Difficulties in conducting research with the use of virtual reality (VR)

Luba Jakubowska

Department of Promotion of Health, Faculty of Health Sciences, Wroclaw Medical University Barta 5, 51-618 Wrocław
E-mail address: luba.jakubowska@umed.wroc.pl
ORCID number: https://orcid.org/0000-0002-0507-6595

Magdalena Kazimierska-Zając

Department of Disorders of the Nervous System, Faculty of Health Sciences, Wroclaw Medical University Barta 5, 51-618 Wrocław
E-mail address: magdalena.kazimierska-zajac@umed.wroc.pl.
ORCID number: https://orcid.org/0000-0003-3758-2975

Abstract

Introduction. Virtual reality is a technology which is increasingly more often used not only by the entertainment industry, but also in education, medicine, trade, and tourism. Conducting research with the use of virtual reality is necessary in order to confirm or disclaim its effectiveness as a tool in particular uses.

The aim. The aim of this paper is to present and analyse the difficulties which arise during research with the use of VR.

Methods and materials. The authors have analysed the difficulties mentioned by researchers, as well as those addressing their own experiences gained during research with the use of VR.

Conclusions. The difficulties arising during the research testing the use of VR can be divided into three groups. The first group includes those connected with the research subjects. There are objections related to certain illnesses, what is more, some individuals may feel fear of new technologies or lack interest in them. The second group contains the problems connected with the features of the equipment. The cost, the space necessary to carry out the research, and the number of assistants required make it difficult to conduct research on a large number of individuals at the same time, and to popularise the use of the equipment. That is why researchers often use one tool only while working with a number of people, which leads to wear and tear of the equipment. There is still a shortage of software solutions dedicated to therapists and educators. Researchers often use software designed for entertainment. The third group of difficulties is related to the persons carrying out the research. The researchers ought to receive sufficient training, they may require help transporting the equipment, and they cannot anticipate the reactions of the particular research subjects. When writing the article we have noticed yet another obstacle, which may prove impossible to overcome in the near future. VR glasses are typically used by a number of people, which may be a threat in the times of an epidemic.

Key words: VR, virtual reality, research, new technologies.

Introduction

Virtual reality is a technology which is used more and more frequently not only in the entertainment industry, but also in education, medicine, trade, and tourism.

In cases of such mental disorders such as phobias and PTSD a virtual environment provides therapists with the opportunity to control the intensity of a stimulus which a patient fears, which in unsummed environments is much more difficult. When used in medical education the students can benefit from a safe, controlled environment, which makes it possible for them to practice procedures repeatedly on a virtual patient.

Conducting research with the use of VR is necessary to confirm or disclaim its effectiveness as a tool in particular uses. A number of questions arise as to whether the effect of VR is lasting, if the equipment is safe to use, how far the equipment can be personalised, and to what extent can the experience in the world of VR be transferred into the real world. When analysing the problems mentioned by researchers as well as those which we have experienced we have organised the difficulties into three broad groups: difficulties connected with the character of the investigated group, the characteristics of the equipment, and the problems related to the researchers/assistants. In practice we witness a combination of these three areas, which is why the proposed coding ought not to be perceived as a set of rigid categories.

Virtual reality and the features of research subjects

Research subjects, when presented with virtual reality, are often interested in the technology, especially when they see it for the first time. Before their eyes they can see an environment which looks real, which is experienced as real, yet it is the work of specialists in VR technology. This leads to the first problem, which consists of the fact that the reactions of people using VR glasses for the first time may vary significantly from the reactions of those who have used them before. The problem may be significant when we investigate, for example, the effect of VR on the emotions of research subjects or the influence of the effect of immersion on, e.g., the feeling of pain or stress.

Yet another problem lies in personality differences between research subjects. Most research subjects approach the technology with great enthusiasm, however, sometimes people refuse to take part in research with the use of VR because they claim that they are not interested in the technology. Because of the innovativeness of the tool it may be assumed that the persons who volunteer for tests are the ones characterised by greater openness to new experiences as a personality trait.

In the rules and regulations of VR arcades, as well as in references sources, one may find information about side effects which may prove dangerous to persons with certain illnesses. Attention is drawn to the fact that some such individuals, while using VR, may experience sensory conflict (Denisow, 2019), which can, in turn, lead to impaired coordination and nausea. Motion sickness, "simulation"

sickness, or "cyber-sickness" can be a contraindication for persons with some neurological illnesses, as well as a difficulty for researchers when research subjects use VR standing up (an insecure person may lose their coordination and fall). The typical symptoms are disorientation (systemic and non-systemic vertigo), nausea (e.g. belching, stomach discomfort, salivating), as well as oculomotor symptoms (headaches, tired eyes, distorted vision) (Kruk, Mętel, & Cechnicki, 2019).

In the research carried out by the authors of the present paper no significant side effects have been encountered. However, as other authors emphasise, it is crucial to constantly control the level of comfort and anxiety of research participants (Biernacki, Dziuda, 2012). One needs to pay attention to the fact that these difficulties may be avoided by conducting interviews with research participants before the sessions, and by proper selection of the used software/games.

Among the unfavourable consequences of the use of VR researchers place also the threat of addiction, the lack of the sense of self-agency, hazards to mental health, and the loss of authenticity (Kruk, Mętel, & Cechnicki, 2019). However, such results mostly appear with long-term, unsupervised use of VR. In research one is more likely to encounter short-term side effects.

Obstacles resulting from the characteristics of VR equipment

Virtual reality technology is still relatively costly. In numerous cases it is calculated whether the cost of the equipment and software is worth the potential results of the research. It is natural that researchers want to use technology which resembles the real world as closely as possible. Such equipment is more expensive and frequently it is necessary to adjust the equipment to a particular individual: their height and eyesight, as well as the space where the research takes place. Nevertheless, the realism of the presented characters is not greatly important, because even basic equipment provides the opportunity to model uncomplicated social interactions (Kruk, Mętel, & Cechnicki, 2019). However, the quality of the equipment is important because of its capability to use more specialist software and its impact on the health of users (e.g. more expensive devices have better eyesight protection). What is more, in some of the uses the high quality of the simulated conditions is essential, for example, in medical education.

There is one more difficulty connected with cost: the opportunity to conduct research on a larger group, because researchers will typically only have access to a limited number of devices. In conducting VR sessions in the case when a person is standing up and moving around certain space is required, which can also be a problem in smaller laboratories. What is more, sessions are usually conducted with at least two assistants, which is why individual sessions are preferred. The limitations pertaining to group research lie not only in time constraints, but also in standardisation of conditions, the greater wear on the devices, and the difficulties arising in classes with university students.

Yet another problem lies in the availability of software designed for therapists or educators. Developing software is costly and requires interdisciplinary cooperation,

which is why researchers often use programmes originally designed for entertainment, which limit the possibilities to explore the full potential of the technology.

Although the costs of the use of the technology remain high, the potential benefits lead to the search for new ways to employ it.

Competences of the researchers using VR

Carrying out research with the use of VR often requires cooperation and help of other people as well as the finances and technical support of institutions.

The use of virtual reality requires researchers to possess a number of competences. First of all, basic language competences are necessary (a number of programmes are available in English only), as well as technical (the equipment is mobile and it needs to be set up and adjusted every time it is run) and communicative ones (researchers need to conduct an interview with the research participants, be able to adjust the programs in case of contraindications, and properly react to unexpected reactions of research subjects).

The characteristics of the equipment (work in simulated conditions) require researchers to be methodologically well-prepared. A question arises as to the standardisation of the conditions and the reliability of VR experiences (White, & Siu, 2016). The software ought to be tested and incorporated into educational (Li, Cheng, & Yuan, 2018) or therapeutic programmes. From a metanalysis of the use of VR in neuroscience it can be concluded that in relation to the reliability of the results as well as the safety of the participants technological competences of researchers and monitoring the quality of the equipment (developing detailed reports is required) are essential (Kourtesis, Collina, Doumas, & MacPherson, 2019). Because research with the use of VR is relatively new, it requires good theoretical grounding and designing tests monitoring the long-term impact of VR (Liaw, Carpio, Lau, Tan, Lim, Goh,2018).

Summary

Difficulties in the use of VR result from the characteristics of the technology which, depending on the quality of the equipment, allow a close simulation of reality, and require broad competences of the individuals using the technology in their research.

It appears that the use of VR is likely to increase and enter into new areas. It is possible that in near future VR will become a commonly employed tool in sectors of education and therapy, however, in order to competently assess the benefits of VR technology it is necessary to conduct further research into educational (Lewandowska, Ozimek, & Lewandowska) as well as ethical and health-related aspects connected with the risks of long-term hazards resulting from the use of VR (Kruk, Mętel, & Cechnicki, 2019).

It is also crucial to carry out research into the use of VR in education and therapy of particular research groups, including age groups (the youngest and the

oldest), as well as persons with certain disorders and ailments. In the case of the ethical aspects it will be of highest importance.

What is crucial are the competences of the researchers, which ought to exceed the competences connected strictly with the branch of science which they practice to also include technological competences. It is important to work on adjusting the equipment and the software (which was originally used for entertainment) to the needs of therapists and educators, and on making possible a broader access to technology while reducing the costs without decreasing the quality.

References

Biernacki, M., Dziuda, Ł., (2012). Choroba symulatorowa jako realny problem badań na symulatorach [Simulation sickness as a real problem in research with simulatros] , *Medycyna Pracy* [Occupational medicine], *63(3), 377-388.*

Denisow, E. I., (2019). Robots, Artificial Intelligence, Augmented And Virtual Reality: Ethical, Legal And Hygienic Issues, *Gigiena i Sanitaria, 98*(1), 5–10.

Kourtesis, P., Collina, S., Doumas, L. A. A., & MacPherson, S. E. (2019). Technological competence is a pre-condition for effective implementation of virtual reality head mounted displays in human neuroscience: A technological review and meta-analysis. *Frontiers in Human Neuroscience, 13.* https://doi.org/10.3389/fnhum.2019.00342

Kruk, D., Mętel, D., & Cechnicki, A. (2019). A paradigm description of virtual reality and its possible applications in psychiatry. *Advances in Psychiatry and Neurology/Postępy Psychiatrii i Neurologii, 28(2),* 116-134. https://doi.org/10.5114/ppn.2019.86255

Liaw, S. Y., Carpio, G. A. C., Lau, Y., Tan, S. C., Lim, W. S., & Goh, P. S. (2018). Multiuser virtual worlds in healthcare education: A systematic review. *Nurse Education Today*, *65*, 136–149. https://doi.org/10.1016/j.nedt.2018.01.006

Ozimek, A.P. & Lewandowska, P.K. (2019). Możliwości zastosowania wirtualnej rzeczywistości w edukacji oraz ich konsekwencje [The opportunities to use virtual reality in education, and their consequences]. *Ogrody Nauk i Sztuk. 9, 9 (sie. 2019), 267-275.* DOI:https://doi.org/10.15503/onis2019.267.275.

White, & Siu, Virtual Simulation and Surgical Education : Current Challenges and Future Solutions, In: Hill, Z. B. (2016). *Virtual Reality : Advances in Research and Applications.* (pp 11-26). Nova Science Publishers, Inc.

Zhe Li, YuNing Cheng, & YangYang Yuan. (2018). Research on the Application of Virtual Reality Technology in Landscape Design Teaching. *Educational Sciences: Theory & Practice*, *18*(5), 1400–1410. https://doi.org/10.12738/estp.2018.5.037