE Access*, 9, 6798-6809. <https://doi.org/10.1109/ACCESS.2020.3048708>
- Joo, Y. J., Park, S., & Lim, E. (2018). Fatores que influenciam a intenção de professores em serviço de usar tecnologia: Autoeficácia do professor TPACK e modelo de aceitação de tecnologia. *Journal of Educational Technology & Society*, 21(3), 48-59. Available at: <https://www.jstor.org/stable/26458506>
- Mystakidis, S., Berki, E., & Valtanen, J. P. (2021). E-learning profundo e significativo com ambientes de realidade virtual social no ensino superior: Uma revisão sistemática da literatura. *Applied Sciences*, 11(5), 2412. <https://doi.org/10.3390/app11052412>
- Nambiar, D. (2020). The impact of online learning during COVID-19: students' and teachers' perspective. *The international journal of Indian psychology*, 8(2), 783-793.
- Radziewska, I., Trepet, G., Radzikhovska, N., Sukhostavets, N., Yuryk, O., & Saienko, V. (2022). Modern achievements and prospects for the development of higher medical education: Ukrainian realities. *Amazonia Investiga*, 11(55), 114-123. <https://doi.org/10.34069/AI/2022.55.07.12>
- Saab, M. M., Hegarty, J., Murphy, D., & Landers, M. (2021). Incorporating virtual reality in nurse education: a qualitative study of nursing students' perspectives. *Nurse Education Today*, 105, 105045. <https://doi.org/10.1016/j.nedt.2021.105045>
- Scavarelli, A., Arya, A., & Teather, R. J. (2021). Virtual reality and augmented reality in social learning spaces: a literature review. *Virtual Reality*, 25(1), 257-277. <https://doi.org/10.1007/s10055-020-00444-8>
- Shevchenko, Y., Dubiaha, S., & Fefilova, T. (2021). Information approach to the problem of improving the readiness of future teachers for the spiritual and moral development of junior schoolchildren. *AD ALTA: Journal of Interdisciplinary Research*, 11(1), 74-78. https://www.magnanimitas.cz/ADALTA/110117/papers/A_15.pdf
- Smolych, D., & Zavadskaya, O. (2021). Social-psychological aspect of adjusting interaction of cluster participants. *Problems of theory and practice of financial and credit activity*, 2(37), 476-481. <https://doi.org/10.18371/fcaptop.v2i37.230652>
- Soliman, M., Pesyridis, A., Dalaymani-Zad, D., Gronfula, M., & Kourmpetis, M. (2021). A aplicação da realidade virtual na educação em engenharia. *Applied Sciences*, 11(6), 2879. <https://doi.org/10.3390/app11062879>
- Turchyn, I., Zaitseva, S., Rudenko, N., Saienko, V., Kuzemko, N., & Denefil, O. (2023). Using distance learning models as opportunities for blended learning for foreigners. *Romanian Magazine for Multidimensional Education*, 15(4), 178-191. <https://doi.org/10.18662/rrem/15.4/787>

