# Opportunities, challenges, and training needs in the use of VR in Higher Education and SMEs: The case of Cyprus and Finland

Panagiotis, Kosmas
Center for the Advancement of Research & Development in Educational Technology, panagiotis.kosmas@cardet.org

Eria, Makridou
Center for the Advancement of Research & Development in Educational Technology, eria.makridou@cardet.org

Henri, Pirkkalainen
Faculty of Management and Business, Tampere University, henri.pirkkalainen@tuni.fi

Osku, Torro
Faculty of Management and Business, Tampere University, osku.torro@tuni.fi

Charalambos, Vrasidas
Center for the Advancement of Research & Development in Educational Technology, pambos@cardet.org

## Abstract

The use and adoption of VR solutions have increased rapidly due to recent technological developments. Over the last years, there have been many initiatives to develop and adopt VR in many different fields, including education and business. This paper describes the state-of-the-art of VR use in Cyprus and Finland, focusing on the use of VR technology in Higher Education (HE) Institutions and in Small to Medium Enterprises (SME). Interview sessions were conducted with 16 expert people from Higher Education and business to firstly identify the key technologies available and secondly to analyze the opportunities, strengths, challenges, and training needs concerning the adoption of VR. The analysis revealed essential considerations and valuable insights about the development, adoption, and promotion of VR solutions in Higher Education and the business sector.

**CCS CONCEPTS** • General and reference • Cross-computing tools and techniques • Empirical studies

## Keywords

Virtual Reality, Higher Education, SME, good practices, challenges, training needs.

## 1 Introduction

Virtual reality can be defined as a technology that provides "the effect of immersion in an interactive three-dimensional computer-generated environment in which the virtual objects have a spatial presence" [17]. Virtual Reality (VR; 2D/3D computer-generated immersive environments) is expected to significantly impact education, training, business, and industry [2]. This will also have a solid direct impact not only on Small to Medium Enterprises (SME) but also on Higher Education (HE) business management and related studies. HE managers and teachers themselves need in-depth education and training concerning what VR is about, what kind of VR skills and competence the industry requires from graduates and how their own pedagogical approaches and classes can be boosted by using VR applications.

Over the last years, there have been many VR development and implementation initiatives, specifically in the Higher education field [3]. In this paper, we present an overview of the state of the art in the field of VR within HEIs and SMEs. Specifically, the study addresses the main opportunities, barriers, and training needs in applying VR in HEIs and SMEs. A series of interview sessions were conducted with Higher Education managers and teachers and SME managers and education experts. The purpose of the interviews is to help us get a clear picture of the state of the art in adopting VR in Cyprus and Finland. These two countries are currently in the process of experimentation and initial adoption of VR, which provides a good opportunity to capture the lessons learnt from the initial activities. The study aims to boost the use of VR applications within HE business management and related studies, contributing to the broader acceptance of the technology.

The article starts with an overview of VR use in Cyprus and in Finland by covering the previous research in the area and providing good practice examples from both countries. The following sections report on the methods and procedures of the study and present the results of this investigation. Finally, the paper concludes with recommendations and implications for future work to promote and facilitate the use and development of VR in HE and in SME.

# 2 VR overview

VR has been around since the 1970s, but it turned into a commercialized technology during the last five years [10]. VR evolution was dictated by the need to improve human-machine interaction through realistic multi-sensory channels [15, 24]. There has been a vast improvement in VR technologies primarily in terms of hardware quality and decreased cost. Some of the latest steps in VR platforms include stand-alone Head-mounted devices (such as Oculus Quest) that do not require a separate powerful laptop or beacons placed in a room to function fully. As technology becomes even cheaper and more widely used, we can expect many more innovative applications, including entertaining ourselves, working more productively and even to be able to better communicate with one another. People tend to associate VR with gaming, but the possibilities of VR extend to many industries and education. For example, VR is now being used in healthcare, real estate, marketing, architecture, product design, Cultural Heritage, corporate training and to some extent, in higher education [3, 9]. One of the emerging topics in VR is about multi-user or virtual social reality where teams consisting of learners or employees can immerse themselves in VR and work seamlessly together in a shared virtual space accessed through HMDs [7].

