Virtual Reality for Developing Intercultural Communication Skills of Engineering Students

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Abstract. Nowadays, virtual reality (VR) systems gain popularity in various applications ranging from space to entertainment. Education took up this challenge thus promoting virtual reality into the learning environment, first of all, in teaching science and engineering. Courses in humanities, however, are often ignored, though they have a great potential of applying VR techniques to develop students’ soft skills, intercultural communication among them. To bridge this gap, the paper aims at analyzing the demand for VR, the experience in virtual reality and readiness of Master’s degree engineering students for taking courses with immersion into virtual reality, using the example of intercultural communication courses. The authors analyzed recent publications in research journals and conference proceedings on the use of VR tools in higher education paying special attention to engineering curricula. The authors also conducted a survey among 87 MSc students focusing on the degree to which students are familiar with VR and ready to study through immersion into VR. The overall analysis of the survey results revealed that the students have a limited experience of using VR in any applications but most of them are ready for this experience in education. Based on these interpretations of the survey results, the authors made an attempt to develop a draft course to introduce elements of VR into EFL teaching for engineering students. Further research can be done to disseminate the initial experience of VR applications and to update the course developed.

Keywords: Virtual reality · Intercultural communication · Engineering students

1 Introduction

The modern globalized world made communications between the nations and countries easy. Higher education as part of this global world is following the same internationalization trends with the changing roles of professors and students [1] and multiple academic mobility programs [2, 3] within the European Union and beyond [4].

The recent COVID-19 outbreak, however, changed many of the academic mobility practices, urging students and faculty members to stay home. These circumstances lead to new scenarios of using digital technologies, and virtual reality can substitute mobilities inside or outside the country [5].
Any immersive virtual reality is a communication process, either between a human and artificial intelligence or between humans mediated by computers through additional visual and sensual effects. We are already facing VR under different circumstances such as 3D movies and google watch. Virtual reality systems gain popularity in various applications ranging from space to entertainment. Therefore, university students should be aware of the use of VR tools in order to be competitive in the globalized world [6] and ready for cross-cultural communications [7, 8].

Education took up this challenge thus promoting virtual reality into the learning environment. Some studies propose that VR can be very effective as an instructional media. There are great prospects for the use of VR which are nowadays limited due to a number of technical problems, including high requirements to computer hardware and software.

At the same time, many researchers state that these problems will be solved in the nearest future. This will lead to a paradigm shift in the whole educational process, where VR will be an indispensable component of teaching and learning. VR technologies can be further used for intensification of professional training [9]. Nowadays, however, there is still insufficient empirical data as in regard of VR efficiency in teaching and learning.

Secondary schools are actively testing VR tools, both in primary and secondary education and in different subjects. Being digitally native, schoolchildren very quickly adopt these new technologies and show a growing motivation to study subjects with the use of VR [10, 11].

VR is also making its way to higher education through different courses. These technologies are used, first of all, in teaching courses related to science and engineering, where experimental practicums can be demonstrated, e.g. space engineering [12], architectural practice [13], or environmental engineering [14]. In these cases, VR is considered as an active learning method involving students with the course material through virtual practice [15].

VR tools, however, are often ignored in courses in humanities. There have recently been very few publications in research journals regarding VR in humanities, these discussions mainly occur during conferences or round tables.

To bridge this gap, the paper aims at analyzing the demand for VR, the experience in virtual reality and readiness of MSc students for taking courses with immersion into virtual reality to study humanities and languages.

## 2 Methods

The authors started with theoretical analysis of recent publications in research journals and conference proceedings on the use of VR tools in higher education paying special attention to engineering curricula. Numerous recent years publications have supported the authors’ ideas on the fast dissemination of VR tools and their application in teaching.

The authors decided to introduce a course in intercultural communication into an engineering MSc curriculum in the academic year of 2020/21, and received seed
financing from one of the national foundations to buy a VR headset, a 3D camera, computer hardware and software.

In order to have a better understanding of the MSs students’ expectations in regard of VR use in education, the authors developed an online questionnaire using SurveyMonkey free tools and conducted a survey among 87 MSc students. The survey focused on the degree to which students are familiar with VR and ready to study through immersion into VR. They survey included 10 questions.

The questions were of two types: close-ended and open-ended. The close-ended questions included multiple choice questions concerning the definition of virtual reality, the presence of experience of using VR, the plans to own a VR headset, the importance of a free English language command in order to use VR tools, the readiness to use VR in teaching and learning, and the expected effect of VR use on academic progress.

The survey included two close-ended rating scale questions. In the first question, the respondents had to rate the following spheres of VR application: education, computer games, leisure time, retail, and work. In the second question, the respondents set their priorities for the use of VR tools in the following university curriculum components: natural sciences, engineering sciences, humanities, foreign languages, experimental practicums.

The two open-ended questions included the description of the respondents’ experience of using VR tools (if any), and additional spheres of human activities where VR tools could be useful.

Through summarizing the results for close-ended questions and content analysis for open-ended questions, the authors categorized the survey results thus arriving at conclusions regarding the prospects of VR in developing soft skills of engineering students [16].

Based on the results of the theoretical analysis of recent research and publications and the empirical survey results, the authors drafted elements of a course in intercultural communication with the use of VR tools for MSc students majoring in Innovation Management [17] and Smart Materials [18] degree programs. The authors bear in mind that in the future, the course can be also used in other degree programs [19, 20].

3 Results and Discussion

3.1 Survey Results

Recent publications in research journals and conference proceedings show a great interest toward VR tools in education [21].

In order to reveal the factors contributing to the use of VR in higher education environment, the authors conducted a survey on VR among 87 MSc students. The survey gave the following results.

The majority of respondents, 73 survey participants (84%) chose a correct definition of virtual reality as the world created by technical tools communicated to a person through his or her perceptions. At the same time, 6 survey participants (7%) thought
that VR is the same as a computer play station, and 8 respondents (9%) considered VR to be an imaginary world of a person’s emotions and relationships.

Out of 84 respondents, only 29 (33%) had an experience of using a VR headset. They listed the following popular locations where they had this experience: game clubs (10 respondents, 11%), retail shopping centers (7 respondents, 8%), home (6 respondents, 7%). Only 48 respondents (55%) want to own a VR headset. These answers suggest that VR tools and technologies are still available for a limited number of people, even those in the higher education, and, there is a great potential for the growth of interest in this sphere.

Table 1. Ranks of potential VR application spheres in % of the responses from 87 respondents.

| Spheres of VR application | Rank 1 | Rank 2 | Rank 3 | Rank 4 | Rank 5 |
|---------------------------|--------|--------|--------|--------|--------|
| Leisure time              | 25.61% | 28.05% | 19.51% | 17.07% | 9.76%  |
| Computer games            | 35.71% | 14.29% | 11.90% | 10.71% | 27.38% |
| Education                 | 18.07% | 22.89% | 37.35% | 16.87% | 4.82%  |
| Retail services           | 4.94%  | 13.58% | 24.69% | 30.86% | 25.93% |
| Work                      | 14.46% | 21.69% | 6.02%  | 24.10% | 33.73% |

In rating the spheres of potential VR applications (see Table 1), 30 respondents (36%) topped computer games which were followed by leisure time chosen number two by 23 respondents (28%), education selected by 31 respondents (37%) as priority number 3, retail services ranked number 4 by 25 survey participants (30%), and work rated number 5 by 28 respondents (34%). Among other spheres of VR applications, 10 respondents suggested travelling, 7 respondents voted for medicine, and 5 respondents offered sports. Only 63 respondents (72%) think that a free English language command is necessary for an efficient use of VR tools. These answers show the interest to VR in different spheres, education, however, not being in the top position.

Table 2. Ranks of courses to be taught using VR in % of the responses from 87 respondents.

| Spheres of VR application | Rank 1 | Rank 2 | Rank 3 | