МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ
Федеральное государственное автономное образовательное учреждение
высшего образования
«ТЮМЕНСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ»
ШКОЛА ПЕРСПЕКТИВНЫХ ИССЛЕДОВАНИЙ (SAS)

РЕКОМЕНДОВАНО К ЗАЩИТЕ В ГЭК
Директор школы
(Ph.D., кандидат филологических наук)
_____ А.В., Щербенок
15.05. 2023 г.

**ВЫПУСКНАЯ КВАЛИФИКАЦИОННАЯ РАБОТА**
магистерская диссертация

# FACULTY'S PERCEPTIONS OF VIRTUAL REALITY TECHNOLOGY USE IN HIGHER EDUCATION / ВОСПРИЯТИЕ ПРЕПОДАВАТЕЛЯМИ ИСПОЛЬЗОВАНИЯ ТЕХНОЛОГИЙ ВИРТУАЛЬНОЙ РЕАЛЬНОСТИ В ВЫСШЕМ ОБРАЗОВАНИИ

44.04.01 Педагогическое образование:
Магистерская программа «Экспериментальное высшее образование»


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Тюмень
2023

MINISTRY OF SCIENCE AND HIGHER EDUCATION
OF RUSSIAN FEDERATION
Federal Autonomous Educational Institution of Higher Professional Education
«UNIVERSITY OF TYUMEN»

SCHOOL OF ADVANCED STUDIES

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**GRADUATE THESIS**

# FACULTY'S PERCEPTIONS OF VIRTUAL REALITY TECHNOLOGY USE IN HIGHER EDUCATION / ВОСПРИЯТИЕ ПРЕПОДАВАТЕЛЯМИ ИСПОЛЬЗОВАНИЯ ТЕХНОЛОГИЙ ВИРТУАЛЬНОЙ РЕАЛЬНОСТИ В ВЫСШЕМ ОБРАЗОВАНИИ

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Tyumen
2023

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# INTRODUCTION

Immersive technologies are no longer something new. Their usage for educational purposes is only growing every year. Various companies offer their own technological products and ready-made simulators, which are aimed at mastering skills or learning new information. Virtual reality is one of immersive technologies. The first who started the integration of the virtual reality were companies and big corporations which are engaged in oil and gas extrusion, maintenance and repair of oil and gas equipment, medicine, pharmacy, electric power industry, metallurgical industry, mineral extraction. Then the implantation of virtual technologies began in schools. Digitalization came to higher education too. At the moment, this technology has already been applied at universities around the world. Considering Russia, the process of virtual reality implantation into higher education was launched in 2017. Institute of Mechanical Engineering, Materials and Transport in Saint Petersburg, Far Eastern Federal University in Vladivostok, Southern Federal University (Rostov-on-Don), Higher School of Economics, Moscow Polytechnic University, The National University of Science and Technology MISIS, ITMO University, The Graduate School of Management of Saint Petersburg University (GSOM SPbU), Tomsk Polytechnic University, Pacific State Medical University (Vladivostok). The number of Russian universities where virtual reality is used is low. The diffusion of innovation in higher education happens slowly.

# STATEMENT OF THE PROBLEM

However, without comprehension of technical, methodological, economic, psychological and organizational aspects of virtual reality implantation into higher education, it will be challenging to achieve innovation diffusion. There are no existing guidelines for implementing virtual reality technologies into the educational process. This is a complex task because it includes search of virtual reality simulators,

development, testing and implementation of simulators in the educational process, training of teachers and university staff, organizing virtual reality classes or laboratories with equipment, etc.

In addition, it brings such stakeholder as students, faculty, administration and virtual reality companies in one diplomacy context. There is a gap in each of these directions. There is insufficient data on faculty's, administration's and virtual reality companies' perception towards implementation and use of virtual reality in higher education in Russia.

## RATIONAL FOR THE STUDY

Since this problem is complex, there is a need to start by clarifying the attitude towards virtual reality from the faculty side. Since they are the ones the most actively involved in the courses and educational programs compilation, the issue of use and implementation of virtual reality will depend on them, their attitude to these technologies and their understanding of the need and expediency in the educational process. That is why faculty of higher education were chosen as the object of the study. The geography of the study is the Russian Federation.

## PURPOSE OF THE STUDY

This study will allow us to find out faculty's perception of virtual reality use in higher education and in particular: perception of digital competence, assessment of the technical aspects of virtual reality, ease of use, attitude towards adoption, didactic usefulness, educational tasks solvation, advantages, disadvantages and barriers of the use and implementation.

## RESEARCH QUESTION

The central question posed for this study was: What are the faculty's perceptions of virtual reality use in higher education? (in Russian context). Guiding

topics included: (a) Perception of digital competence; (b) Assessment of the technical aspects of virtual reality; (c) Ease of use; (d) Attitude towards adoption; (e) Didactic usefulness of virtual reality; (f) Educational tasks solvation; (g) Advantages and Disadvantages of virtual reality (h) Challenges of using virtual reality (i) Barriers of the implementation.

# CHAPTER 1. LITERATURE REVIEW

This review of literature explores the definition of virtual reality describes cases of universities using virtual reality all over the world, including the situation in Russia, as well as the innovation diffusion theory.

## 1.1 VIRTUAL REALITY IN HIGHER EDUCATION IN GLOBAL CONTEXT

There exist many definitions of virtual reality. Stephen Bryson [2013] presented his paper on "Virtual Reality: A Definition History". In this paper, virtual reality is defined as "the use of computer technology to create the effect of an interactive three-dimensional world in which the objects have a sense of spatial presence" [2013, p. 1- 6].

Ronak Dipak Kumar Gandhi et al. [2018] presented their "Virtual Reality – Opportunities and Challenges" paper. In this paper, the author considers definition of Bharath [2016] who identifies virtual reality as "an immersing technology that can provides capability to realize actual working environment" [2018, p. 2714-2724]. Tomasz Mazuryk et al. [1996] presented their paper "Virtual Reality: History, Applications, Technology and Future". In this paper, the author provides examples of definitions. And one of them is "virtual reality refers to immersive, interactive, multi-sensory, viewer-centered, three-dimensional computer generated environments and the combination of technologies required to build these environments" [1996, p. 72].

Virtual reality technology includes headsets, headphones, controllers and software. All this equipment is necessary for immersion in virtual reality.

The technology is used in engineering, design, mining, military, construction, marketing and advertising, entertainment, and education. For the study was chosen education and, in particular, higher education. There are main directions in higher education where it is used: for distance learning, classroom education and supplementary training. There is no limitation in scientific fields where it can be

implemented: medicine, archaeology, astronomy, engineering, environmental studies, linguistics, social sciences, art and humanities, etc.

The universities start to organize the in-house virtual reality classes. This is the case of the University of Sydney [Marks, Thomas, p. 1287-1305]. There was designed a virtual reality laboratory to conduct classes for students. The space is organized only for classes from 15 to 30 students. For two and a half years the laboratory was visited by 7952 students. It was used mostly by the Faculty of Engineering (53%), by the Faculty of Arts & Social Science (23.8%) and the Faculty of Science (23.2%). They calculated the cost, only 19.50 Australian dollars per visit per student. They also provide information on what equipment they bought and how they organized the technical maintenance. One more example is the University of Toledo's Interprofessional Immersive Simulation Center in the United States of America [Resnick, Morgan, 2017]. There students from different fields such as medicine, geology, nursing, law, business, engineering and environmental science study to create immersive products. In the Harvard Innovation Labs AR/VR Lab, created by Harvard University, future scientists can master augmented and virtual reality technologies and learn how to apply innovations in their research. The University of Colorado has launched a virtual reality lab for groups of up to 100 students, which allows you to study anatomy, explore 3D images of body parts or conduct a virtual practice based on an anatomical corpse. Another experiment was conducted at Stanford University. The Virtual People class is the first to take place entirely in virtual reality. The class was put together by communication professor Jeremy Bailenson and first-year PhD student, Cyan DeVeaux, and uses virtual meeting platform ENGAGE to provide tools for students and teachers to build and interact in virtual environments. Class assignments include participating in a guided meditation in outer space, creating a performance with different avatars, and building a unique scene. The flipped classroom method is employed, where students do readings over

the weekend in preparation for interactive lessons the following week - class sessions were also limited to 30 minutes to avoid simulator sickness.

There are some universities, which conduct studies to find out what faculty's perception toward virtual reality adoption into higher education. The study was conducted among faculty of information technology at the University of Jordan [Alfalah, p. 2633-2653]. The research showed a promising tendency towards accepting virtual reality and opportunities for integration into the curriculum. Another study was conducted by Hamilton, D., McKechnie, J., Edgerton, E., and Wilson, C. [2021] "Implementing immersive virtual reality in higher education: a qualitative study of instructor attitudes and perspectives" to find out what faculty who are already using virtual reality to teach students think about applications and benefits, curriculum integration, classroom logistics, barriers to application and evaluation. Antón-Sancho, Á., Vergara, D., Fernández-Arias, P., and Ariza-Echeverri, E. A. [2022] "Didactic use of virtual reality in Colombian universities: Professors' perspective" conducted research among 204 universities of Colombia to find out their perception of the didactic use of virtual reality from the point of view of their digital competencies. The average level participants rated virtual reality very highly, both in its technical aspects and in its didactic benefits in higher education.

## 1.2 VIRTUAL REALITY IN HIGHER EDUCATION IN RUSSIAN CONTEXT

Boom on virtual reality happened in Russia in 2017, when universities started to open in-house virtual reality labs. Laboratories were opened at the Ural State University of Economics, the Institute of Mechanical Engineering, Materials and Transport in Saint Petersburg, the Far Eastern Federal University in Vladivostok, the Southern Federal University (Rostov-on-Don), the High School of Economics, Moscow Polytechnic University, MISIS, ITMO University, Tomsk State University.

Virtual reality can be used for practical training of students, for example, students of geology at Tomsk Polytechnic University undergoing an internship in virtual reality. Lidia Yatluk [2020, p. 165-192] mentioned that such universities as ITMO University, Lomonosov Moscow State University (MSU), Higher School of Economics (HSE), Far Eastern Federal University (FEFU), Kazan (Volga) Federal University (KPFU), Southern Federal University (SFU), Ural Federal University (UrFU), Moscow Aviation Institute (MAI), Volga State Technological University (Volgatech), Tomsk State University (TSU) and Tomsk Polytechnic University (TPU) use virtual reality to teach computer science. HSE, ITMO and Ural State University of Architecture and Art (USUAA) use virtual reality to teach design, Moscow City University (MPGU) and URFU use virtual reality to teach pedagogy. Bachelor's and master's programs are also being implemented to train students who have the skills to create virtual products [Nabokova, Zagidullina, p. 2710-2719]. University of Science and Technology MISIS posted an article on VR/AR technologies and staff training for mining industry [Vavenkov, p. 180-187], where a comparative analysis is carried out on the world practices of using virtual reality in the mining industry and in Russia. And the question is raised about the role of universities not only in the role of training young specialists with the help of virtual reality, but also the centers where these virtual reality is being developed. In the article “The Use of Virtual Reality in Teaching Students”, Anna Smirniva [2022, p. 897-904] studied the possibilities of virtual reality in higher education. The author came to the conclusion that this is a technology which can meet the needs of academia and industry. She marks such advantages such as active learning and risk-free. Lidia Yatluk [2020, p. 165-192] mentioned that virtual reality uses in higher education to change internships from industries to virtual in order to train skills and work with expensive facilities, to learn abstract scientific materials, to work in virtual laboratories in order to decrease risks, to learn foreign languages, to develop soft skills.

According to the research, “Strategies and Tactics of Adaptation of Scientists in the Transition to an Entrepreneurial University” [Yatluk, p. 165-192] highlighted the most frequent topics of research about virtual reality in higher education. It includes perception and interaction, in particular, sickness, 3D design, usability, immersion degree and interaction; simulation development; UX, in particular, features of interaction with virtual interfaces and minimization of discomfort; virtual reality in health science.

## 1.3 DIFFUSION OF INNOVATION THEORY

Kinnunen, J. [1996, p. 431-442] writes about the founding father of innovation diffusion research - Gabriel Tarde is the inventor of diffusion theory. It focuses on the dissemination and adoption into society. The work helps to understand what kind of activities influence on adoption or rejection. Saltzman [2021] gives a definition of diffusion “the process in which an innovation is communicated through certain channels over time among the members of a social system”. The innovation goes through five stages: knowledge, persuasion, decision, implementation, and conformation.

The knowledge stage includes the finding out about the existence of innovation, and it is functioning. During the stage, the potential adopters get information about the innovation and its usefulness. Talking about virtual reality technology, it might be lectures, seminars, workshops, presentations, etc., to familiarize faculty and administration with it.

The persuasion stage includes the formation of positive or negative opinion about the innovation, which leads to adoption or rejection. Faculty’s and administration’s opinions of virtual reality will be important to the usage and implementation of this technology into higher education. The more positive the perception is, the higher chances for its adaption in the future.

The decision stage includes the decision-making process, when the adaptors decide whether to adapt the innovation or not. On this influences different factors such as costs, benefits, academic outcomes, opportunities, ease of use/hard-to-use, advantages and disadvantages, barriers and so on.

