

UDC 338.2
МРПТИ 06.81.30

DOI: <https://doi.org/10.37788/2025-1/70-78>

P. Caputo^{*1}, C. Zhambutaeva², Skylar Ryan Allen³

¹Innovative University of Eurasia, Kazakhstan, University Parthenope, University Federico II, Achii International Institute, Italy

²Innovative University of Eurasia, Kazakhstan

³University of Arkansas, United States of America

*(e-mail: info@paolocaputo.eu)

Extended reality in the field of education and health: an opportunity for young entrepreneurs

Annotation

The main problem: The purpose of the article is to describe the use of Extended Reality (Virtual Reality, Augmented Reality, Mixed Reality) in the field of Education and Health, and the opportunities XR technologies can offer to individuals to create new startups and new businesses. The article looks at the use on different field of business and education, the impact on the economy and society and how XR can help in the daily lives of vulnerable groups and the challenges they face in using these technologies.

Purpose: Describe the use of Extended Reality (Virtual Reality, Augmented Reality, Mixed Reality) in the field of Education and Health, the opportunities and benefits XR technologies can offer to individuals and businesses, and the impact on the economy and society.

Methods: The study was based on direct experience in the field and data collected during the research phase carried out for the implementation of various projects (including interviews with key stakeholder groups, XR researchers, XR company representatives, research studies, reading of success stories).

Results and their significance: The research outcome is current knowledge of the use of XR in the field of Education and Health and the relative Business Opportunities.

Key words: Extended Reality, Virtual Reality, Augmented Reality, Mixed Reality, Educations, e-Health, Innovative Startup, Research and Development, Inventions, Investments, Business.

Introduction

This study covers all possibilities offered by production of applications in Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR), all referred to as XR. The article takes in consideration the potential of use of the XR and the impact on the economy and society. In terms of sectoral scope, this report focuses largely on the application of XR in the health and education sectors, with attention on XR for vulnerable groups like children and young people with special needs especially people with disabilities, including people with physical disabilities, including those with neurological conditions and people with mental disorders. By Exploring the field of XR applications readers can take inspiration for develop new business ideas.

Materials and methods

Extended Reality is an all-encompassing term that combines augmented reality, virtual reality, and mixed reality experiences. It can be defined as “non-reality” of the new models of human-computer interaction. This type of immersive technology makes it possible to concretely change the way human beings perceive reality, translating their user experience to a completely new and enormously more satisfying level. The level of immersion is closely linked to the possibility of interaction with the digital environment. Through this technology, users find themselves in a virtual world or interact with a virtually augmented world. Virtual content is therefore perceived as extremely close to reality.

Virtual Reality (VR) differs from other realities by virtue of the possibility of complete immersion in a world that is, in all respects, digital. In this world, you can interact with each element as if you were physically in that specific place. The goal of Virtual Reality is to make the individual forget the real world, catapulting him into a new totally virtual reality. The advantages represented by Virtual Reality are often reduced to the world of video games or more generally of entertainment in the most generic sense of the term. What many fail to realise is the myriad of benefits that Virtual

Reality can bring to companies that make the wise decision to adopt it and use it in their sales and marketing strategies.

Augmented Reality is a computer-generated content come together in the real world. To better understand how Augmented Reality works, we can imagine wearing glasses that allow us to see objects with which, however, we are precluded from physically interacting.

Mixed Reality includes all immersive technologies that combine the virtual world with the real one through the adaptation of digital content to the physical world based on the information it can process about the surrounding environment, thus allowing the user to interact indiscriminately with both real and digital objects. The goal of Mixed Reality is to add user-relevant digital information about the physical world in real time and allow the user to physically interact with it.

Results

E-Health and education use cases for XR technologies. Following section is about the applications and opportunities for XR technologies in the health and education sectors.

E-HEALTH. E-health is the use of information and communication technologies in healthcare to improve the health and care of citizens. It is the innovative scientific medical field in which healthcare treatment is based on the use of software or software-driven solutions, in combination with hardware devices and traditional medical therapies such as drugs. XR-based applications for health can be broadly categorised in two separate areas, depending on their user group. Applications to be used by medical professionals and students.