## 2.1 VR overview and good practice examples in Cyprus and Finland

Over the last years in Cyprus, VR solutions and applications have been explored in educational settings. Examples regarding good practice cases and examples in education include STEM courses where students can work with VR technologies, enabling them to visualize the solar system in an immersive manner, providing intense experiences previously unknown to the human mind. VR allows learners to visit a foreign country, using language in an authentic context and interacting with local people in foreign language teaching. With VR, users can use a target language in a novel, but affordable way. There are also continuous initiatives related to VR development and implementation in the field of HE as well. Notably, some research labs are focusing especially on the use and development of VR technology.

One example is the Microsoft Computer Games and Emerging Technologies Lab [16] established in 2012. Another example is the CYENS center [19], the first research center in Cyprus focusing on Smart systems and emerging technologies. Along the same lines, the Visual Media Computing lab [22] is a research lab that researches digital image processing and computer graphics, emphasizing the development of VR applications. Moreover, the Experimental Psychology Lab (EPL) [5] conducts research in topics related to Spatial Cognition using a variety of tools, including personal computers and VR technology. In this area, there is also the Institute for the Future (IFF) [8] which is aimed at advancing emerging technologies and contributing to their practical application in industry, government and education.

One initiative in the business sector is the use of VR devices in architecture and real estate. One architectural company uses 3D models and VR tools that turn their architectural designs into reality. This is only a part of the services that this company provides to clients. With VR, mainly PC-based devices like Oculus, clients can walk in the space and see how their houses/offices/spaces look like. That opportunity gives a chance to the clients to make some strategic decisions before the actual implementation of the project. Last, apart from the Higher Education field and business, in Cyprus, there are some Virtual Reality Centers focusing on gaming and entertainment. These centers offer VR experiences to people.

Finland has been at the forefront of VR development since the launch of Oculus Rift and HTC Vive in 2016. Already in 2017, more than 100 companies specifically focused on VR/AR technology (AR stands for “augmented reality” where virtual elements are embedded directly within the physical environment). Additionally, many conventional software companies started to experiment with these technologies as well [1].

VR is still mainly focusing on “viewing 3D things in VR” (e.g., marketing, visualizing), and only recently has there been an attempt to implement more advanced VR solutions on a wider scale, with more complex interactions or organizational communication processes. Different social VR applications appeared in the Finnish landscape during the year 2018. The most potential use cases for VR relate to collaboration/co-design (intuitive 3D interface, no physical boundaries in interaction), sales/marketing (“wow-effect”), operative work (e.g., visualizations that support it) and education/simulation.

Although, the Finnish VR ecosystem still lags far behind reaching its full potential [23], Finland has a lively scene for technology enthusiasts, hackathons, game development companies, and visual computing experts. High-quality education and academic research also provide a solid ground for taking the Finnish VR scene further. One particularly interesting Finnish VR company is Varjo that gathered wide global interest and hype with their “human-eye resolution” Head-Mounted-Displays (HMDs) aimed at industrial use [6]. Recently, Varjo closed $54 million in funding from international investors [21].

Last, Finland is known to be one of the world’s leading countries in the field of education. VR technology is also developed and studied extensively in Finnish HEIs (e.g., CIVIT [4], TAUCHI [18] in Tampere University). Interestingly, Professor Steven LaValle, one of the world's most renowned VR pioneers, and an early founder of Oculus VR is currently conducting his research at University of Oulu [13]. However, despite Finland’s top position in VR related research and development, Finnish HEIs do not yet use VR that much in teaching. HEIs lack wider practical and pedagogical knowledge of implementing the use of VR in their curriculums.

# 3 Method

A qualitative approach has been adopted to identify the key topics related to VR adoption in HE and in SMEs [11]. A series of semi-structured interviews were conducted to help us to get a clear picture of the state of the art in the field of VR developments in Cyprus and Finland. Specifically, we investigated the participants’ perceptions on the main opportunities and strengths, barriers, and training

needs about applying VR solutions. Next, we describe how the interview data were collected from two countries and how the data was analyzed.

## 3.1 Participants

Sixteen respondents took part in this study (eight from Cyprus, eight from Finland). The interview data were collected from experts in HE and SMEs with semi-structured interviews.

In the HE in Cyprus, we gathered information regarding the situation, needs, and demands of HEIs' state of the art and future planning regarding applying VR in teaching and learning. This part involves three people from the HE, two professors and one post-doc researcher. All three participants (male) have extensive experience in VR research and have experience in teaching VR in the HE context. Then, in SME interviews were five people (three female, two male, age group: 28 –35). Two participants with a background in Computer Science are working in the Higher education field as post-doctoral researchers. Two participants with a background in education work as managers and consultants in educational organizations related to teachers' professional development. One participant with a background in Architecture and Business Management works as a manager in Architecture Company.

The Finnish team interviewed eight persons in total (male). The interviews were tape-recorded to help with the analysis. Finnish HEI interviews involved three professors, whose main area of research is related to business management (one professor) or virtual reality (two professors). Finnish SME interviews involved five individuals who worked closely with VR (two CEOs, two CTOs, and one VR specialist). One of these interviews was not made in SMEs; in this case, we interviewed a national chief technology officer (CTO) in a large multinational, multi-billion company who had extensive insights into the SME field as well. Table 1 presents some demographic data of the people who participated in the study from Cyprus and Finland.

**Table 1: Participants involved in the study from Cyprus and Finland**

| Field | No of Participants | Gender | Country | Expertise/Area of interest |
|---|---|---|---|---|
| Higher Education | 6 | Male | 3 Cypriot<br>3 Finnish | VR research, Business Management, VR in Education |
| SMEs | 10 | 3 female, 7 male | 5 Cypriot<br>5 Finnish | Computer Science, Consulting, Professional Training, Architecture |
| **Total Sample** | **16 experts** | | | |

## 3.2 Interview sessions and analysis

Semi-structured interviews can be used to collect information about practices, beliefs, opinions, and information on past or present behaviours or experiences. This data collection method is very common in qualitative research and is appropriate for the overall scope of this research, as we want to collect and identify the perceptions and attitudes of respondents and enable probing for more information and clarification of answers [12, 14]. We followed means of appreciative interviews, which Schultze and Avital [20] describe as follows: "an appreciative interview is particularly appropriate in studies that aim to surface and capitalize on the capacity of people, teams, and organizations to construct enriching practices, and design work environments through a discourse that encourages positive change and participative action."

An interview protocol was prepared with some predefined questions and topics to be used as a guide in the interview session. All the interviews were conducted after the permission of the participants, they have been recorded and transcribed. Each interview lasted on average 40 minutes in total. We followed the guidelines and the interview protocol with the list of initial predefined questions in all the interviews. The interview protocol includes some predetermined questions that must be covered, but the order can be modified based upon the interviewer's perception of what seems most appropriate. The Table 2 presents some indicative questions asked in the interview sessions. Once the interviews were conducted, we classified the findings according to the following themes: a) Opportunities of VR, b) Challenges and barriers in adoption and, c) Staff training needs.

**Table 2: Sample questions asked in the interview sessions**

| Question | |
|---|---|
| 1 | Are you currently using any VR tools in your university/company (you personally or others)? |
| 2 | What makes VR so important that you are using it right now? |
| 3 | What kind of boundaries are there for using VR in your organization now? |
| 4 | What kind of possibilities does VR offer for your organization? |
| 5 | What your staff would need to know about VR to use it? |
| 6 | What are your personal training needs for the use of VR in teaching and learning? |

# 4 Findings

Based on the qualitative data gathered from the interview sessions in Cyprus and Finland, it seems that VR is a good common practice in HE institutions and SMEs. However, participants highlighted some important practices and challenges in the use of VR. They also emphasized the need for more training options in terms of VR use in specific learning or working environments. The participants have mentioned many VR technologies such as Unity, Oculus, Cave, Lenovo Explorer, Google glasses, and many other standalone VR devices. As HEs and SMEs argued, now many affordable VR devices can accurately track a user's physical movement and display these movements in a virtual space. This is considered very important because professionals can use VR in many different environments and for many different purposes in a truly interactive manner.

In the following sections, we provide a summary of results considering the participants' responses. We focus on good practices, challenges and needs as reported from both countries, Cyprus and Finland.

## 4.1 Opportunities and challenges in adoption of VR practices

### 4.1.1 View on Cyprus.

All participants from Cyprus, HEs and SMEs, argued that VR technologies provide many opportunities in different sectors, including education. Students/learners also have a positive attitude towards using VR in their learning process. Furthermore, VR grabs and holds students' engagement, probably because it is exciting and challenging to interact, create, and manipulate objects in a virtual environment. According to the participants, virtual technologies promote a whole student-centered learning experience, given that students are leading performers when experimenting and practicing with virtual objects. Today, as all participants claimed, it is not just about using virtual technologies in the classroom, but technological improvements allow various alternatives with different levels of interaction and immersion. The key opportunities and strengths were elaborated in two key areas. The first was maximizing the learning effect through immersion. The second key opportunity and strength were the *ability to learn soft skills effectively in VR*. Further, in SMEs sector, one participant highlighted that "for researchers is easier to have a very control situation in the lab, where at the same time it does look realistic, because usually, they can't design an environment away, so they need to do the studies and still running in the lab well, maintain in the realist word, of the real world" (SME 2).