The implementation stage includes integration of the technology into the organization. On this stage, the faculty and administration should decide how they would implement virtual reality into the university, whether it be virtual reality laboratory or class. It also might include the way of how it will be implemented into curricula from methodological and logistical point of view.

The confirmation stage includes the decision of adaptors to keep using or not. Positive results are increasing the percentage of keeping, while the negative results are decreasing it. In the case of virtual reality, if it shows bad results, the hard-to-use or high costs the university might refuse subsequent use.

For the research, we will take into consideration knowledge, persuasion, decision and implementation stages in order to understand the faculty's perception. Knowledge stage will be used to organize the virtual reality demo day for faculty because we proceed from the position that they do not know about this technology and that is why it will be hard to find out their perception without experiencing it. During the event, the faculty might try virtual reality headset and simulators to form a positive or negative opinion. This opinion will be important for the purpose of research. For the decision stage, we will consider didactic usefulness and assessment of the technical aspects of virtual reality. Talking about implementation, we will consider advantages and disadvantages, challenges and barriers.

## 1.4 CHAPTER SUMMARY

This chapter reviewed the existing literature surrounding virtual reality and virtual reality in higher education. From this review, one research question was

developed to explore faculty's perception of virtual reality technology use in higher education. The next chapter will discuss the design and methodology being used in this study to explore the perception.

# CHAPTER 2. DESIGN AND METHODOLOGY

This chapter presents the context of the study, the research methods, including a description of the participants and research instruments. In addition, the chapter presents an explanation of the data sources and the data collection methods.

## 2.1 RESEARCH DESIGN

The purpose of this mixed methods study was to explore the faculty's perception of virtual reality technology use in higher education. The central question posed for this study was the following: What is the faculty's perception of virtual reality technology use in higher education? (In Russian context).

In order to answer the research question posed in this study, a mixed method research approach (quantitative and qualitative) was used. Quantitative method is used to find out faculty's perception toward general attitude to technologies including virtual reality, ease of use, advantages and disadvantages in higher education. Qualitative method is used to find out faculty's perception toward perception of digital competencies, assessment of technical aspects of virtual reality, didactic usefulness of virtual reality, advantages and disadvantages, challenges of usage and implementation of virtual technology. Using mixed method will help better understand the faculty perceptions, beliefs, and experiences to virtual reality use in higher education.

## 2.2 CONTEXT OF THE STUDY

In order to explore faculty's perception about using virtual technology in higher education, three universities were included in the study. These three universities are located in different cities across Russia. It includes Saint Petersburg Electrotechnical University ETU "LETI" in Saint Petersburg, Adyghe State University in Maikop and Immanuel Kant Baltic Federal University in Kaliningrad.

School of Educational Program Managers was organized by these three universities from February to March in 2023. The aim of the school is to master the necessary techniques and tools for organizing intra-university teams in such a way that each educational program has long-term prospects. Universities are trying to transform higher education in Russia and the administration organizes such event. The event included two offline modules and two online modules. First offline module was hold at Saint Petersburg Electrotechnical University ETU "LETI" and the second was hold at Immanuel Kant Baltic Federal University.

As part of the training, participants should understand who the educational programs managers are and transform the educational program taking into account the content, logistics and management system of the program, the launch and implementation plan, the market situation, the interests of stakeholders. The participants had lectures, workshops and group work during offline and online modules.

For the study, we will consider only offline module Saint Petersburg Electrotechnical University ETU "LETI". The participants have never used virtual reality in education before and some of them never seen virtual reality in real life, that is why the decision was made to organize the event LETI VR demo day on February 15, 2023, and demonstrate the participants virtual reality technologies in education. This event included one-hour lecture and one-hour workshop with virtual reality simulators. The participants were able to learn about virtual reality and the possibilities of simulation training, to structure the idea of virtual reality as a projected learning environment and an innovative teacher's tool, to get acquainted with the case of practical application of the virtual reality simulator in the educational process of the Higher School of Management of St. Petersburg State University, to put on a virtual reality headsets and try out various simulators.

Dmitry Kirillov, the president of Modum Lab, was invited as a speaker with the topic "Virtual Reality and new horizons of simulation training" and Rostislav Speransky, the adviser on the development of Modum Lab with the topic "Virtual technology in higher education".

After the speakers' speeches, the participants had the opportunity to put on a virtual reality headsets. Five virtual reality simulators were presented at the one place:

• Public speaking. The simulator helps to cope with the fear of public speaking and improve public speaking skills;

• Regular management practices. The simulator provides support and development of management skills;

• VR Arena. The simulator introduces technological objects and processes;

• Simulator of operational switching. The simulator helps to practice operational switching on the basis of Sayano-Shushenskaya and Votkinsk hydroelectric power plants;

• Automated group measuring unit. The simulator provides the development of theoretical and practical skills in performing maintenance and repair of oil and gas equipment.

## 2.3 PARTICIPANTS

*Quantitative research*

Participants (N=45) included faculty from three universities at the input (before the event LETI VR demo day). Faculty identified as female (n = 31, 69%), male (n = 14, 31%).

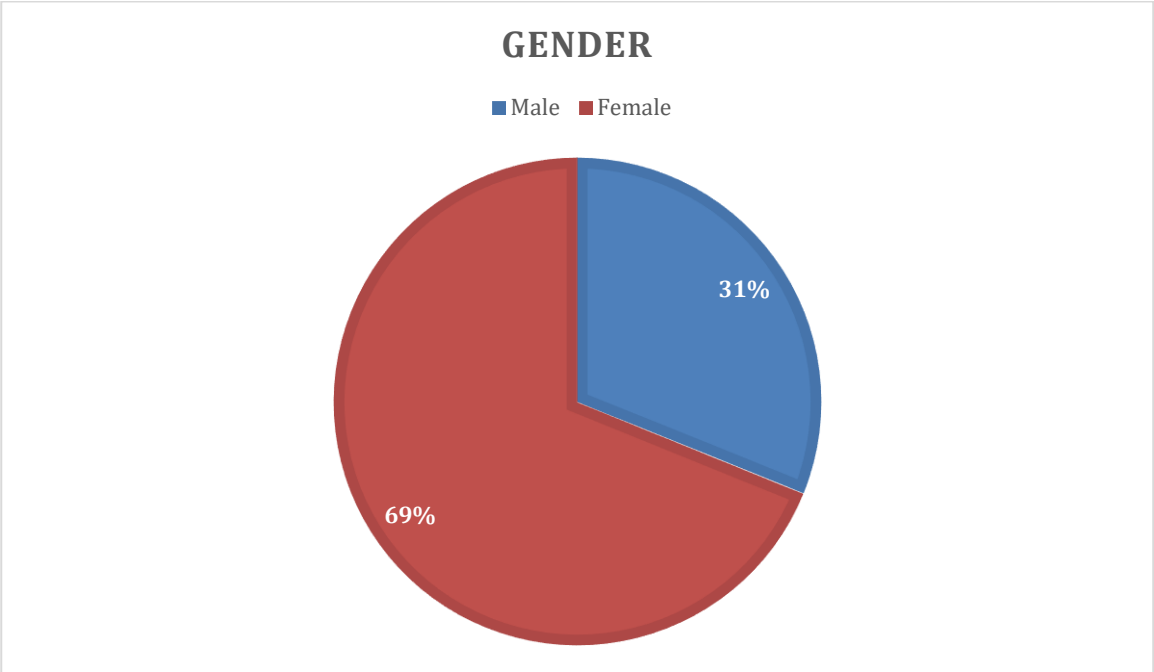


Fig. 2.1 Participants' gender (before the event LETI VR demo day)

Ages ranged under 30 to over 59, where under 30 (n=3, 7%), 30-39 (n=7, 16%), 40-49 (n=22, 49%), 50-59 (n=11, 24%), over 59 (n=2, 4%).

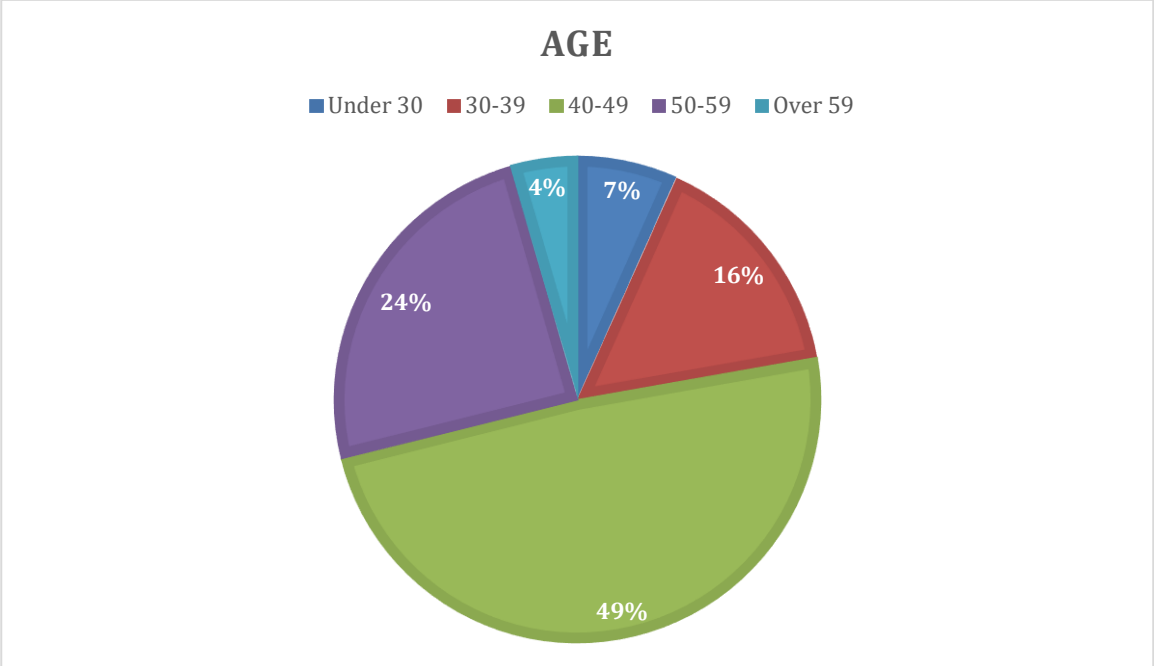


Fig. 2.2 Participants' age (before the event LETI VR demo day)

Years of teaching in higher education ranged from under 1 year to over 20 years, where under 1 year (n=2, 5%), 1–5 years (n=3, 7%), 6–10 years (n=4, 9%), 11–15 years (n=2, 4%), 16–20 years (n=10, 22%), over 20 years (n=24, 53%).

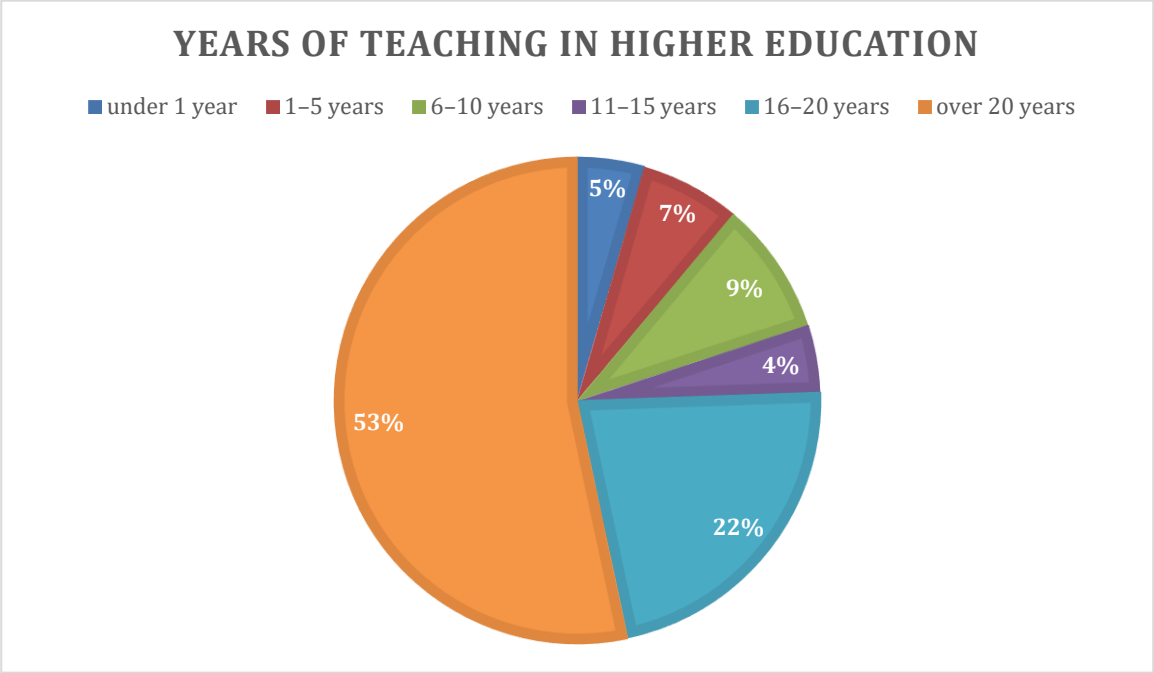


Fig. 2.3 Participants' years of teaching in higher education (before the event LETI VR demo day)

The main scientific fields of the participants: physical and mathematical sciences (n=12, 26.7%), biological sciences (n=4, 8.9%), technical sciences (n=11, 24.4%), historical sciences (n=1, 2.2%), economic sciences (n=5, 11.1%), philological sciences (n=8, 17.8%), legal sciences (n=1, 2.2%), pedagogical sciences (n=4, 8.9%), psychological sciences (n=1, 2.2%), sociological sciences (n=1, 2.2%), earth sciences (n=1, 2.2%), materials science (n=1, 2.2%), ecology (n=1, 2.2%), design (n=1, 2.2%), physical education and sports (n=1, 2.2%), art and science (n=1, 2.2%).

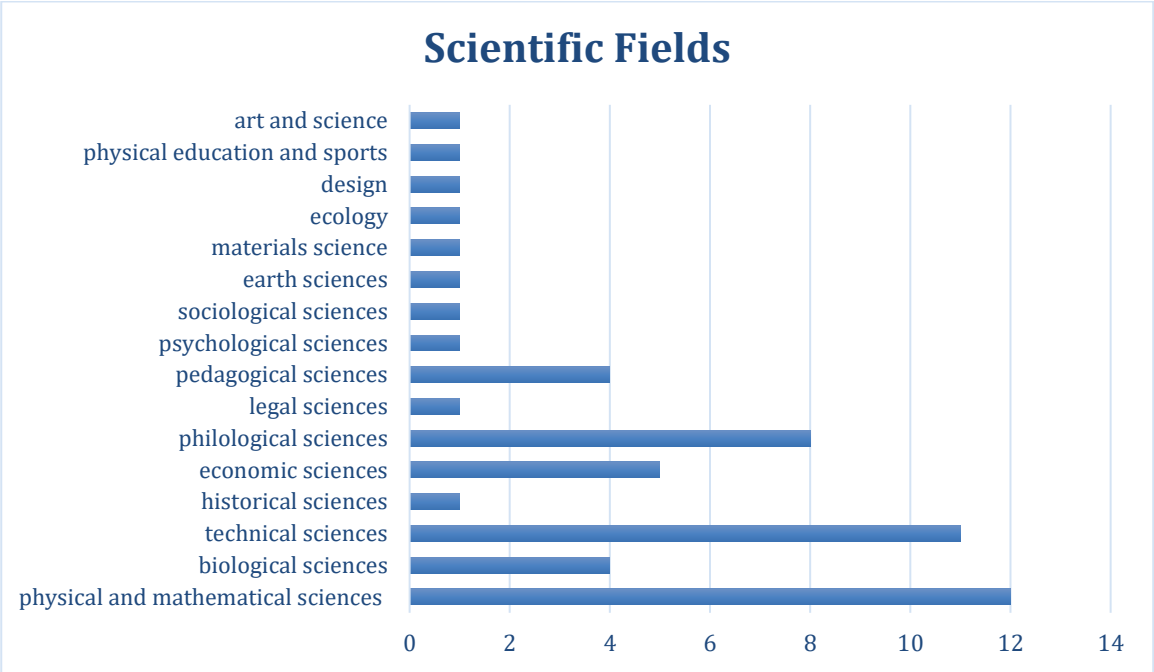


Fig. 2.4 Participants' scientific fields (before the event LETI VR demo day)

Participant' statuses included manager (n=7, 15.6%), teacher/senior lecturer (n=4, 8.9%), research associate (n=4, 8.9%), associate professor (n=17, 37.8%), professor (n=1, 2.2%), head of the department/ dean of the faculty/director of the institute/director of the higher school (n=21, 46.5%).

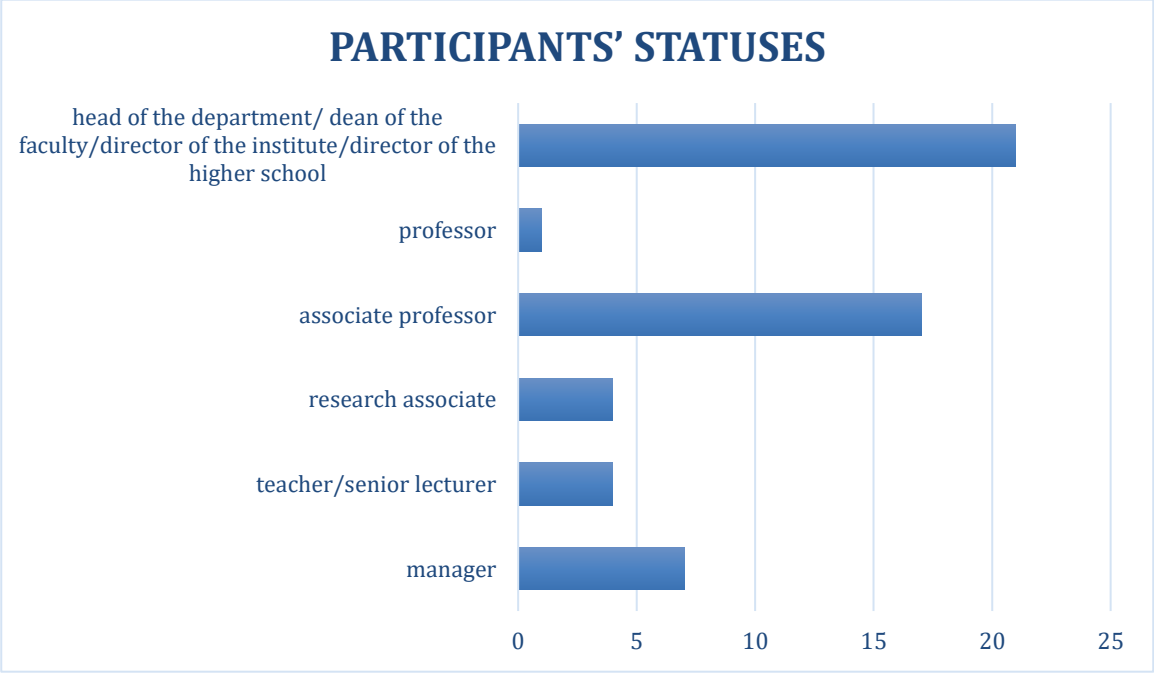

Fig. 2.5 Participants' statuses (before the event LETI VR demo day)

Participants (N=21) included faculty from three universities at the output (after the event LETI VR demo day). Faculty identified as female (n = 13, 62%), male (n = 8, 38%).

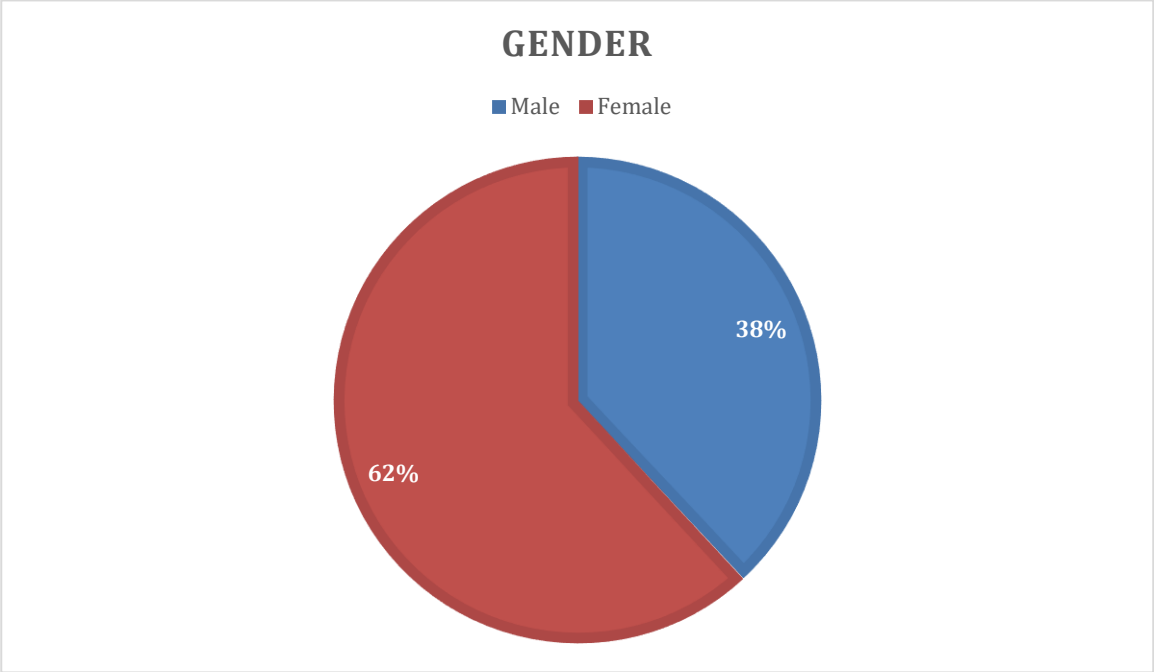


Fig. 2.6 Participants' gender (after the event LETI VR demo day)

Ages ranged under 30 to over 59, where under 30 (n=0, 0%), 30-39 (n=3, 14%), 40-49 (n=13, 62%), 50-59 (n=4, 19%), over 59 (n=1, 5%).

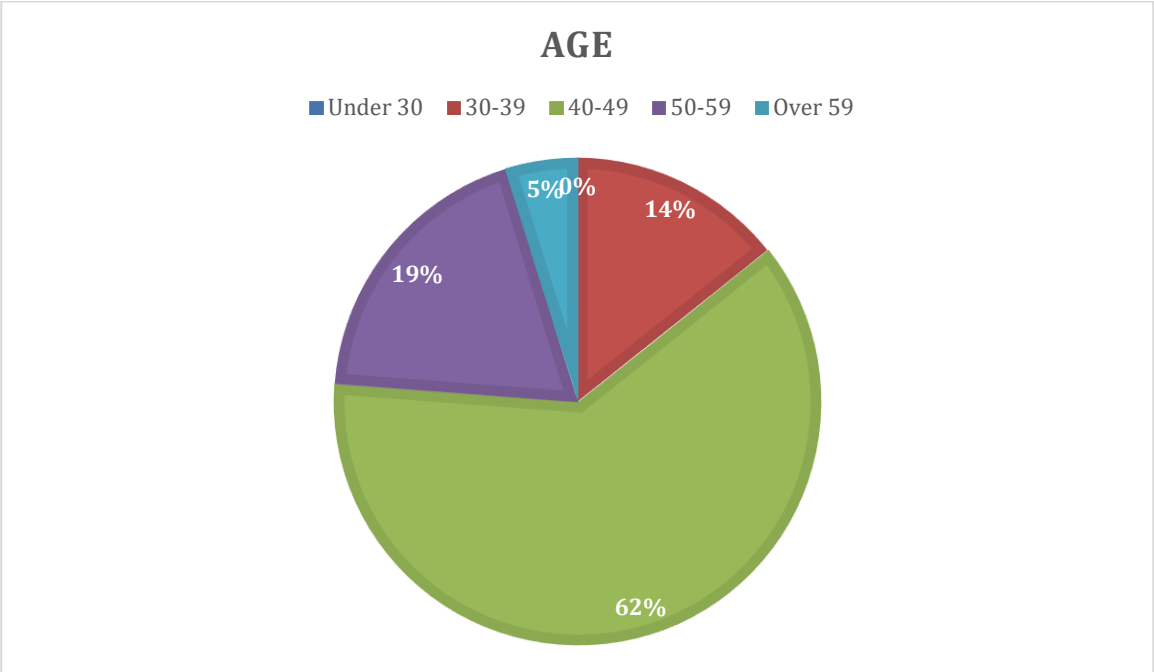


Fig. 2.7 Participants' age (after the event LETI VR demo day)

Years of teaching in higher education ranged from under 1 year to over 20 years, where under 1 year (n=0, 0%), 1–5 years (n=0, 0%), 6–10 years (n=2, 9%), 11–15 years (n=1, 5%), 16–20 years (n=4, 19%), over 20 years (n=14, 67%).

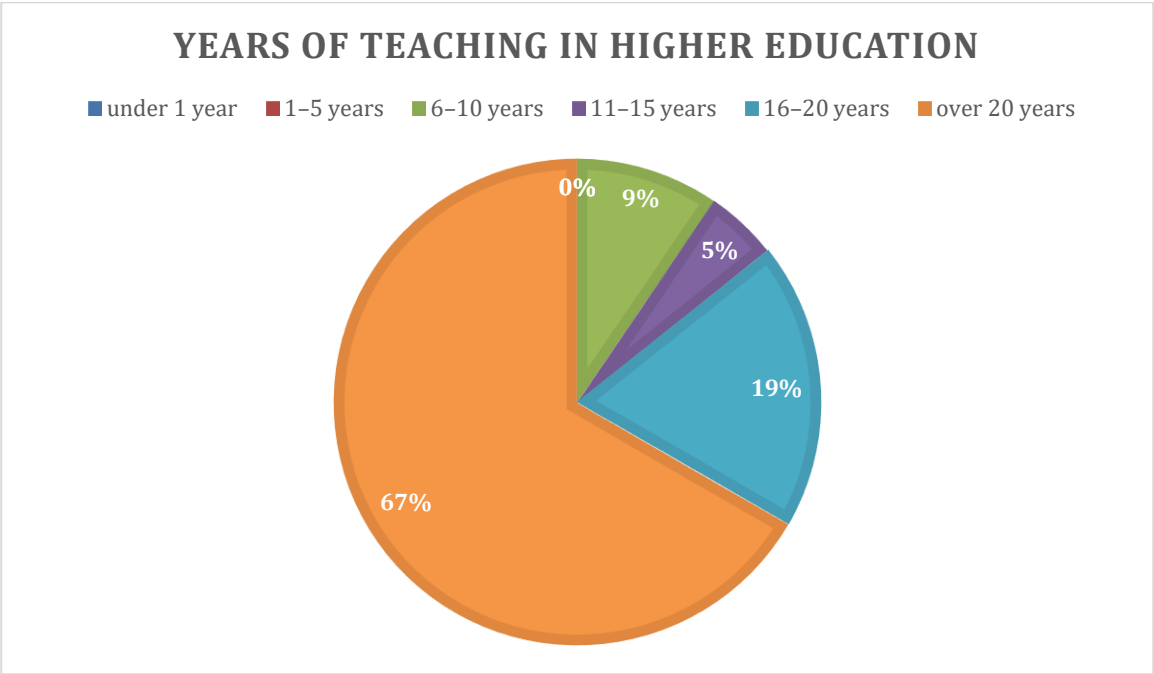

Fig. 2.8 Participants' years of teaching in higher education (after the event LETI VR demo day)

The main scientific fields of the participants: physical and mathematical sciences (n=4, 19%), biological sciences (n=1, 4.8%), technical sciences (n=6, 28.6%), historical sciences (n=0, 0%), economic sciences (n=3, 14.3%), philological sciences (n=5, 23.8%), legal sciences (n=1, 4.8%), pedagogical sciences (n=1, 4.8%), psychological sciences (n=1, 4.8%), sociological sciences (n=0, 0%), earth sciences (n=1, 4.8%), materials science (n=0, 0%), ecology (n=0, 0%), design (n=0, 0%), physical education and sports (n=0, 0%), art and science (n=0, 0%).

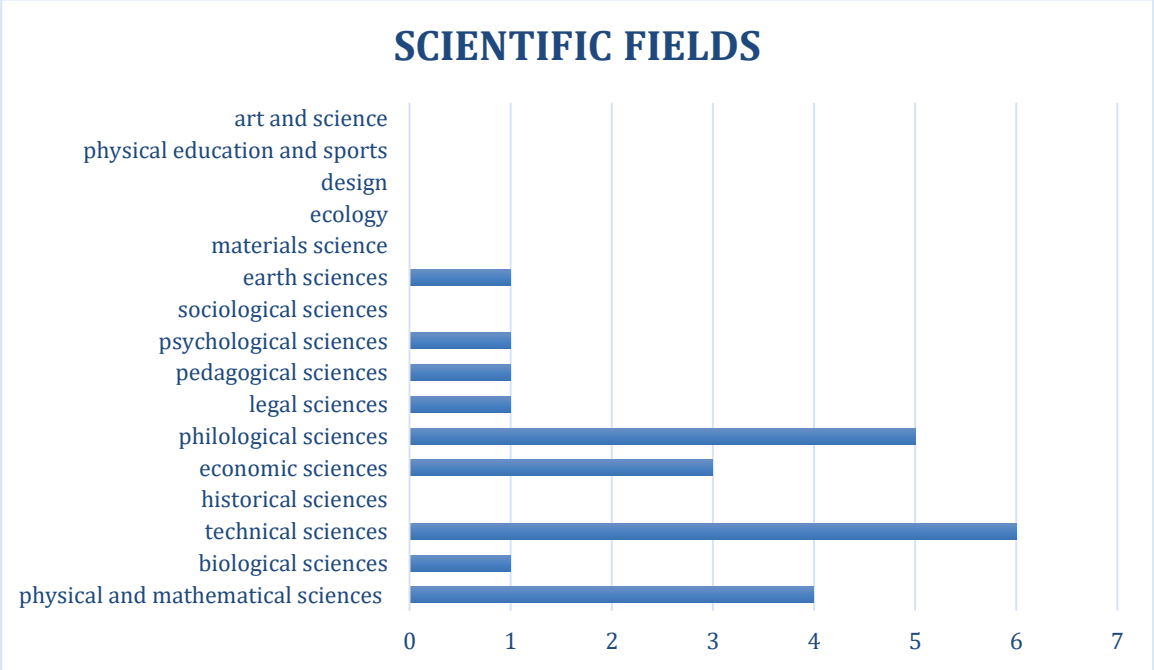


Fig. 2.9 Participants' scientific fields (after the event LETI VR demo day)

Participant' statuses included manager (n=1, 4.8%), teacher/senior lecturer (n=2, 9.5%), research associate (n=1, 4.8%), associate professor (n=12, 57.1%), professor (n=1, 4.8%), head of the department/ dean of the faculty/director of the institute/director of the higher school (n=11, 52.4%).

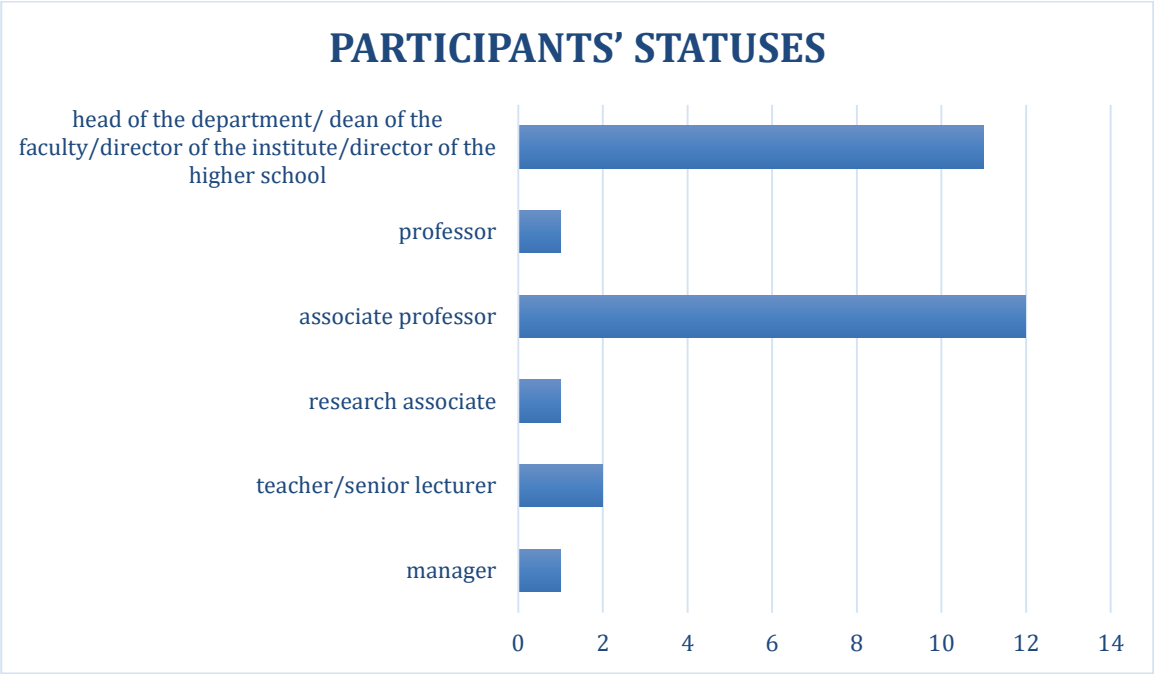


Fig. 2.10 Participants' statuses (after the event LETI VR demo day)

*Qualitative research*

Participants (N=10) included faculty from three universities. Faculty identified as female (n = 6, 60%), male (n = 4, 40%).

Interviewee 1. Participant holds associate professor of the management department. Participant's scientific field is regional economy. Participant teaches enterprise planning, human resource management, marketing, change management. Participant teaches from 40 to 60 students per semester. Participant uses presentations and online tests in the classroom. These technologies are used for 15 years.

Interviewee 2. Participant holds head of the department of economics and finance position. Participant's scientific field is regional and sectoral economics. Participant teaches theory of accounting, state audit, main directions of improvement of accounting and audit. Participant teaches from 36 to 50 students per semester. Participant uses only presentations as technology in the classroom.

Interviewee 3. Participant holds head of the botany department of botany. Participant's scientific field is biology. Participant teaches plant physiology, botany and systematics of plants. Participant teaches approximately 60 people per semester. Participant uses computers (since 2005), presentations and videos (since 2005), electronic microscope (long ago).

Interviewee 4. Participant holds senior lecturer of the department of automatic control systems. Participant's scientific fields are robotics, mathematical modeling of automatic control systems, SCADA systems and development of human-machine interfaces, programming of microcontrollers. Participant teaches theory of automatic control, motion control systems, microprocessor technology in mechatronics and robotics, special sections of the theory of automatic control in robotics, computer-based technologies of control in technical systems. Participant teaches from 70 to 85 students in autumn semester and from 90 to 100 in spring semester. Participant uses presentations, LMS Moodle (since 2021), LMS LETIteach (since 2020), video recording tools (since 2021).

Interviewee 5. Participant holds head of the department of automated information processing and management systems. Participant's scientific fields are system analysis, management and information processing. Participant teaches DSS, high-tech systems and networks, information systems in the economy. Participant teaches from 2 to 4 courses per semester. Participant uses presentation, interactive whiteboard and LMS Moodle.

Interviewee 6. Participant holds head of educational programs at the Higher School of Interdisciplinary Research and Engineering. Participant's scientific fields are physics and materials science. Participant does not teach any courses.

Interviewee 7. Participant holds head of educational programs. Participant's scientific fields are physics and magnetism. Participant teaches physics of magnetic

phenomena. Participant teaches from 5 to 10 students per semester. Participant uses presentations.

Interviewee 8. Participant holds head of the laboratory of modeling optical properties of nanomaterials. Participant's scientific fields are physics and biophysics. Participant teaches fundamentals of nanophotonics. Participant teaches from 15 to 20 students per semester. Participant uses presentations (since 2011).

Interviewee 9. Participant holds head of the department of management. Participant's scientific field is regional and sectoral economy. Participant teaches marketing, logistics, organization economics, information technology in management, etc. Participant teaches from 100 to 150 students per semester. Participant uses presentations and LMS Moodle (since 2018).

Interviewee 10. Participant holds head of the department of Russian language. Participant's scientific field is philological science. Participant teaches grammar of the Russian language, creative writing, and speech communication. Participant teaches from 100 to 110 students per semester. Participant uses presentations (since 2013).

## 2.4 INSTRUMENTS

*Quantitative survey*

The purpose of the virtual reality survey (Appendix A) was to gather data about the perception and attitude of university educators to virtual reality technologies before and after LETI VR demo day event. The survey used in this study was primarily adapted from a dissertation "Faculty Perceptions about Virtual World Technology: Affordances and Barriers to Adoption" written by Linda W. Wood [2010]. The number of statements were shortened under eleven. Such statement were included in the survey: 1. When preparing my lectures/courses/modules, I use multimedia technology tools. 2. I believe that my teaching methods do not need to change in order

to adapt to new technologies. 3. I see technology in teaching as a positive challenge. 4. Technology integration benefits my students. 5. The use of virtual reality (VR) technology would improve the quality of education. 6. If virtual reality (VR) technology is effectively integrated into the learning process, it has a positive effect on the learning process of students. 7. The use of virtual reality (VR) technologies in my course(s) is not suitable for the subject(s) that I teach. 8. I would find virtual reality (VR) useful in learning. 9. It would be easy for me to learn how to use virtual reality. 10. Using virtual reality will allow me to perform pedagogical tasks faster. 11. I find virtual reality easy to use. Participants' responses were measured with a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Two samples of answers for each question of the survey were received after the experiment. For each question, one sample is answers before and after the event LETI VR demo day. It is expected that answers in two surveys are different as participant of the event received new competences and qualities during the event. Differences between answers can show how the faculty's perception toward virtual reality changed, and what is the probability that obtained results are just statistical randomness. Our aim in this part of the research is to reveal differences between samples and interpret them.

*Qualitative interview*

The purpose of the interview (Appendix B) was to gather data about the perception and attitude of university educators to virtual reality technologies. The questions were composed under six topics with different number of questions. The questions for the interview were adapted from an article written by Antón-Sancho, Á., Fernández-Arias, P., & Vergara, D. [2022] and they have been changed into open-ended questions.

**Background and demographics:** 1. What faculty position do you currently have within the university? 2. What is the main scientific profile (profiles) in which (in which) you specialize? 3. What courses do you typically teach? 4. How many undergraduate/graduate students do you typically teach in a semester? 5. What kinds of technology do you use in the classroom, and how long have you used it for? **Perception of digital competence:** 1. How would you reflect on your digital skills? 2. What did you know about VR before LETI VR demo day? 3. Has your knowledge/understanding of virtual reality changed after this LETI VR demo day? If so, what exactly?

**Assessment of the technical aspects of virtual reality:** 1. What do you think about 3D design? 2. What do you think about usability? 3. What do you think about immersion degree? 4. What do you think about interaction?

**Didactic usefulness of virtual reality:** 1. What do you see as the didactic usefulness of virtual reality? 2. What educational tasks can virtual reality solve? 3. What educational tasks can virtual reality solve in your academic discipline/course/program? 4. What are your thoughts prior to implementing the technology in teaching?

**Advantages and disadvantages of virtual reality:** 1. What advantages do you see to using virtual world technologies into the higher education? 2. What disadvantages do you see to using virtual world technologies into the higher education? 3. What could make you to implement VR technologies into your course/discipline/program?

**Challenges of using virtual reality:** 1. What do you see as challenges for faculty using virtual world technology in the higher education? 2. What challenges may arise with the implementation of VR technologies in the higher education?

## 2.5 PROCEDURE

Participants were asked to participate in a virtual reality survey (Appendix A) thirty minutes before the LETI VR demo day event. The survey took approximately ten minutes for the participants to evaluate the statements in the survey. That was sample number one. In two hours, when the event finished, the participants were asked to complete the same virtual reality survey (Appendix A). That was sample number two. The survey took approximately ten minutes for the participants to evaluate the statements in the survey. Forty-five faculty members took part in the first sample and twenty-one faculty members took part in the second sample.

The data received from two samples of the survey (Appendix A) was analyzed with the help of average meaning and its differences. The conclusions about differences of the results were interpreted in the context of this research.

The virtual reality interview questions (Appendix B) were conducted after the LETI VR demo day. Potential participants were contacted via social massages to ask about their participation in a survey, which has been used as a research instrument. Interviewees were informed they would be asked questions about virtual reality and their perception towards use and implication into higher education. The survey took approximately thirty minutes for the participants to answer the questions. The interviews were conducted online via Zoom. At the beginning of each interview, permission was confirmed by the interviewees to audio record the interview. The videos were recorded, saved and manually transcribed into a word processor. Ten faculty members were interviewed for this study.

## 2.6 CHAPTER SUMMARY

This chapter discussed the research design, context of the study, participant's information, the instrumentation and procedure. In chapter three will be interpreted the results and discussion.

# CHAPTER 3. RESULTS AND DISCUSSION

This mixed method was used to explore the faculty's perception toward virtual reality use in higher education. Data were collected through survey (Appendix A) and virtual reality interview questions (Appendix B). The research question posed in this study was: What is the faculty's perception of virtual reality use in higher education?

The results of this study are described in this chapter. It includes: (1) the results of quantitative survey (Appendix A) before LETI VR demo day (2) the results of quantitative survey (Appendix A) after LETI VR demo day (3) the results of qualitative survey (Appendix B).

## 3.1 RESULTS AND DISCUSSION

*Quantitative survey results and discussion*

The following survey (Appendix A) results were obtained before LETI VR demo day and presented in Table 3.1:

Table 3.1

Survey results before LETI VR demo day

| № | Statements | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % | n | % | n | % |
| 1 | When preparing my lectures/courses/modules, I use multimedia technology tools | 0 | 0 | 0 | 0 | 4 | 8.9 | 11 | 24.4 | 30 | 66.7 |
| 2 | I believe that my teaching methods do not need to change in order to adapt to new technologies | 6 | 13.3 | 10 | 22.2 | 18 | 40 | 7 | 15.6 | 4 | 8.9 |

Table 3.1 continued

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | I see technology in teaching as a positive challenge | 0 | 0 | 0 | 0 | 2 | 4.5 | 19 | 43.2 | 23 | 52.3 |
| 4 | Technology integration benefits my students | 0 | 0 | 0 | 0 | 3 | 6.7 | 18 | 40 | 24 | 53.3 |
| 5 | The use of virtual reality (VR) equipment would improve the quality of education | 0 | 0 | 3 | 6.7 | 17 | 37.8 | 13 | 28.9 | 12 | 26.7 |
| 6 | If virtual reality (VR) technology is effectively integrated into the learning process, it has a positive effect on the learning process of students | 0 | 0 | 2 | 4.5 | 11 | 25 | 15 | 34.1 | 16 | 36.4 |
| 7 | The use of VR technologies in my course(s) is not suitable for the subject(s) that I teach | 6 | 13.6 | 12 | 27.3 | 13 | 29.5 | 9 | 20.5 | 4 | 9.1 |
| 8 | I would find VR useful for purposes of learning | 0 | 0 | 0 | 0 | 15 | 33.3 | 19 | 42.2 | 11 | 24.4 |
| 9 | It would be easy for me to learn how to use virtual reality | 0 | 0 | 1 | 2.2 | 19 | 42.2 | 14 | 31.1 | 11 | 24.4 |
| 10 | Using VR will allow me to perform pedagogical tasks faster | 0 | 0 | 7 | 15.6 | 19 | 42.2 | 15 | 33.3 | 4 | 8.9 |
| 11 | I think that VR is easy to use | 1 | 2.3 | 5 | 11.4 | 25 | 56.8 | 10 | 22.7 | 3 | 6.8 |

Table 3.2 illustrates statements that indicate a level of agreement in regard to faculty's perceptions of technology and virtual reality use in higher education before the event LETI VR demo day. It includes the average mean and standard deviation for each statement.

Table 3.2

Means and Standard Deviation before LETI VR demo day

| № | Statements | M | SD |
|---|---|---|---|
| 1 | When preparing my lectures/courses/modules, I use multimedia technology tools | 4.58 | 0.66 |
| 2 | I believe that my teaching methods do not need to change in order to adapt to new technologies | 2.84 | 1.13 |
| 3 | I see technology in teaching as a positive challenge | 4.48 | 0.59 |
| 4 | Technology integration benefits my students | 4.47 | 0.63 |
| 5 | The use of virtual reality (VR) equipment would improve the quality of education | 3.76 | 0.93 |
| 6 | If virtual reality (VR) technology is effectively integrated into the learning process, it has a positive effect on the learning process of students | 4.02 | 0.90 |
| 7 | The use of VR technologies in my course(s) is not suitable for the subject(s) that I teach | 2.84 | 1.18 |
| 8 | I would find VR useful for purposes of learning | 3.91 | 0.76 |
| 9 | It would be easy for me to learn how to use virtual reality | 3.78 | 0.85 |
| 10 | Using VR will allow me to perform pedagogical tasks faster | 3.36 | 0.86 |

Table 3.2 continued

| | | | |
|---|---|---|---|
| 11 | I think that VR is easy to use | 3.20 | 0.82 |

The following survey (Appendix A) results were obtained after LETI VR demo day and presented in Table 3.3:

Table 3.3

Survey results after LETI VR demo day

| № | Statements | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | % | n | % | n | % | n | % | n | % |
| 1 | When preparing my lectures/courses/modules, I use multimedia technology tools | 0 | 0 | 0 | 0 | 1 | 4.8 | 4 | 19 | 16 | 76.2 |
| 2 | I believe that my teaching methods do not need to change in order to adapt to new technologies | 6 | 28.6 | 9 | 42.9 | 3 | 14.3 | 3 | 14.3 | 0 | 0 |
| 3 | I see technology in teaching as a positive challenge | 0 | 0 | 0 | 0 | 1 | 4.8 | 8 | 38.1 | 12 | 57.1 |
| 4 | Technology integration benefits my students | 0 | 0 | 0 | 0 | 1 | 4.8 | 12 | 57.1 | 8 | 38.1 |
| 5 | The use of virtual reality (VR) equipment would improve the quality of education | 0 | 0 | 0 | 0 | 3 | 14.3 | 11 | 52.4 | 7 | 33.3 |
| 6 | If virtual reality (VR) technology is effectively | 0 | 0 | 0 | 0 | 2 | 9.5 | 13 | 61.9 | 6 | 28.6 |

Table 3.3 continued

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | integrated into the learning process, it has a positive effect on the learning process of students | | | | | | | | | | |
| 7 | The use of VR technologies in my course(s) is not suitable for the subject(s) that I teach | 3 | 14.3 | 6 | 28.6 | 7 | 33,3 | 3 | 14.3 | 2 | 9.5 |
| 8 | I would find VR useful for purposes of learning | 0 | 0 | 0 | 0 | 3 | 14.3 | 10 | 47.6 | 8 | 38.1 |
| 9 | It would be easy for me to learn how to use virtual reality | 0 | 0 | 0 | 0 | 9 | 42.9 | 10 | 47.6 | 2 | 9.5 |
| 10 | Using VR will allow me to perform pedagogical tasks faster | 0 | 0 | 0 | 0 | 5 | 23.8 | 12 | 57.1 | 4 | 19 |
| 11 | I think that VR is easy to use | 0 | 0 | 0 | 0 | 10 | 47.6 | 9 | 42.9 | 2 | 9.5 |

Table 3.4 illustrates statements that indicate a level of agreement in regard to faculty's perceptions of technology and virtual reality use in higher education before the event LETI VR demo day. It includes the average mean and standard deviation for each statement.

Table 3.4

Means and Standard Deviation after LETI VR demo day

| № | Statements | M | SD |
|---|---|---|---|
| 1 | When preparing my | 4.71 | 0.56 |

Table 3.4 continued

| | | | |
|---|---|---|---|
| | lectures/courses/modules, I use multimedia technology tools | | |
| 2 | I believe that my teaching methods do not need to change in order to adapt to new technologies | 2.14 | 1.01 |
| 3 | I see technology in teaching as a positive challenge | 4.52 | 0.60 |
| 4 | Technology integration benefits my students | 4.33 | 0.58 |
| 5 | The use of virtual reality (VR) equipment would improve the quality of education | 4.19 | 0.68 |
| 6 | If virtual reality (VR) technology is effectively integrated into the learning process, it has a positive effect on the learning process of students | 4.19 | 0.60 |
| 7 | The use of VR technologies in my course(s) is not suitable for the subject(s) that I teach | 2.76 | 1.18 |
| 8 | I would find VR useful for purposes of learning | 4.24 | 0.70 |
| 9 | It would be easy for me to learn how to use virtual reality | 3.67 | 0.66 |
| 10 | Using VR will allow me to perform pedagogical tasks faster | 3.95 | 0.67 |
| 11 | I think that VR is easy to use | 3.62 | 0.67 |

Table 3.5 Quantitative Survey Results illustrates differences between participants' answers before and after LETI VR demo day.

Table 3.5

Quantitative Survey Results

| № | Question | Mean in sample before experiment | Mean in sample after experiment | Difference in means | Conclusion |
|---|---|---|---|---|---|
| 1 | When preparing my lectures/courses/modules, I use multimedia technology tools | 4.58 | 4.71 | 0.14 | Difference in means is not statistically significant. |
| **2** | **I believe that my teaching methods do not need to change in order to adapt to new technologies** | **2.84** | **2.14** | **-0.70** | **Difference in means is statistically significant. Average answer before experiment is statistically higher than one after experiment.** |
| 3 | I see technology in teaching as a positive challenge | 4.48 | 4.52 | 0.05 | Difference in means is not statistically significant. |
| 4 | Technology integration benefits my students | 4.47 | 4.33 | -0.13 | Difference in means is not statistically significant. |
| **5** | **The use of virtual reality (VR) equipment would improve the quality of education** | **3.76** | **4.19** | **0.43** | **Difference in means is statistically significant.** |
| 6 | If virtual reality (VR) technology is effectively integrated into the learning process, it has a positive effect on the learning process of students | 4.02 | 4.19 | 0.17 | Difference in means is not statistically significant. |
| 7 | The use of VR technologies in my course(s) is not suitable for the | 2.84 | 2.76 | -0.08 | Difference in means is not statistically significant. |

Table 3.5 continued

| | | | | | |
|---|---|---|---|---|---|
| | subject(s) that I teach | | | | |
| **8** | **I would find VR useful for purposes of learning** | **3.91** | **4.24** | **0.33** | **Difference in means is statistically significant.** |
| 9 | It would be easy for me to learn how to use virtual reality | 3.78 | 3.67 | -0.11 | Difference in means is not statistically significant. |
| **10** | **Using VR will allow me to perform pedagogical tasks faster** | **3.36** | **3.95** | **0.60** | **Difference in means is statistically significant.** |
| **11** | **I think that VR is easy to use** | **3.20** | **3.62** | **0.41** | **Difference in means is statistically significant.** |

There is one statement, which will not be considerate in this part. It is statement 1: “When preparing my lectures/courses/ modules, I use multimedia technology tools”. The event could not influence on it, it is not possible to make any conclusions.

Average answer before the event is statistically lower than one after the event for statement 2: “I believe that my teaching methods do not need to change in order to adapt to new technologies”. The event made the participants less confident that their teaching methods do not need to change in order to adapt to new technologies. The event might show to participants new forms of teaching methods and inspire them to change to adopt best practices.

Average answer before the event is statistically lower than one after the event for statement 3: “I see technology in teaching as a positive challenge”. We can make an assumption that the event slightly changed the perception of participants, making them to consider the technology as an opportunity and not like a threat.

Average answer after the event is statistically lower than one before the event for statement 4: “Technology integration benefits my students”. We can make an assumption that the event made participants a little bit less confident about the utility and efficiency of technology for students.

Average answer before the event is statistically lower than one after the event for statement 5: “The use of VR equipment would improve the quality of education”. The event made the participants more confident that virtual reality improves the quality of education. Participants may see that virtual reality allows students to understand concepts more deeply and efficient that increase quality of education process as the participant tried virtual reality tools themselves.

Average answer before the event is statistically lower than one after the event for statement 6: “If virtual reality (VR) technology is effectively integrated into the process, it has a positive effect on the learning process of students”. We can make an assumption that the event slightly changed the perception of participants, making them to think that virtual technology can positively effect on the learning process.

Average answer after the event is statistically lower than one before the event for statement 7: “The use of VR technologies in my course(s) is not suitable for the subject(s) that I teach”. Virtual reality might be considered as technology which is more suitable for engineering science rather than for art and humanities. We can make an assumption that participants changed their mind about the possibility of virtual reality use for their courses after the event.

The average answer before the event is statistically lower than one after the event for statement 8: “I would find VR useful for purposes of learning”. The event made the participants more confident that virtual reality is useful in learning. Participants might understand that virtual reality makes learning process visual, interactive and more interesting for students as the participants tried virtual reality tools themselves.

Average answer after the event is statistically lower than one before the event for statement 9: “It would be easy for me to learn how to use virtual reality”. We can make an assumption that the event made the participants slightly doubted that they could learn how to use virtual reality easily. This may be due to the fact that the participants had the opportunity to see offline how the virtual reality technology works and see all the nuances of use, including technical problems, which had a slightly negative impact on perception about ease of use.

Average answer before the event is statistically lower than one after the event for statement 10: “Using VR will allow me to perform pedagogical tasks faster”. The event made participant more confident that virtual reality allows to perform pedagogical tasks faster. Participants might understand how virtual reality works and how virtual reality can help with every day and routine tasks.

Average answer before the event is statistically lower than one after the event for statement 11: “I think that VR is easy to use”. The event made participant more confident that virtual reality is easy to use. Participants might master new competences during the event, understand how to work with virtual reality, what technical support is needed and how to organize education in virtual reality.

*Interview Data Analysis*

In order to gain additional insights about faculty’s perception of virtual reality use in higher education, there were conducted ten interviews with faculty members. There are six main topics which include different number of questions. *The first topic background and demographics* was described in chapter two in participants section. It contains information about participants who took part in the interview.

*The perception of digital competence*

The following answers were collected for the Question 1 “How would you reflect on your digital skills?”:

(I1) “I don't consider myself as a super advanced user. I do not use virtual reality in daily life. I use a computer to create presentations for educational purposes. Furthermore, I want to build up my skills in the field of creating presentations. Of course, I would like to improve my digital skills.”;

(I2) “I would describe myself as a confident user, but technology is developing, and I don't keep up with everything. I have twenty years of computer experience. I studied the digital tools on my own”;

(I3) “It is user level, so I can create a presentation. I can use it, but I can't develop something”;

(I4) “I would rate it as an average level. Because I started getting acquainted with more interactive platforms last year, for example, the Miro board. I use this board, but I have not introduced it into education. I use simple things like presentations. Furthermore, I also use a graphics tablet to show students how to draw graphs during online lectures. Talking about online platforms, I work in LETIteach and Moodle”;

(I5) “I would rate my digital skills above average. However, if we consider virtual reality technologies, it is weak. I actively use e-mail, Bitrix, 1C and etc. But I would like to improve my skills”;

(I6) “User level. I work with a computer 99%. I use Excel, Word, presentations. I use 1C for work and “Graphpodprism” for calculating statistics. I often use digital products and learn how to use them”;

(I7) “Average level, perhaps even closer to above average. But definitely not advanced. For classes, I use presentations or conduct online classes on the webinar platform. I also use the digital environment of the university where I post lectures, assignments and tests. So I create assignments for online platforms”;

(I8) “I would rate as average. We physicists are usually good with technology. In our work, we use PowerPoint for presentations and that is enough”;

(I9) “I would rate my digital skills well, slightly above average, but I can't say that I'm at the highest level”;

(I10) “I would rate my digital skills below average. Because I use only presentations in my work and that's it”.

The following answers were collected for the Question 2 “What did you know about VR before LETI VR demo day?”:

(I1) “I knew that virtual reality exists, but I knew more about it from the theoretical part. I've tried it in games, but no more than that”;

(I2) “Yes, I knew about virtual reality technologies, but I did not correlate it with education. I attributed it more to the entertainment and gaming industry”;

(I3) “Yes, I did, but I usually heard more about its use for entertainment purposes, and not for educational purposes. From the point of view of education, I have never used it. You can meet virtual reality in museums now”;

(I4) “I have heard about virtual reality technologies, but more in terms of gaming. I have not heard about it being used in education”;

(I5) “Yes, I knew. Moreover, within the framework of our activities, but we had a similar event, the presentation of the laboratories of physics, which offered simulators for educational purposes. We looked at several biology and math lessons in VR/AR. In addition, in our scientific work, we approach the topics of digital twins, and we will use virtual reality technologies to apply and implement it. Since it is now required”;

(I6) “Yes, a few years ago I was at an immersive reality exhibition in Moscow and there was an opportunity to draw in virtual reality and this was my first experience. Then I did not come across it often, but a colleague bought headsets for computer

games. However, talking about education, I do not know much about it. There is a network of centers for teaching children and teenagers, and virtual reality is used there";

(I7) "Yes, I knew about virtual reality and came across it sometimes, but I never used it in my courses";

(I8) "Yes, I did, but more from the entertainment side, for instance in games. Moreover, I know that the university is working on the project the virtual house of Kant. They created a house where Kant lived, and you can walk around and look at objects in it";

(I9) "Yes, I knew, because I met the virtual reality at the IT educational center for children. I work there as an instructional designer, and we have supplementary education programs dedicated to virtual reality";

(I10) "Yes, I know about virtual reality, but more from the gaming industry".

The following answers were collected for the Question 3 "Has your knowledge/understanding of virtual reality changed after this VR demo day? If so, what exactly?":

(I1) "Yes, it has changed. After this event, I realized that it would be interesting for young people. This can be used in work as a feature in order to conduct a job interview, and this is close to us for professional activity. Before this event, I had not thought about virtual reality in an educational context";

(I2) "I realized that it can be used in education and especially for teaching young people. Considering that young people like all this. There are a lot of interesting simulators for the humanity field";

(I3) "Yes, it has changed. I realized what opportunities virtual reality opens up in learning";

(I4) “Yes, I realized that it can be used in education, and if you do not focus on a good design, then it can be available financially. If, for example, we do not have the equipment, then this will be a very good alternative. But the question for the development is exactly how it will take place”;

(I5) “Yes, it has changed. Namely, I realized that these virtual reality technologies could be used to build digital twins. Since at the demo day, a double of various places for practicing safety techniques were demonstrated. I saw that this is already being implemented. And this confirmed my idea of creating digital twins”;

(I6) “Yes, it has changed, I really liked the fact that it is progressing and developing. I was very impressed that it is possible to make digital twin of a whole factory. Before that, there was more of an entertaining idea of virtual reality, and now it has opened up from a new side”;

(I7) “Yes, it has changed, I have learned new learning options using virtual reality technologies. And I learned that there are practices when a student enters the virtual reality environment, he can say and do something, for instance not just watch but do something himself. And this environment also evaluates the student's interaction with the environment, and then these results can be given as statistics”;

(I8) “Yes, it has changed. I realized that this is useful. I realized that virtual reality could be used in education. Once you purchase it and can use it”;

(I9) “Yes, it has changed, it was interesting to find out that virtual reality can be used to train students in management. Training to get out of conflict situations on the simulator. For conducting trainings for interviews. That was interesting”;

(I10) “Yes, it has changed, I found out that virtual reality is used in education sphere”.

To sum up, eight out of ten participants evaluate their digital competencies as average. One participant evaluates it as above average and another participant evaluates it as below average. Most of the time, participants use a computer and Office

tools for work. The participants would like to improve their digital skills. Usually, the participants learn how to use digital tools by their own. It should be noted they have never worked with virtual reality before LETI VR demo day. All the participants heard about virtual reality, but they thought about it only from the entertainment part, such as gaming. According to the results, we can see that the event LETI VR demo day changed the faculty's perception about virtual reality in particular that it is used in education industry.

*Assessment of the technical aspects of virtual reality*

The following answers were collected for the Question 1 "What do you think about 3D design?":

(I1) "It is noticeable that it is a little unnatural. I would rate the quality of 3D design as average, I would like to have a little higher";

(I2) "I rate 3D design as good. There is a moment of habituation. The visualization was very good. There is a feeling that you are in place and that because of 3D design";

(I3) "The graphics were realistic, there was a feeling that you were standing in the hall. Some items differ in design, and it was clear that they were not quite realistic. There was a feeling that this is graphics, but the level was good";

(I4) "I felt sick. They explained to me that this was a problem of old glasses, but I felt it. The presented 3D design depends on the amount of finance resources that you put there, therefore, the more resources the more realistic the picture. The smoothness of the transition was not very good. Working out the algorithm was very well worked out";

(I5) "I did not look in detail at the 3D design, because it was clear for what purposes it was created, and this is basically enough for training. If it is necessary to convey more subtle things, then of course a better design may be required";

(I6) “It is quite detailed and normal in my opinion. The details are drawn cool, and you can even look inside and there they are also cut out as if real models. It takes a lot of time to create a 3D model”;

(I7) “I liked what I saw that day at the 3D design demonstration. The graphics quality is very good. I have had the experience of diving into other simulators, and it seems to me that at first, it is unusual, and it takes some time to get used to. After 30 minutes or an hour, you are already completely immersed and it becomes comfortable. At first there are difficulties because first the process of realizing that you are in the hall and at the same time you are in virtual reality begins, and then you are completely immersed in virtual reality forgetting that you are in the hall”;

(I8) “I think it is very well done. For a long time, when I was a student, I was fond of computer games and in virtual reality, you can also wander and do something, and it looks realistic. The graphics did not cause any rejection and everything was fine”;

(I9) “3D design seems to me quite good and realistic. What we were shown was very close to reality”;

(I10) “It seems to me that the reaction in the public speaking simulator is very well done. The quality is average, I was quite satisfied. This is enough for training”.

The following answers were collected for the Question 2 “What do you think about usability?”:

(I1) “You need to get used to the controls, because it does not repeat all your movements. You also need to get used to it, like a mouse or keyboard. It has its own peculiarities, and you need to get used to it and how it reacts to your commands. But I think you can adapt to this in a week. In the future, I see that it all response to the movement of a person, and not to the pressing of buttons”;

(I3) “You need to adapt. At first, it was unusual”;

(I4) “If it is implied that we are wearing glasses and just sitting, turning our heads at most, then this is convenient. And in the classroom, nothing needs to be additionally equipped. But when it is implied that a person will walk, then you need to think through the space”;

(I5) “I think it's better to use virtual reality simulators than to use nothing and immediately go to work. You need to understand that virtual reality works this way, and you can adapt to it”;

(I6) “It is rather convenient, but unusual. You need to gain experience and get used to it because diving does not completely repeat the movements, and you need to get used to it”;

(I7) “When I was diving and when there is a full adaptation, there is such a feeling of immersion. I think the better the graphics, the more you forget that it's unreal and more immersed in the environment. You start thinking only about the object in virtual reality”;

(I8) “Convenient. I have had experience and if you try it a couple of times, then you are already getting used to using the equipment”;

(I9) “I can say that it is quite convenient”;

(I10) “I wore a helmet for the first time, so it's hard for me to say something about comfort yet”.

The following answers were collected for the Question 3 “What do you think about immersion degree?

(I1) “You get a little lost and a little dizzy. The level of immersion is sufficient, there is a feeling that you are there”;

(I2) “There is a feeling that you are on there. If you remove extraneous noises from the hall and make noises from the station, then the feeling of immersion would be fuller”;

(I3) “The degree of immersion is sufficient, you forget that you are wearing glasses and there is a feeling that you are really there”;

(I4) “The immersion is not strong, but this is only due to the fact that there were extraneous sounds. If they make sounds, the immersion would be stronger”;

(I5) “It seemed to me quite realistic and the degree of immersion is high”;

(I6) “There was a feeling that you were there. When I read a book, I have a feeling that I am immersed, and here, too, there is a feeling that you are there. When you put on headsets, you move away from the real world, and if you add sound, the feeling is even greater”;

(I7) “After some time (about after 40 minutes), you start to feel discomfort from being in virtual reality for a long time from the headset, and your hands get tired. And this makes you want to take it off”;

(I8) “Yes, everything is plausible enough that the feeling that you are there is. Only there were very few people who could walk with their feet, but if they did it, it would be great. It looks pretty realistic”;

(I9) “Immersion occurs and the feeling that you are really there is it”;

(10) “The feeling that you are there happens on 70%”.

The following answers were collected for the Question 4. What do you think about interaction?”:

(I2) “It takes time to get used to a new way of interacting. You need to understand how to behave there. Trying to get used to these controllers. It takes 15 minutes to adapt. It's convenient to use the controllers, you just need to adapt that you don't even need to walk to move, you can even sit in a chair”;

(I6) “Moving around with controllers inside virtual reality is much easier than with your feet”;

(I7) “You need to get used to the controllers because you need to understand how to simulate manual grips, it takes 15 minutes”;

(I8) “Two buttons – a couple of functions and headset. Probably everyone can master it”;

To sum up, faculty evaluate positively the quality of 3D design, noticing that it is close to the reality and 3D objects are well-made. They note that it is convenient to use headset and controllers. Of course, it takes time to get used to virtual reality. Some participants mention feeling of sickness that might be a potential problem. The immersion feeling was quite good, but the participants note that it would be good for immersion to have headphones with sounds for virtual reality simulators.

*Didactic usefulness of virtual reality*

The following answers were collected for the Question 1 “What do you see as the didactic usefulness of virtual reality?”:

(I1) “I think this is an increase in interest in acquiring knowledge and skills among students, as well as an additional motivation for them. Everything about computers attracts their interest. I believe that the interactive form will motivate them to listen more carefully and reduce the number of missed classes. Virtual reality is a distraction from the everyday educational forms, such as lectures and seminars”;

(I2) “I think virtual reality is needed more as a practical tool. It will also allow you to simulate a dangerous environment and students need to be taught how to behave and how to manipulate objects. To reduce the negative consequences of unprofessional actions of students. The simulator will help to teach the teacher how to work with the class, how to build training. That is, how to consolidate practical knowledge”;

(I3) “It is a good addition for gaining knowledge and skills. Technology would help to improve the interest and motivation due to this academic performance”;

(I4) “If there is a shortage of equipment or when you need to work out an algorithm of actions. It is better to work it out on a virtual reality simulator, and we can make sure that they have worked out the algorithm. It turns out that this is clearly and useful. Since the real equipment will not be involved. For me as a teacher, this would allow me to immerse the student more than through PowerPoint slides. It will also add interest and interactivity, for example, I could tell that there is a constant current motor, and it can be disassembled. Show how something works”;

(I5) “A person can study a process or phenomenon more deeply while inside it. Virtual reality technologies make this possible, unlike conventional training. Any data analysis is useful, and if it comes in real time, then you can process something, and it helps to confirm or refute it, then it is useful. Any data is especially high-quality, they are useful”;

(I6) “Two things, firstly that you can look at something in more detail in an enlarged format and look at the dynamics. I think it is useful. I perceive information better when it is visual, and virtual reality copes well with this task. Secondly, some practices that are dangerous to conduct are easier to conduct virtually. That is, the same bioreactor, it is better to view it in this mode than to break it. I think that at the moment of attention and interest, yes, because you yourself can move and move inside. Therefore, I believe that it will increase, but if you over-saturate it, then rejection can go like this”;

(I7) “This is the closest way to reality in practice to learn any action. This promotes practical learning to choose something, i.e. when the student can choose how to act. And it's not just to answer standard questions, but a real action, and here you can tell and explain in classical education, but until the student begins to perform these actions. Virtual reality allows you to train him without the presence of a teacher.”;

(I8) “I believe that virtual reality is useful for students of technical specialties. When we were in Samara at the Aerospace University, they had rocket science there. In rocket science, all the basic things can be viewed and studied, for example, where the blades, the engine, etc. are located on the same virtual reality simulators.”;

(I9) “For technical specialties, these are the most suitable areas for virtual reality, since it is possible to simulate life-threatening processes in virtual reality. There is no need to put people and equipment at risk. As for the humanities, including management, I really liked the simulators presented. And we thought about the introduction of virtual reality simulators.”;

(10) “I believe that the human factor in education is very important. However, it is no longer possible to do without technical tools. This allows you to solve routine tasks. If the teacher has digital skills, then he will be interesting to students. Well, it's over virtual reality will arouse interest from students.”.

The following answers were collected for the Question 2 “What educational tasks can VR solve?”:

(I2) “Virtual tours of production facilities, including closed ones. And the student can manipulate the objects there”;

(I3) “The skill of public speaking, they are necessary for students. Preparation of students for public speaking for the defense of coursework and thesis. The idea arose that it was the preparation of students for pedagogical practice, it would be easier for them to be in front of the class later.”;

(I4) “If you take courses, then there are already simulators in my courses, that is, foreign students who cannot come, they collect the scheme through the proteus environment. Its ability is to assemble a circuit and encode it. It would be possible to do this with virtual reality. It could help theoretical disciplines become more practice-oriented. Show real elements and show students. For example, robots and how to use

the robot arm, it will move so that it is visible. Because not all enterprises are ready to show everything how everything functions in reality.";

(I5) "A very long time ago, we were engaged in programming with schoolchildren for a very long time, and it was not entirely clear to them. Then we decided to rebuild the program and started with graphics, and we showed the principle of some algorithms on the graph, that is, more clarity. And it went when they saw that it turns out so-and-so. And it seems to me that the same analogy can be drawn here. Someone can imagine and someone can't imagine what it will look like and what will happen after something. There is a project that our students did from the neighboring faculty, there are such historical structures called dolmens – places of ancient graves. There are a lot of them on our territory, and very often they are destroyed. And now augmented reality allows you to finish what it looked like. A person immediately has a visual idea of this, and after that he may show interest in it. It can be any industry, I just gave an example. And I'm not talking about such complicated things as medicine and nuclear energy. For sure, they are used there in the first place and developed there.";

(I7) "I think virtual reality is more suitable for practical tasks. If we talk about my course, then these are engineering and technological tasks. Creating a 3D model of real objects (digital twins) where the student must perform some actions as in life with objects. My educational program prepares students to work at a factory as an operator of installations, respectively, it would be possible to create a conveyor line in 3D, put students there so that he performs certain actions there.".

The following answers were collected for the Question 3 "What educational tasks can VR solve in your academic discipline/course/program?":

(I1) "It can solve the following tasks such as getting out of various conflict situations, resolving conflicts in the management, since the manager must be able to

manage conflicts. It also solves the tasks of team building, holding meetings and interviews, how to establish communication with partners, potential consumers.";

(I2) "If we take economics, then here I am considering a simulator for conducting negotiations, a simulator for making managerial decisions (to study business experience and shift experience into situational tasks). In the field of accounting, document management or decision-making of a student in the role of chief accountant in terms of taxation,";

(I3) "If we take the physiology of plants, then it would be possible to work out certain techniques with equipment, performing research on devices, since we use different devices, but we don't have everything here. Preparing and setting up these devices in reality takes a very long time, and so it could be simulated so that students learn how to perform experiments virtually. In botany, the study of sections under microscopes.";

(I4) "In my opinion, this would be great because it would help make learning more practical and not purely theoretical. It is necessary to take into account what is needed to equip classrooms for virtual reality simulators so that no one is injured and so that virtual reality equipment does not suffer. It is necessary to understand the development of the simulator so that students do not have motion sickness or epilepsy attacks. We need to understand what we want to achieve with the help of virtual reality technologies.";

(I5) "Digital twins are part of the simulation. This may be part of the tasks related to interdisciplinary. I have already given an example of history and the study of ancient history using modern information technology. There can be a lot of such intersections. As with biology, ecology, monitoring and modeling.";

(I6) "I would think about how to adapt virtual reality into courses. We have many classes that come in the form of practices or laboratory. Laboratories such as chemical and physics and biological. We also have courses where foreign teachers

taught and now this is not happening. Not all students can be sent to Brazil to watch how nanoparticles purify water, so it would be good to have a virtual reality simulator that would show this process. In this way, we could influence the quality of education.";

(I7) "I am absolutely not against its introduction into my practice, but I will not say that it is a direct necessity and that it is impossible to do without it, but I would not mind introducing it.";

(I8) "If we talk about my area, then this is most likely chemical synthesis, i.e. where we can mix objects and get some particles. This could be adapted to some routine processes of chemical synthesis. However, with the development of science, it will have to be rewritten. But so far it seems to me that it is more useful where there are developed protocols, as in production, and it can be trained in virtual reality. In order not to break the equipment or where it is dangerous or to minimize the risks.";

(I9) "Management program. This formation of soft skills is associated with teamwork, the ability to communicate, conflict resolution, conflict management. And such simulators exist, what they showed us. So these things can be used. In addition, any program contains life safety and there, too, you can use a virtual reality simulator. I think we will find a lot of opportunities where to use. We were also shown how to lose situations in banks, and this can be used in disciplines related to finance. I am sure that this can be used both in philosophy and in history, such as excursions to antiquities and museums. Since management is related to psychology, then perhaps you can also come up with simulators, as for mathematical modeling, then you can also come up with something.";

(10) "I would use virtual reality for public speaking in my field. This would help improve presentation skills, as well as help students see reactions from the audience and understand what he is doing wrong.".

The following answers were collected for the Question 4 “What are your thoughts prior to implementing the technology in teaching?”:

(I1) “I think it can be used for practical exercises to diversify them. There is an interest in introducing virtual reality technologies into education. We want to see it at the university”;

(I2) “This is good in the field of technical education, where there are a lot of laboratories. It is worth implementing because young people live with vivid emotions and impressions, and it will help to give them knowledge through impression. They associate knowledge with Google, namely, quick search and quick satisfaction of needs. Virtual reality is well suited for consolidating knowledge.”;

(I3) “My opinion is that it is worth implementing. If the university has such an opportunity, then of course it is worth it. However, for example, at our department there are elderly professors who are wary of the introduction of technology. But talking about me, I consider it as something interesting. This expands the methods of teaching the discipline.”;

(I4) “If we talk about the implementation of the program, then we need funding and the interest of teachers in whose disciplines it is really implemented. The product must be ready for use. Not every teacher is ready to develop virtual reality simulators.”;

(I5) “I would implement it because it will allow you to see and understand those things that cannot be seen in the textbook. Any means that allow you to understand the picture of the world should be used, and especially when such technologies are available.”;

(I6) “It is more difficult for me to answer the question because I do not teach but deal with administrative processes. I deal with documents and help teachers and students solve current issues. However, now it is time to design educational programs

and perhaps virtual reality technologies will be useful there. But as for the implementation, I would try, since I am always for this approach.";

(I7) "Students' interest is most likely. Virtual reality technology is one of the most advanced, so it is expensive and technically not so simple and therefore requires mass production. Such costs should be commensurate, they should be justified. If students show a high interest in this program and continue to work in this profile, however, this is not always the case. If students show a high level of knowledge and involvement in the educational discipline, then of course teachers have a desire to give them more, including virtual reality technologies.";

(I8) "I would start thinking about the implementation if virtual reality helps to minimize the load on the teacher, then this should be done. I could give a lecture and give the whole practice to virtual reality, where students would hone routine processes.";

(I9) "I have a positive attitude to the introduction of virtual reality technology in education";

(10) "I would like to use them in my disciplines.".

To sum up, it is good as practical tool, so the education in the future can become more practical-oriented with the help of virtual reality. In addition, it can help to improve the interest and motivation among students because it makes the learning process more interactive. And virtual reality makes education more visual. It can solve different educational tasks, for instance in economics it can be used to train how to get out from various conflict situations, conduct negotiations and make managerial decisions. For ecology science, virtual reality can provide digital twins of equipment or virtual laboratories where some experiments can be done. For philology, virtual reality can provide public speaking training. For history, virtual reality can provide walking through ancient cities or help to see how places looked like in the past.

*Advantages and disadvantages of virtual reality*

The following answers were collected for the Question 1 “What advantages do you see to using virtual world technologies into the higher education?”:

(I1) “I see the benefits of using virtual reality to organize hands-on experience. They can also be used in open university days, we would promote the university with the help of virtual reality”;

(I2) “Reduction of injuries or moments that may be. The opportunity to consolidate knowledge in practice. If students can create content for virtual reality themselves, then this would also be a good training for them.”;

(I3) “I see more advantages because it allows us to convey knowledge to students, especially to modern students. Namely, to speak their language. This has more advantages.”;

(I7) “Practical aspect, would increase students' interest in the discipline. Because it is a more visual and new format. You can also use it as an attraction for young people. For teachers, virtual reality is a convenient digital tool for analyzing different skills and knowledge of students. It can automatically analyze and issue to the teacher.”.

The following answers were collected for the Question 2 “What disadvantages do you see to using virtual world technologies into the higher education?”:

(I1) “As disadvantages, I see that it can break and very often it can be repaired by no one. Also, not everyone will be able to use it, i.e. teachers need to be trained how to use it in their work. It's all going to take a period of time.”;

(I2) “There is a fear of transferring the consolidation of knowledge into the gameplay. So that students will consider it as entertainment.”;

(I3) “I don't see any disadvantages.”;

(I5) “I don't see the disadvantages of using virtual reality”;

(I6) “You need to use it carefully so that the feeling does not interrupt the learning process. So as not to turn into a game, since you can do different things in virtual reality, and you can easily distract yourself from why you are immersed.”;

(I7) “Low availability on the material side. And it is also quite difficult to use it everywhere and for many students. Now these are more one-time stories.”;

(I8) “The need for software and the need to develop for a specific task, and of course it's not cheap. And constantly changing scientific tasks. And if this is a constant algorithm of actions, then it is useful.”;

(I10) “Virtual reality can take up all the space in the learning process and will be associated more with entertainment than with education.”.

The following answers were collected for the Question 3 “What could make you to implement VR technologies into your course/discipline/program?”:

(I1) “The first push came when I saw it with my own eyes and was able to try it in practice at LETI. Practical experience and the lecture part prompted my colleagues and me to the fact that we began to discuss how to use it in education and how to get these technologies. Therefore, it is very important to tell what usefulness it can bring to the educational sphere.”;

(I2) “Firstly, finances, availability of resources. I don't see any other technical problems. I am a person who is for digitalization, ready to learn how to use it.”;

(I3) “The appearance of such headsets and virtual reality simulators at the university. I would have studied them and could already use them in education.”;

(I5) “The realization that it is necessary to have it. You need to synchronize with someone who also understands why it is necessary. And when situations arise where a solution of VR technologies is required , then apply them there . There must be a bundle for what it is needed”;

(I6) “The fact that we have arrived and see how it is used can push. We got the information. Spreading information about what such technologies are and what they can do would make me think about using virtual reality technologies in education. We heard what it is, then it is processed by the hindbrain and the rudiment are there, and then it may turn out so that you start coming up with how it can be used.”;

(I8) “I would think about using virtual reality for large routine procedures with a lot of students who need to automate processes.”;

(I9) “The first push that motivated us is that we are facing the modernization of the program. We want to make it modern, competitive and, accordingly, we need to use new technologies as one of the tools. And then the second push is when we were shown at the LETI VR demo day what it is and showed the simulators. And then we realized that virtual reality is something that can be implemented and refresh our program.”;

(I10) “If I won the grant, I would definitely buy glasses and a simulator.”.

To sum up, Faculty see advantages of virtual reality as hands-on experience or practical tool, promotion of the university as modern and technological and a way of increasing motivation and interests among students. For disadvantages, faculty name a potentiality to make game from education, the price and who will help to maintain the equipment if it breaks down.

*Challenges of using virtual reality*

The following answers were collected for the Question 1 “What do you see as challenges for faculty using virtual world technology in the higher education?”:

(I1) “Technical work skills, maintenance, technical equipment. Is it difficult to manage and technically maintain.”;

(I3) “Let's say a group of students is sitting in class and there are fewer headsets than the number of students in the group. It is necessary that the office is equipped

and everyone has access to headsets. I need to look at my program and determine the place where they would be exactly needed. It would take time to implement them. But this is a surmountable difficulty.";

(I4) "The first problem is the audience. It is suitable for every audience. We need a special laboratory audience. Such classes will be full-time, then the learning process will suffer because it will be problematic to bring it online. From a methodological point of view, if we prescribe how the student works in virtual reality and the educational milestones are put down, then there should be no problems.";

(I5) "And you need to take and use it. Gradually, all this will enter into education and settle down. And the one who has learned to use it will teach others. Methodological kits for virtual reality are needed.";

(I6) "Firstly, the situation at the university is quite difficult with people who are engaged in teaching and organizing training, since not everyone is happy with innovations. People are used to doing something somehow and don't want to implement anything. Secondly, when we do not have enough competencies to use virtual reality technologies, so we will need support teaching how to use them. It should be both technical support and methodological, there should be a course on how to use it and how to implement it into the course. Also, building a community of those who have already introduced virtual reality technologies to their courses and can become a mentor to other people who just want to do it.";

(I7) "Logistical, you need to look for a source of funding. A virtual reality classroom is needed for education.";

(I8) "I don't see any problems if the university already had such simulators. I would just write a manual or a protocol on how to act step by step and give it to the students to work. I think students would have met halfway and would have wanted to study in virtual reality.";

(I9) “I don't see from the students' side. I think that the problem will be in the teachers, because due to different ages, it will be difficult for some to master it, someone will not want to at all. And someone else may take it with a threat, I think virtual reality will replace them. The question is how to present it so that they want to use it. I think it will be like with computerization, virtual reality will also go this way, at first there will be rejection, and then it will become commonplace.”;

(I10) “Equipment of the classroom for students to work with virtual reality simulators.”.

The following answers were collected for the Question 2 “What challenges may arise with the implementation of VR technologies in the higher education?”:

(I1) “Resources, finance and procurement. I'm not sure if all the teachers will accept this.”;

(I2) “The cost of equipment. Not all teachers will want to use. This can only be used for specific disciplines. The management of universities that are partly conservative and look at it as something unnecessary. Regarding the methodology of use, this should be done by people who understand how virtual reality technologies and techniques work. Adaptability of students to virtual reality technologies.”;

(I3) “While it is too expensive to purchase. And the university will think about the need of purchasing it. The problem of mastering, namely, to teach teachers how to use them. Equip the premises and provide maintenance.”;

(I4) “Most likely the conservatism of faculty. Define the requirement for what we need virtual reality for and think about it in detail. What education tasks will take place in virtual reality. Financing.”;

(I5) “I don't see any problems. You need to come to the management and explain why this is necessary. It is necessary to start with children's laboratories, children from a young age”;

(I6) “In this case, I am glad that we have a center for transformation and development of education. These are people who specially gather us and organize a new experience for us. If I have such ideas, then I can go to them and share my ideas. Then this idea will go further and promote the idea. And so it may come to implementation.”;

(I7) “Methodological tasks, I think virtual reality needs to be properly implemented in the general course or the entire program. To understand what percentage of time to give virtual reality, you need to combine virtual reality with traditional methods. What is the position of the teacher to virtual reality, how it analyzes the data and how it gives feedback to the student.”

(I8) “Receiving funding from the university. Writing software and equipping space for virtual reality classes”;

(I9) “Purchase of equipment and software. I think that understanding on the part of the management should not arise because they understand that this is necessary. The problem of resources to purchase equipment. Then it will be necessary to teach colleagues how to use it through training and internships.”;

(I10) “Where to get resources for the equipment and software purchase. It is also human ignorance, namely the lack of desire to learn how to use new technologies.”.

To sum up, the most common challenges are financial, technical, methodological and psychological. From financial part, faculty name the high cost of the equipment and software. It might be too expensive for university to purchase it. From technical part, it might be difficulties to find the necessary virtual reality simulator for the course, also to organize the area where students can use virtual reality equipment and how to maintain the equipment. If it is, a class or laboratory, there should be tech support. If the equipment breaks down, who can help with the repair. From methodological part, faculty name the challenges how to implement it for a big

number of student classes and how to implement virtual reality into education process. From the psychological part, the participants name conservatism of faculty in terms of adoption of new technology. This may include both a reluctance to learn how to use virtual reality and a reluctance to implement it for their courses.

# CONCLUSION

Integration of the findings of the quantitative analyses and the qualitative analyses has led to conclusions for this study based upon the findings. The central question posed for this study was the following: What are the faculty's perceptions of virtual reality use in higher education? (Russian context). Guiding topics included: (a) Perception of digital competence; (b) Assessment of the technical aspects of virtual reality; (c) Ease of use; (d) Attitude towards adoption; (e) Didactic usefulness of virtual reality; (f) Educational tasks solvation; (g) Advantages and Disadvantages of virtual reality (h) Challenges of using virtual reality (i) Barriers of the implementation.

Faculty evaluate their digital competence as average level at the user level, and they would like to improve it. Some faculty members evaluate their digital competence as below average. The most widely used digital technologies they use for educational tasks are computers and Office tools.

Faculty evaluate positively the quality of 3D design, noticing that it is close to the reality and 3D objects are well-made. They note that it is convenient to use headset and controllers. Of course, it takes time to get used to virtual reality.

Faculty note the ease of use of virtual reality, however, at the same time they have doubts towards of easiness of learning how to use the technology for them.

Faculty are positive about implementation and would consider the use of the virtual reality in their courses.

For the didactic usefulness of virtual reality faculty name interactive way of studying, it might increase motivation among students, it makes education more practical and students can gain skills, and of course, it gives more visibility to educational process.

Virtual reality can solve such educational tasks as routine processes, creating a 3D model of real objects (digital twins), conduct practice, show how the real

equipment works, replace training of dangerous processes in labs on virtual training according to the faculty opinion.

For advantages of virtual reality faculty name hands-on experience, reduction of injuries, automatic analyzation of students' action, and for disadvantages of virtual reality faculty name potentiality of replacement education on game, time spent on learning how to use technology for faculty and lack of infrastructure who and how will technically help to maintain the equipment at the university.

For challenges of using virtual reality faculty see technical, methodological and logistics organization at the university.

As barriers of the virtual reality implementation, faculty name the cost of equipment and software, financial support for the maintenance of virtual reality classes, also is mentioned the conservatism of faculty.

To sum up, the study was conducted to minimize the gap on faculty's perception towards implementation and use of virtual reality in higher education in Russia. The faculty's attitudes and thoughts about virtual reality in the higher education is promising towards accepting, use and implementation. Talking about directions for further research, the research might be scaled to a large number of participants from different universities. That information would help to understand the attitude of faculty and determine the level of readiness to use technology in higher education. The other direction might be collecting data on students', administration's and VR companies' perception towards implementation and use of virtual reality in higher education in Russia.

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# APPENDIXES

## APPENDIX A

The purpose of this questionnaire is to collect information about the perception and attitude of university educators to virtual reality (VR*) technologies. Some questions will concern your attitude to technology in general.

*In this review, virtual world technology includes software applications that simulate the environment. The virtual world environment is considered a three-dimensional graphical representation of the real world. It will take you about 5 minutes to complete the questionnaire.

1. What is your gender?

- ☐ Male
- ☐ Female

2. What age group are you in?

- ☐ Under 30
- ☐ 30 - 39
- ☐ 40 - 49
- ☐ 50 - 59
- ☐ Over 59

3. How many years have you been teaching in higher education?

- ☐ Under 1 year
- ☐ 1 – 5 years
- ☐ 6 – 10 years
- ☐ 11 – 15 years
- ☐ 16 – 20 years
- ☐ Over 20 years

4. What is the main scientific profile (profiles) in which (in which) you specialize?

- ☐ Physical and mathematical Sciences

- ☐ Chemical Sciences
- ☐ Biological Sciences
- ☐ Technical Sciences
- ☐ Historical Sciences
- ☐ Economic Sciences
- ☐ Philosophical Sciences
- ☐ Philological Sciences
- ☐ Legal Sciences
- ☐ Pedagogical Sciences
- ☐ Medical Sciences
- ☐ Architecture
- ☐ Psychological Sciences
- ☐ Sociological Sciences
- ☐ Earth Sciences
- ☐ Other:_____

5. What is your instructor status?

- ☐ Manager
- ☐ Teacher/Senior Lecturer
- ☐ Research Associate
- ☐ Docent
- ☐ Professor
- ☐ Head of the Department Dean of the Faculty/Director of the Institute/Director of the Higher School
- ☐ Other:_____

For the following questions, please rate, on a scale from 1 to 5, your attitude to each statement.

**1= Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree**

| № | Statement | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| 6 | When preparing my lectures/courses/modules, I | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | use multimedia technology tools | | | | | |
| 7 | I believe that my teaching methods do not need to change in order to adapt to new technologies | | | | | |
| 8 | I see technology in teaching as a positive challenge | | | | | |
| 9 | Technology integration benefits my students | | | | | |
| 10 | The use of virtual reality (VR) technology would improve the quality of education | | | | | |
| 11 | If virtual reality (VR) technology is effectively integrated into the learning process, it has a positive effect on the learning process of students | | | | | |
| 12 | The use of virtual reality (VR) technologies in my course(s) is not suitable for the subject(s) that I teach | | | | | |
| 13 | I would find virtual reality (VR) useful in learning | | | | | |
| 14 | It would be easy for me to learn how to use virtual reality | | | | | |
| 15 | Using virtual reality will allow me to perform pedagogical tasks faster | | | | | |
| 16 | I find virtual reality easy to use | | | | | |

# APPENDIX B

## Virtual Reality Interview Questions

### Background and demographics questions

1. What faculty position do you currently have within the university?

2. What is the main scientific profile (profiles) in which (in which) you specialize?

3. What courses do you typically teach?

4. How many undergraduate/graduate students do you typically teach in a semester?

5. What kinds of technology do you use in the classroom, and how long have you used it for?

### Perception of digital competence

1. How would you reflect on your digital skills?

2. What did you know about virtual reality before LETI VR demo day?

3. Has your knowledge/understanding of virtual reality changed after this LETI VR demo day? If so, what exactly?

### Assessment of the technical aspects of VR

1. What do you think about 3D design?

2. What do you think about usability?

3. What do you think about immersion degree?

4. What do you think about interaction?

**Didactic usefulness of VR**

1. What do you see as the didactic usefulness of virtual reality?

2. What educational tasks can virtual reality solve?

3. What educational tasks can virtual reality solve in your academic discipline/course/program?

4. What are your thoughts prior to implementing the technology in teaching?

**Advantages and Disadvantages of VR**

1. What advantages do you see to using virtual world technologies into the higher education?

2. What disadvantages do you see to using virtual world technologies into the higher education?

3. What could make you to implement virtual reality technologies into your course/discipline/program?

**Challenges of using VR**

1. What do you see as challenges for faculty using virtual world technology in the higher education?

2. What challenges may arise with the implementation of virtual reality technologies in the higher education?