Surgery. XR offers many opportunities for surgeons to improve their performance during procedures, reducing human and surgical errors while improving surgical efficiency. XR is highly beneficial to preoperative planning, as the ability to view in 3D may help surgeons or radiologists to assess a patient's condition more accurately before undertaking a surgical procedure. Conventional 2D scan data (such as CTA or MRA images) can be transferred into 3D environments such as AR, VR or holograms (MR). In the case of cancers, it can help to analyse the position, shape and size of a tumour with greater precision. Implantology and plastic surgery may also benefit from XR. For example, VR can be used to identify facial asymmetries and create an optimal preoperative design, possibly in consultation with the patient. Accurate and realistic medical models can be incorporated into XR by creating medical models of real human bodies from a collection of 2D images in DICOM format²; these models can then be incorporated as interactive components into VR and AR applications. AR and MR can improve intraoperative navigation. A surgeon can intraoperatively access anatomical information on the patient and overlay virtual holographic elements in real time onto the actual superficial anatomy of the patient while they are on the surgical table. In spinal surgery, AR may assist surgeons in placing screws by enabling them to visualise the patient's anatomy and pre-planned drilling trajectories using an AR visor. Medical staff can benefit from AR systems, which projects a map of a patient's veins before administering an injection. Another aspect enabled by XR is telepresence. Head-mounted VR and AR displays have great potential in surgery, enabling remote communication and telemonitoring. The ability to simultaneously analyse the same data (3D medical images) can also aid pre-operative planning by reducing the number of meetings required by medical teams.

XR/AR-assisted analysis and diagnosis. XR offers greater accuracy and efficiency than conventional techniques and can therefore be used in medical analysis and diagnosis. XR can be used in the detection of disease. By providing enhanced high-resolution 3D microscopic images of the patient's anatomy, XR can enable better data understanding and diagnosis. XR can be applied to analyse and diagnose patients while observing them in virtual environments. VR devices can help to tackle the difficulties of testing human visual conditions, by providing a mechanism to reliably assess the core visual functions with standardised stimuli. When assessing the patient's visual abilities, the patient is fully immersed and not distracted by external factors, allowing the clinician to accurately record/monitor the patient's visual processing components. VR headsets have been found to be as reliable as a standard cathode ray tube computer screen in providing diagnostic tests for the assessment and diagnosis of basic cognitive functions.

Mental health, neurological and cognitive disorders. XR can be used to analyse and diagnose a range of mental health, neurological and cognitive disorders. In these cases, it is often difficult to provide patients with real-life scenarios in which the relevant behaviours can be assessed. In addition, traditional clinical interviews and questionnaires can often lead to bias. XR provides a safe platform to recreate real-life situations in virtual environments through interactive virtual simulations where patient behaviour and responses can be accurately observed and recorded. Thus, XR offers non-

invasive, non-pharmacological and easier-to-use interventions for diagnosis and Therapies. For example, XR could be used to analyse and diagnose addictive disorders, phobias, social anxiety disorders and post-traumatic stress disorders, psychosis and schizophrenia, attention-deficit or hyperactivity disorders, autism spectrum disorder, eating disorders, obsessive-compulsive disorder, dysexecutive syndromes, spatial navigation disorders, Alzheimer's disease and Parkinson's disease. For the problems of AUTISM/ADHD disorders in children, therapeutic games in VIRTUAL AND IMMERSIVE REALITY provide concrete therapeutic support, improving social interaction and autonomy of patients. These therapeutic games have positive scientific evidence in concrete applications on young patients: they help them in stimulating adaptations, overcoming phobias, stimulating communication skills and much more.

Treatment and therapies for patients with mental health problems or disorders. Exposure therapy is the best-known use case for VR in the treatment of mental health disorders. Exposure therapy is a cognitive behavioural therapy (CBT) technique with a strong evidence base in the treatment of anxiety, conduct and substance use disorders, and post-traumatic stress disorder (PTSD). It involves gradual and repeated exposure to feared stimuli, resulting in changes in the patient's cognitions, behaviours, emotional and physical responses. However, some in vivo exposure therapies are challenging to implement (patients may refuse treatment out of fear, it may be difficult to arrange exposure in the therapist's office, etc.). Immersive VR can help overcome these issues by allowing a patient to be sufficiently exposed to the feared stimuli, but in a safer and controlled environment. Potential use cases for VR exposure therapy include eating disorders can be treated by presenting patients with virtual food to reduce food cravings and anxiety. Treating substance use disorders and behavioural addictions (nicotine, cocaine, alcohol, cannabis, gambling, etc.). By exposing patients to specific cues, VR is useful in both assessing (e.g. through eye-tracking and heart-rate monitoring) and treating such disorders VR can trigger cravings and help people learn to control them.

Pain and anxiety. Immersive experiences can alter the perception of pain and can be used to alleviate acute and chronic pain, such as that associated with burns, phantom limb, cancer pain or even labour. Scientists agree that VR can be an effective non-pharmacological, non-invasive complementary adjunct or alternative analgesic technique. There are three mechanisms of VR analgesia: 1) Distraction: VR applications distract and entertain. Embodiment in the virtual world and blocking out sounds from the physical world can overwhelm and reduce a person's ability to respond to neural signals. As a result, immersive experiences (e.g. 360-degree videos) may result in patients experiencing less pain. This may be particularly effective in paediatric patients. 2) Focus shift: VR applications systematically shift the patient's focus to virtual objects. Pain and stress can be minimised by engaging patients in specific tasks of tracking moving targets while requiring them to recall specific information (a more engagement/activating approach than distraction). 3) Skill building: VR applications teach pain management. This can help patients build the skills necessary to regulate their responses to painful stimuli and become agents of their own care (e.g. interactive games that encourage patients to take deep breaths to avoid hyperventilation during painful procedures).

Rehabilitation and cognitive enhancement. XR interventions may be useful for people with neurological conditions. These include therapies for people with progressive neurological decline, such as mild cognitive impairment (MCI) or dementia; people recovering from stroke or traumatic brain injury; and people (especially children) with neurodevelopmental disorders. VR can become a tool for cognitive rehabilitation, a form of non-pharmacological therapy aimed at improving everyday memory. VR systems and applications aim to provide treatment for navigation and orientation, face recognition, cognitive functioning and other instrumental activities. In addition, the use of VR for both stimulation and relaxation can lead to reduced stress, reduced aggression and improved interactions with caregivers for people with cognitive decline.

Improvement of well-being and promotion of a healthy lifestyle. XR technologies can promote healthy lifestyles and improve the physical and psychological/emotional well-being of the general population. In contrast to the XR affordances described above, these use cases are not typically targeted at people with specific health conditions and can be enjoyed by anyone. For example, some XR products have been designed to increase engagement with common indoor exercise activities such as climbing and jumping. XR applications can improve psychological and emotional well-being by helping people to relax, reduce stress and anxiety, or simply improve their mood.

EDUCATION. XR educational applications are into different areas and the use of XR in education can be categorised in terms of the instructional approaches used and the learning activities.

Procedural training. The potential use of XR for procedural improvement is the broadest area of application for XR in education. XR technologies are particularly useful in situations where real-life training is either too expensive or too dangerous. It helps to reduce costs and ensure the safety of trainees by providing simulated scenarios for training activities.

XR is used in aviation training because it enables the simulation of real flight by integrating advanced aviation training devices. These solutions develop the technical skills required for pilots more effectively and without compromising to safety compared to traditional training methods. In addition, stress resistance and emergency skills can be nurtured by simulating dangerous flight scenarios. XR tools can also be applied in training programmes for train crews, not only teach users how to operate new trains but also explain rail classes and grades along with developing the necessary skills involved in being a crew member. In addition, the use of VR simulators in maritime education and training makes the maritime training process cheaper, safer, more immersive, compact and accessible to trainees compared to traditional configurations, while not requiring significant investment or specific literacy skills. Another application for XR is in military and police training, where it can be used to develop the combat skills of individual soldiers or small combat groups by simulating a real vehicle, real soldier or real combat scenarios. This type of training develops the combat command and decision-making skills of the armed forces by realistically simulating 3D battlefields and using a VR-based system to analyse tactics. The application of XR in training for firefighters reduces the risks to safety of serious injuries and great stress. XR helps to simulate a real fire, ensuring both effective and safe practical training, provides an opportunity to create an endless number of learning scenarios that can develop many different practical skills.

Development of soft skills. XR technologies can also help develop transversal soft skills (e.g. communication, critical thinking, problem solving, leadership, teamwork). In general, XR-based training leads to higher achievement in soft skills development compared to traditional training. Test results show that VR-based training ensures a faster learning process, higher confidence in the acquired skills and a deeper focus on learning. VR-based learning is also cheaper (the cost does not usually increase with the number of trainees) and allows trainees to maintain social distance if necessary. For this reason, formal educational institutions at all levels can use XR tools to build soft skills in a more efficient and engaging way. The use of virtual scenarios is a popular area of XR application in soft skills training. Using XR tools, trainers create virtual scenarios (stories) and assign them to learners. Research in this area shows that this learning approach has a positive impact on the learning process and on learners' performance (including communication, leadership, conflict management, collaboration, critical thinking and creative skills) as they are engaged in a more effective and enjoyable way. XR-based learning also addresses the common problem of traditional role-playing, which can make students feel ashamed and afraid of making mistakes with real-life consequences. Another example of the application of XR is the use of virtual platforms to teach, track and evaluate students' teamwork and critical thinking skills in a virtual professional environment. The operation of these virtual platforms is based on a blended learning approach, using game and role-playing elements and applying problem-based and collaborative learning strategies. When using virtual platforms, students work together in teams to complete tasks set by teachers and receive feedback. Research indicates that virtual platforms facilitate the learning and development of teamwork skills; thus, students can achieve better results than in a real classroom.

Art and design. The use of XR also opens many opportunities for art, architecture and fashion students. It can help to stimulate creativity, explore and create works of art in a virtual environment. For example, students can virtually visit museums and explore the world's most famous works of art while physically remaining in the classroom. Such virtual experiences save time and money and create opportunities for students with financial difficulties to access museums. VR-based tools also allow students to explore and create new art forms, such as 3D artwork, that would otherwise be impossible. Architecture students can analyse architectural projects by wearing VR headsets, which allow them to walk virtually around virtual 3D buildings to gain a realistic impression of their structure and floorplan, furniture, decorations and even changing shadows depending on the time of day. Fashion design students have been actively using VR-based computer software that allows them to design clothes in different materials and styles in a 3D virtual design environment.

Raising awareness. XR technologies are used to educate students about environmental issues. It can help to teach students about environmental issues and build environmental awareness. Students can apply AR features using their smartphones by pointing the camera at a target image (a QR code) to display a 3D model on their phone's screen and visualise current environmental issues (e.g. global

warming, deforestation, air or soil pollution), explain their causes and provide recommendations for mitigation. In addition, the use of VR headsets and virtual scenarios also provides an opportunity to create realistic images of environmental disasters (the box below presents one example). The purpose of such applications is to raise awareness and explain how everyone can contribute to positive environmental change. XR tools can also be useful in raising students' awareness of racism and reducing racial discrimination. This can be achieved by involving students in a gamified simulation in which they play the role of a student facing racial prejudice in their studies. In this way, learners can experience first-hand negative experiences and difficulties related to racial discrimination during their studies.

Computational Thinking Development. Students' computational thinking skills can be developed with the help of XR-based video games. Students can play these video games using specific applications on their smart devices, which allow them to tackle tasks oriented around problem solving in an AR or VR-based environment. These tasks are usually interactive, allowing the user's actions to be tracked to assess progress and suggest possible further actions. Research has shown that the use of such XR tools has a significant positive impact on student performance.

Collaborative learning. XR tools enable students to collaborate virtually with their peers to foster learning and develop communication and teamwork skills. VR is used to create collaborative learning experiences that enable students to work together to complete assignments in a virtual environment. Teachers can also apply a virtual collaborative learning environment to the learning and communication of children with autism. These students are invited to collaborate with peers in a virtual environment to complete set tasks and develop necessary communication and problem-solving skills. Research in this field has shown that children with autism who participate in such activities are able to socially interact with their peers in VR-based design tasks, were actively engaged in the collaborative design task, and achieved the targeted design goal. The application of XR also allows learners to study interactively and collaboratively in a virtual laboratory, complete with virtual assistants and 3D models that virtually illustrate chemical or physical reactions.

Learning languages. Application of XR in foreign language learning are in formal educational settings, (e.g. schools and university programmes) and informal education in foreign languages through the individual use of various XR tools. Immersive environments create a holistic, student-centred approach to learning. VR-based apps combine different aspects of reading comprehension, vocabulary retention and speaking skills through gamification, making language learning more engaging and less dependent on face-to-face teaching.

Physical training. XR can be used in all areas of Physical Education and Training (PET), including teaching, learning and improving athletes' sports knowledge and skills. VR fitness applications have become increasingly popular since the introduction of VR systems. By using VR tools with HDMI, motion sensors and 3D display devices, PET teachers can guide students through the process and challenges of VR-based exercises in real time, rather than giving them instructions beforehand.

Visualisation (sensory stimuli), Virtual field trips (content incentives), Storytelling/annotation (perceptual stimuli). XR offers 3D learning materials that can be particularly beneficial in subjects where it is important for learners to visualise the subject matter (e.g. engineering, anatomy and STEM). This feature ensures interactivity in learning, overcoming a common problem with traditional videos, which tend to be passive learning objects. Engineering students tend to have difficulties in reading and understanding 2D and even 3D representations, as well as a lack of knowledge about the functions of components and in analysing the chain of power transmission and transformation of motion. An example of visualisation using XR technologies as a teaching approach in education is in Anatomy, which is equipped to teach and study lung anatomy and airflow patterns, as well as complex morphology. Another growing application for XR-based visualisation is in chemistry. A comprehensive understanding of atomic and molecular elements requires spatial and visual thinking that is sometimes lacking in traditional methods, which use limited teaching aids and therefore fall short of providing a detailed understanding of scientific theories and concepts related to molecular symmetry. Virtual field trips help to widen access to field-based learning in various subjects, which may be limited by geographical constraints in real-life settings. Subjects covered by virtual field trip applications include arts and culture, history, geography and astronomy, among others. An example are applications in Museum where the use of XR in the context of exhibitions has changed from the display of information to offering emotive, immersive, and rich experiences. The emergence of AR glasses offers the possibility for more accessible connections to social and cultural audiences,

personalising the visitor experience and enhancing communication. Other use of xr in virtual trips are in geography (engage students in key fieldwork practices and techniques and improve employability prospects as said technologies grow in commercial usage and applications) and astronomy (the virtual trip is capable of going beyond realistic possibilities and can provide field trips to places that are impossible to undertake in reality using today's technology, such as a space exploration field trip). Interactive Digital storytelling is a digital media platforms and interactivity for narrative purposes, first for speech and language therapy for children who have difficulties in language learning and speech development.

SOCIAL AND THERAPEUTIC EFFECTS ON VULNERABLE PEOPLE. XR tools enable better inclusion of people with disabilities. In the healthcare sector, XR can serve as a therapeutic modality, as people with limited mobility can enjoy 360-degree relaxation videos in VR. In the education sector, XR tools offer the opportunity to remotely participate in the educational process for students who cannot attend face-to-face classes due to physical limitations. XR offers novel treatment/therapy opportunities for people with various disabilities and disorders. This includes patients with mental health problems or disorders, neurodegeneration, neurodevelopmental disorders and mobility challenges, XR can benefit children by making them less anxious about undergoing medical procedures and enduring painful episodes as well as by bringing playful and exciting elements into repetitive rehabilitation exercises. In addition, children with ADHD or autism spectrum disorders are particularly interested in processing visual information and using digital devices, making XR technologies an enjoyable alternative to conventional therapy. The application of XR tools creates opportunities to involve students with autism more actively in the education process. XR provides gamified educational tools for people with autism to develop communication and teamwork skills. Research in this area has shown that children with autism who use such tools are able to successfully complete VR-based tasks and maintain social interactions with their peers. XR allows them to learn how to behave in real-life situations (such as crossing the street or shopping in a supermarket) in a safe way that is tailored to them. Students with ADHD were able to concentrate better and achieve classroom objectives when using VR headsets. XR technologies are also beneficial for students with Down syndrome, as it allows them to learn vocabulary and improve their reading skills in a more entertaining manner.

RISKS OF XR USE. The content of XR interventions may not be suitable for all users. There is a risk that people seeking treatment may try out a VR exposure therapy programme without first consulting a clinician and thus end up with no positive results or even worsening trauma symptoms. The same risk applies to the education sector, where content is tailored only to students in specific fields of education or should only be shown after special psychological preparation. XR embodiments can also change personal identities. The ability to adopt different avatars in VR worlds, or to superimpose AR filters on their real-life appearance, allows people to modify their bodies in the way they want to be seen. Similarly, engaging with VR-based content may cause difficulties in distinguishing what is real from what is produced by virtual reality tools. Moreover, the use of XR technologies in education itself could have a negative impact on the mental well-being of students. While traditional learning is based on real-life communication and human connection, immersive learning approaches could lead to personal isolation from the learner's peers, as XR tools are used individually most of the time. There are some risks about potential inequalities among educational institutions. The application of XR technologies in the education process requires financial capacities and a sufficient level of digital skills on the part of teachers. However, not all educational institutions possess both. Negative impacts on vulnerable groups regarding XR tools can be harmful to children or adults with mental disabilities. XR tools are usually based on realistic virtual scenarios, which involve high-quality 360-degree environmental images. Such a feature can have an overwhelming effect on persons with mental disabilities, who are more sensitive to unpredictable and frequent changes in their environment.

ECONOMIC ASPECTS. The wide use of XR applications offers many opportunities for the creation and development of new enterprises, not only in the specific field of computer development, but also in the design and production of hardware, start-ups that realise new concepts, scientific consultancy and research activities, and service enterprises that use these applications (induced) in the various fields of health and education.

Economic impact of XR in Education and health are different. It increased cost-efficiency. The application of XR in both the health and education sectors allows an increase in the efficiency of treatment and learning processes. In other words, XR ensures better results can be achieved in less

time and with lower financial costs. Researchers are all agree on XR allows training to be organised at lower cost. This is especially useful for training involving many participants (e.g. training for military servants), which usually leads to increased transportation and living costs for the training organisers. On top of this, research reveals that the use of XR allows students to achieve better learning outcomes in less time. XR makes students more engaged in the learning process, and thus they remain more focused on learning and ignore external distractions. The application of XR allows students to develop the skills required in the labour market. For medical students, XR enables more and better opportunities for practice, which may result in a faster learning curve to achieve higher precision and speed during a real procedure. From an economic viewpoint, virtual simulators reduce the costs and need for cadavers for educational purposes and give students the freedom to practice medical scenarios that in a traditional setting would be limited both financially and in terms of resources. In the same way in health field there are cost reductions relate to shortening the length of hospital stays, less doctor time being needed for aftercare, reductions in the use of drugs and an increase in patient satisfaction. In addition, respondents to the healthcare sector survey rated XR's impact in terms of time and resource savings. XR has the potential to allow better diagnosis, which may lead to better and more accurate treatment and rehabilitation methods, impacting both society and the economy. Economically, this also saves medical institutions and insurance providers the time and resources they would otherwise spend finding the right diagnosis and selecting treatment methods. XR may also benefit preoperative planning and intraoperative navigation, which leads to higher precision during surgery and a reduced risk of surgery complications. This results in reduced time/financial costs for the hospital and fewer hospital days for the patient. In terms of rehabilitation, VR and AR offer cost-effective, accessible and flexible interventions for patients who have difficulty in attending outpatient appointments due to distance, lack of transport or disability, which is often the case with older patients suffering from dementia or post-stroke symptoms. Telerehabilitation therapy, in combination with low-cost VR equipment, can reduce the number of hospital days for stroke patients and can promote self-motivation in the home for chronic patients.

Economic difficulties for business creation. Financial limits. XR solutions are costly for potential users. Although the price of XR hardware has come down significantly, the availability of customisable software is limited. The development of personalised XR software requires a different set of skills (design, programming, 3D modelling, etc.) and thus significantly increases the cost of adopting an XR solution for potential users. There are many costs in addition when you adapt XR in health and education as space requirements and programming expertise required to develop and operate custom applications in specialised virtual environments using multiple data collection peripherals. The cost of equipment such as motion capture cameras, haptic gloves, inertial measurement units and external stimulus triggering can be a limiting factor for many organisations and can discourage the use such technologies. Furthermore, producing an impactful VR simulation requires the work of an interdisciplinary team including social psychologists, artists, modellers, filmmakers, developers, technologists and others. This requires a considerable financial investment.

Market fragmentation. The XR market is fragmented. Several research groups and small companies are developing XR solution are too small to compete on a global level. Healthcare systems are also very fragmented. Different countries and even different regions within countries have different healthcare models, different legal environments. This makes it difficult to scale up digital health solutions across the market and requires a lot of resources and a long-term strategy to do so.

Difficulty in finding professional skills in the market. There is a shortage of content creation professionals and XR developers, as well as skilled XR instructional designers for the XR learning experience. This could be due to the lack of dedicated formal training programmes in this area and the lack of overall funding available. This shortage of professionals makes it difficult to start, maintain and grow a business and can result in poor quality XR content. It is difficult for companies to attract XR professionals. This relates both to difficulties in competing with global players that can offer more attractive salaries and working opportunities, as well as with other related sectors (mostly the gaming industry).

Technical limitations. The affordable costs for peripherals clash with their technical limitations, such as not ergonomic, low image resolution, a lack of precision in AR hardware, speed and battery life, poor internet connection.

Discussion

The use of the Extended Reality (Virtual Reality, Augmented Reality, Mixed Reality) in the field of Education and Health has a great impact on social and economics and give opportunities to individuals to create new startups and new businesses.

Conclusion

This work describes the latest developments in the XR for professional use. and provides an assessment of the strengths and weaknesses of the results of existing research the healthcare and education sectors. This includes an analysis of how XR can assist the daily lives of vulnerable groups (children and adults with disabilities), as well as the challenges that such groups face when using these technologies. The article looks at how XR can help in the daily lives, the use on different field of business and education and the impact on the economy and society. XR applications in health and education is a great opportunity to business creation and for the birth of new startups in different market segment.

СПИСОК ИСПОЛЬЗОВАННЫХ ИСТОЧНИКОВ

- 1 Zweifach, S. M. Extended Reality in Medical Education: Driving Adoption through Provider-Centered Design / M. M. Triola // Digital Biomarkers. – 2019. – №3(1). – P. 14–21. <https://doi.org/10.1159/000498923>.
- 2 Alamäki A. Students' Experiences of 2D and 360° Videos With or Without a Low-Cost VR Headset: An Experimental Study in Higher Education / A. Alamäki, A. Dirin, J. Suomala, C. Rhee // Education and Information Technologies. – 2021. – № 3. – P. 2751–2770.
- 3 Di Natale A.F. Immersive virtual reality in K-12 and higher education: A 10-year systematic review of empirical research / A.F. Di Natale, et al. // British Journal of Educational Technology. – 2020. – № 6. – P. 2006–2033.
- 4 Liagkou V. Realizing virtual reality learning environment for Industry 4.0 / V. Liagkou, D. Salmas, C. Stylios // Procedia CIRP. – 2019. – №. 84. – P. 751–756.
- 5 Zhang L. Design and evaluation of a collaborative virtual environment (CoMove) for autism spectrum disorder intervention / L. Zhang, et al. // ACM Transactions on Accessible Computing (TACCESS). – 2018. – № 3. – P. 1–26.

REFERENCES

- 1 Zweifach, S. M., & Triola, M. M. (2019). Extended Reality in Medical Education: Driving Adoption through Provider-Centered Design. Digital Biomarkers, 3(1), 14–21. <https://doi.org/10.1159/000498923>. [in English]
- 2 Alamäki, A., Dirin, A., Suomala, J., & Rhee, C. (2021). Students' experiences of 2D and 360° videos with or without a low-cost VR headset: An experimental study in higher education. [in English]
- 3 Di Natale, A. F., et al. (2020). Immersive virtual reality in K-12 and higher education: A 10-year systematic review of empirical research. British Journal of Educational Technology, 51(6), 2006–2033. [in English]
- 4 Liagkou, V., Salmas, D., & Stylios, C. (2019). Realizing virtual reality learning environment for Industry 4.0. Procedia CIRP, 84, 751–756. [in English]
- 5 Zhang, L., et al. (2018). Design and evaluation of a collaborative virtual environment (CoMove) for autism spectrum disorder intervention. ACM Transactions on Accessible Computing (TACCESS), 11(3), 1–26. [in English]

П. Капуто*¹, К. Жамбутаева², Скайлар Райан Аллен³

¹Инновациялық Еуразия Университеті, Қазақстан, Парфеноп университеті, Федерико II университеті, Асһіі халықаралық институты, Италия

²Инновациялық Еуразия Университеті, Қазақстан

³Арканзас Университеті, Америка Құрама Штаттары

**Білім беру мен денсаулық сақтаудағы кеңейтілген шындық:
жас кәсіпкерлер үшін мүмкіндік**

Мақаланың мақсаты-білім беру және денсаулық сақтау саласындағы кеңейтілген шындықты (виртуалды шындық, кеңейтілген шындық, аралас шындық) пайдалану және XR

технологиялары адамдарға жаңа стартаптар мен жаңа бизнестерді құру үшін ұсына алатын мүмкіндіктер туралы айту. Мақалада бизнес пен білім берудің әртүрлі салаларында қолдану, экономика мен қоғамға әсер ету, сондай-ақ XR халықтың осал топтарының күнделікті өміріне қалай көмектесе алатындығы және осы технологияларды қолдану кезінде қандай проблемалар туындайтыны қарастырылады.

Білім беру және денсаулық сақтау саласындағы кеңейтілген шындықты (виртуалды шындық, кеңейтілген шындық, аралас шындық) пайдалануды, хг технологияларының адамдар мен бизнеске ұсынатын мүмкіндіктері мен артықшылықтарын, сондай-ақ экономика мен қоғамға әсерін сипаттаңыз.

Зерттеу осы саладағы тікелей тәжірибеге және әртүрлі жобаларды (соның ішінде мүдделі тараптардың негізгі топтарымен, XR зерттеушілерімен, XR компанияларының өкілдерімен сұхбаттарды, ғылыми зерттеулерді, табыс тарихын оқуды) жүзеге асыру үшін жүргізілген зерттеу кезеңінде жиналған деректерге негізделген.

Зерттеудің нәтижесі білім беру және денсаулық сақтау саласында XR қолдану туралы қазіргі білім және тиісті бизнес мүмкіндіктері болып табылады.

Түйін сөздер: Кеңейтілген шындық, виртуалды шындық, кеңейтілген шындық, аралас шындық, білім беру, электрондық денсаулық сақтау, инновациялық стартаптар, зерттеулер мен әзірлемелер, өнертабыстар, инвестициялар, бизнес.

П. Капуто*¹, К. Жамбутаева², Скайлар Райан Аллен³

¹Инновационный Евразийский университет, Казахстан, Университет Партенопе, университет Федерико II, Международный институт Ачи, Италия

²Инновационный Евразийский университет, Казахстан,

³Университет Арканзаса, Соединенные Штаты Америки

Расширенная реальность в образовании и здравоохранении: возможность для молодых предпринимателей

Цель статьи – рассказать об использовании расширенной реальности (виртуальной реальности, дополненной реальности, смешанной реальности) в сфере образования и здравоохранения, а также о возможностях, которые технологии XR могут предложить людям для создания новых стартапов и новых бизнесов. В статье рассматривается использование в различных сферах бизнеса и образования, влияние на экономику и общество, а также то, как XR может помочь в повседневной жизни уязвимых групп населения и с какими проблемами они сталкиваются при использовании этих технологий.

Опишите использование расширенной реальности (виртуальная реальность, дополненная реальность, смешанная реальность) в сфере образования и здравоохранения, возможности и преимущества, которые технологии XR могут предложить людям и предприятиям, а также влияние на экономику и общество.

Исследование основывалось на непосредственном опыте работы в данной области и данных, собранных в ходе исследовательской фазы, проведенной для реализации различных проектов (включая интервью с ключевыми группами заинтересованных сторон, исследователями XR, представителями компаний XR, научные исследования, чтение историй успеха).

Результатом исследования являются текущие знания об использовании XR в области образования и здравоохранения и соответствующие возможности для бизнеса.

Ключевые слова: Расширенная реальность, виртуальная реальность, дополненная реальность, смешанная реальность, образование, электронное здравоохранение, инновационные стартапы, исследования и разработки, изобретения, инвестиции, бизнес.

Date of receipt of the manuscript to the editor: 2025/02/02