On the other hand, as the participants mentioned, VR technology could bring dozens of benefits to almost any field, but it also has many barriers and important challenges in adoption and implementation. Challenges in VR implementation are mainly related to the cost of devices and compatibility. In some cases, some restrictions that deal with the fact that we are allocating systems which are not currently supported. As one participant explained: "There are many weaknesses such as High cost, Motion sickness, discomfort in some cases, VR is a more personal experience and many other challenges. Also, some VR devices have not a really good accuracy regarding the physical movement in a very large space" (SME3).

Along the same lines, one participant from HE pointed out: "The main issue that prevented me from applying VR is the cost of the equipment. Another serious issue is the negativity from some of the teachers, or they can be afraid to use VR in their classes. They need to be extremely well trained to do that and they attend to view this kind of technology with some fear, so it's hard for me to convince them".

### 4.1.2 View on Finland.

Each of our interviewees in HE saw the potential of VR in the context of remote teaching. For example, teachers could use immersive 3D environments or 180-degree lecture videos to "*increase students' sense-making in different learning contexts"*, but without a necessity for face-to-face communication. Furthermore, the use of social VR could "*increase collaborative learning"* when users could communicate online in a collaborative manner comparable to the real-world brainstorming sessions. Interactive simulations could also prove to be valuable use cases when students experiment with, for example, different virtual machinery (e.g., digital twins). Gamification of learning activities was also seen as an interesting option to foster a student's motivation to learn.

In the context of SMEs, it was clear that the availability and usability of different VR solutions have improved significantly in the past couple of years. For example, Oculus Go was a major milestone in this development. It was the first product that was able to provide a cordless and cheap VR experience for the masses. Almost every interviewee saw that Oculus Quest HMD could significantly improve this user experience, as it can provide six degrees of freedom (6DoF) and better performance in terms of resolution and computing power. Many interviewees saw that VR is at its best when removing physical boundaries for interaction. VR could potentially substitute videoconferencing, especially in cases when interaction occurs around different 3D objects. Shared 3D-models could act as "living documents" in different construction projects, reducing the amount of confused communication in other channels (e.g., email, chats).

As for the challenges, interviews revealed that barriers to adopting VR technology related to both technological and human factors. Interviewees referred to the 1st generation HMDs and argued that VR technology had not been fully matured yet: too big, too expensive, too difficult. However, standalone HMDs were seen to transform this landscape significantly. VR is a tool for many different use cases, but content creation was still a serious bottleneck. There is not much content available to justify all the expenses that relate to investing in VR hardware and staff costs. HE institutions did not have a way to scale up content creation by themselves. In the SME context, many companies did see the potential of VR, but they were not able to scale the use of VR, or sell scalable VR products, quite just yet. There was also a lack of end-to-end VR solutions. Companies need to have a certain amount of VR capabilities and understanding before using VR. This is one of the biggest bottlenecks of using VR at large scale: there is no network effect. If other companies are not using VR in their processes, it is difficult to push VR adoption just within one's own company.

To sum up, focusing on VR opportunities, based on the interview data from both countries, as presented in table 3, participants discussed the potential of VR in many sectors and pointed out the following strengths:

**Table 3. Strengths of the VR use**

| VR strengths | |
|---|---|
| 1 | Users can immerse in both realistic and fictional virtual spaces |
| 2 | VR gives a full and detailed view of the place |
| 3 | Users can interact with and simulate any content |
| 4 | VR promotes self-guided exploration and independent practice – autonomy in learning |
| 5 | VR platforms offer a wide range of applications for various purposes |
| 6 | VR provides outstanding 3D-visualizations that are not possible in the traditional classroom |
| 7 | Users can experience things that are impossible in F2F or other digital environments |
| 8 | VR promotes self-determination and motivation to learn |
| 9 | VR increases students' engagement |

## 4.2 Training needs for VR

### 4.2.1 View on Cyprus.

VR technology opens new, exciting possibilities for many different purposes. Being able to implement VR different scenarios from anywhere in the world is extremely powerful, as it allows each learner to practice their skills with no real-world consequences. As all participants explained, staff (in education and business management) needs a high-quality level of training to apply VR solutions effectively in their working environments. People need to be familiar with VR technologies, so they must know the limitations and strengths of technologies. As participants mentioned, people also must know the audience very well, to identify their needs, their expectations, their interests, to integrate more successfully the VR technologies. Below we present some indicative opinions of HEs and SMEs regarding the training needs of people who are going to use VR in their workplace.

- "Computer literacy, technology knowledge, and understanding of the use of technology in different workplaces. You have to be aware of VR technology and understand how it works." (HE4).
- "I believe that one of the most necessary skills to embrace this technology is computer/technical literacy that will familiarize people to technology. Moreover, adaptability is another important skill, as we live in an era of constant changes; thus, those how are not able to embrace the new advancements will become outdated and possibly jobless." (SME7)
- "Willingness to learn, adaptability and constant update of computer skills are a necessity in order to understand the use of VR and adapt it to meet your needs." (SME 9).
- "Staff needs to be efficient in the technical aspects of technology and need to be willing to learn this new technological tool." (HE4)

### 4.2.2 View on Finland.

In the future of Higher Education, VR was seen as a unique computing platform, both in terms of social interaction and human-computer interaction (HCI). HCI with multiple senses and input methods (touch, smell, speech, etc.) was already studied intensively at Tampere University. When technology develops further, it becomes also possible to use it for a longer period, with more people, more casually and routinely as a part of daily work. However, VR does not suit everything and, therefore it is critical to study it more. The effects that relate to using VR technology are often underestimated (e.g., sensory immersion). Accordingly, there may be some psychological barriers as well, which we do not yet know much about. However, at first, faculty/staff/students of HE institutions need to learn the basics of VR technology.

In the context of SMEs, most of the respondents that we interviewed worked closely with VR and, therefore, training their staff was a critical part of their work. They either sell VR software or consult other companies in the use of VR. However, the industry seemed to have "clusters of VR enthusiasts" instead of organized, large-scale VR training. Hiring individuals with proper VR competence is a crucial starting point in this sense as well. Companies need employees who can train other employees about VR.

Interviews indicate that training needs for SMEs could be summarized into five parts: (1) what VR is and what it enables, (2) how to use VR (controls, hardware), (3) what VR software/platforms already exists, (4) how VR could potentially affect to the specific industry (e.g. construction, education), and (5) understanding other emerging technologies that could be potentially be utilized with VR (now and in the future).

# 5 Discussion

This study provided a state-of-the-art analysis of VR adoption in HEIs and SMEs in Cyprus and Finland. The study's objective was to highlight interviewees' key experiences in terms of VR-related opportunities, barriers, and training needs.

The findings of this study showed that experts in both HEIs and SMEs anticipate that VR technology is likely to have an impact on education and business [2, 3]. They expect that VR allows finding new ways of working and opens new business opportunities. Many of

the benefits and strengths of VR are specifically in visualization, simulation, training, and remote collaboration [9, 10]. The major benefits relate to immersion in VR and interacting with 3D content and other users. However, the findings show that there is still no clear vision of integrating these technologies in a stable way into an educational or institutional process. In this regard, there are many challenges and difficulties in implementing and adopting such new technologies. The findings illustrate both technological and human-related issues. The availability of hardware and devices has been identified as one of the major bottlenecks. However, considering the quick evolution of stand-alone devices (such as Oculus Quest), the use of VR is more feasible and affordable for educational institutions and businesses than ever before. These devices can potentially scale VR adoption as these devices can provide seamless access to both business and education-related applications. Indeed, HEIs and SMEs consider that the increase in accessibility and affordability, like mobile technologies, is a key driver for wider adoption. Consequently, it will be possible to conduct immersive experiences by interacting with objects, concepts, or processes, as a regular learning workflow at any educational level, from primary school to higher education [10]. As all participants agree, what makes VR so important is the fact that it can promote knowledge and support learners to achieve something new.

The findings also highlight that the wider adoption of VR is highly dependent on overcoming the training needs of HEIs and SMEs for such an emerging technology. The findings showed that awareness and skills need to be increased on multiple levels, such as on essential IT skills, content creation, installing and setting up the VR environments and business/educational potentials of VR. This means that both HEIs and SMEs should react to these training needs and set up sufficient support structures to smooth the adoption.

## 5.1 Implications and future research topics

As our findings indicate, VR has major benefits that can be realized probably in a short time span. However, much has to be done. Following our interview data, it is argued that VR can provide significant benefits for training and business renewal. We wish to highlight that VR is essentially interesting for disciplines and businesses dealing with 3D content of either real-life or imaginary objects, such as buildings and cities that have not been designed yet. VR is likely to add value over other technologies when individuals can immerse themselves with such content and objects and interact with them in ways that they couldn't in real-world settings, such as when the car, engine or building does not exist in the physical world. Future work should explore and compare effective ways to transform current ways of learning and working in VR.

Another positive takeaway is regarding overcoming the major obstacle of affordable hardware. This obstacle has kept wider adoption at bay and made it unrealistic to consider large-scale use of VR for students or employees. We wish to highlight that the developments in stand-alone VR devices (that work ubiquitously like mobile phones and do not require a powerful laptop to run) has shaped the VR industry in the last couple of years. The most advanced solution is Oculus Quest by Facebook, but alternative stand-alone devices are coming to the market at an increasing speed. The critical need from our respondents was in enabling affordable access to new collaborative spaces between users, allowing new VR-based collaborative environments to emerge. The takeaway here is that many of these applications are already available for stand-alone devices, such as Oculus Quest. Currently, many of the applications that run on stand-alone devices cannot deploy the computing power of expensive PCs and thus, cannot run complex 3D models that would look as realistic as objects in the physical world. However, these applications already enable students, team workers and businesses to meet each other in a multi-user environment. Thus, supporting the synchronous connection of many users from different parts of the world. Therefore, the ideal solution would be to invest in applications that will provide the learners and employees with a chance to interact with the virtual world and each other seamlessly and ubiquitously. Future research should study how such interactive and multi-user VR environments can create value for both learners and employees.

Another key takeaway of the study is that there is a lack of awareness and practical training offerings to fill the knowledge gap to unlock many of these benefits. As such, existing offerings with university curriculums and training programs are either missing or limited. Future work on VR should find out optimal ways to transfer key knowledge of VR to both HEIs and businesses. We urge institutions to set up training programs for the adoption of VR at multiple educational levels. The basic skills related to the use of VR should be embedded in school systems prior to entering higher education, whereas the learning and business-related potentials and applications should be actively explored in the curriculum of various disciplines, ranging from mechanical engineering to business management.

To conclude, as all participants of our study believe, VR will gain much importance in education and other industries. The enormous possibilities have been identified in this and other related studies. The good news is that technologically, the platforms and ecosystems, computing power and bandwidth, hardware and software of VR have been taking major leaps in the last three years and the technology is ready to spread widely. However, to allow this to happen, both providers and user organizations must do much. Co-creation needs to take place on educational- technological and research levels to realize the potentials and overcome the remaining bottlenecks. The first essential step is to tackle the critical training needs discussed in this study.

## ACKNOWLEDGMENTS

This research was co-funded by Erasmus+ project VRinSight (2018-1-DE01-KA203-004277).

## REFERENCES

<bib id="bib1"><number>[1]</number>Business Finland. 2017. Retrieved from https://www.businessfinland.fi/en/whats-new/news/2017/finpro-and-tekes-uniting-as-business-finland </bib>
<bib id="bib2"><number>[2]</number>Christopher Dede J, Jeffrey Jacobson and John Richards. 2017. Introduction: Virtual, Augmented, and Mixed Realities in Education. http://doi.org/10.1007/978-981-10-5490-7_1</bib>

<bib id="bib3"><number>[3]</number>Christian Pierre Fabris, Joseph A. Rathner, Angelina Yin Fong and Charles Philip Sevigny. 2019. Virtual Reality in Higher Education. International Journal of Innovation in Science and Mathematics Education (formerly CAL-laborate International), 27(8), p. 69-80.</bib>
<bib id="bib4"><number>[4]</number>CIVIT- The Centre for Immersive Visual Technologies. 2020. Retrieved from https://civit.fi/about/ </bib>
<bib id="bib5"><number>[5]</number>Experimental Psychology Lab (EPL). Retrieved from https://experimentalpsych.com/ </bib>
<bib id="bib6"><number>[6]</number>Forbes. 2019. The Varjo VR-1: Everything You Need To Know About The Highest-End VR Headset In The World, https://www.forbes.com/sites/jessedamiani/2019/02/19/the-varjo-vr-1-everything-you-need-to-know-about-the-highest-end-vr-headset-in-the-world/#77d8ef225b91Chelsea Finn. 2018. Learning to Learn with Gradients. PhD Thesis, EECS Department, University of Berkeley.</bib>
<bib id="bib7"><number>[7]</number>Henri Jalo, Henri Pirkkalainen, Osku Torro, Mauno Lounakoski and Jukka Puhto. 2020. ENABLING FACTORS OF SOCIAL VIRTUAL REALITY DIFFUSION IN ORGANIZATIONS. Proceedings of the European Conference on Information Systems (ECIS 2020), Research Papers, 7.</bib>
<bib id="bib8"><number>[8]</number>Institute For the Future (IFF). Retrieved from https://www.unic.ac.cy/iff/about-iff/ </bib>
<bib id="bib9"><number>[9]</number>Isabell Wohlgenannt, Jennifer Fromm, Stefan Stieglitz, Jaziar Radianti and Tim A. Majchrzak. 2019. Virtual reality in higher education: Preliminary results from a design-science-research project.</bib>
<bib id="bib10"><number>[10]</number>Jaziar Radianti, Tim A. Majchrzak, Jennifer Fromm and Isabell Wohlgenannt. 2020. A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education, 147, 103778.</bib>
<bib id="bib11"><number>[11]</number>Khalifa Elmusharaf. 2012. Qualitative data collection techniques. Training Course in Sexual and Reproductive Health Research. Geneva </bib>
<bib id="bib12"><number>[12]</number>Lioness Ayres. 2008. Semi-structured interview. The SAGE encyclopedia of qualitative research methods 1, 810-811</bib>
<bib id="bib13"><number>[13]</number>Manninen Janne-Pekka. 2019. VR headset developer Steven LaValle chose Oulu. https://www.oulu.fi/itee/news/stevenlavalle</bib>
<bib id="bib14"><number>[14]</number>Margaret C. Harrell and Melissa A. Bradley. 2009. Data collection methods. Semi-structured interviews and focus groups. Rand National Defense Research Inst santa monica ca.</bib>
<bib id="bib15"><number>[15]</number>Mel Slater and Maria V. Sanchez-Vives. 2016. Enhancing our lives with immersive virtual reality. Frontiers Robotics AI, Vol. 3, pp. 1–47. https://doi.org/10.3389/frobt.2016.00074</bib>
<bib id="bib16"><number>[16]</number>Microsoft Computer Games and Emerging Technologies Research Lab (GET Lab). Retrieved from http://getlab.org/ </bib>
<bib id="bib17"><number>[17]</number>Steve Bryson. 1995. Approaches to the successful design and implementation of vr applications. In R. Earnshaw, J. Vince, and H. Jones, eds., Virtual Reality Applications. San Diego, CA: Academic Press, 3–15.Sam Anzaroot and Andrew McCallum. 2013. UMass Citation Field Extraction Dataset. Retrieved May 27, 2019 from http://www.iesl.cs.umass.edu/data/data-umasscitationfield</bib>
<bib id="bib18"><number>[18]</number>Tampere Unit for Computer-Human Interaction. Retrieved from https://research.tuni.fi/tauchi/ </bib>
<bib id="bib19"><number>[19]</number>The Research and Innovation Centre on Interactive Media, Smart System and Emerging Technologies – CYENS Centre of Excellence. Retrieved from https://www.cyens.org.cy/en-gb/ </bib>
<bib id="bib20"><number>[20]</number>Ulrike Schultze and Michel Avital. 2011. Designing interviews to generate rich data for information systems research. Information and organization 21, no. 1, 1-16.</bib>
<bib id="bib21"><number>[21]</number>Varjo. 2020. Retrieved from https://varjo.com/ </bib>
<bib id="bib22"><number>[22]</number>Visual Media Computing Research Lab. Retrieved from https://vmc.cut.ac.cy/ </bib>
<bib id="bib23"><number>[23]</number>VR/AR industry of Finland, Tekes. 2017. Retrieved from https://fivr.fi/survey2017/</bib>
<bib id="bib24"><number>[24]</number>William R. Sherman and Alan B. Craig. 2003. Understanding virtual reality. San Francisco, CA: Morgan Kauffman (2003).</bib>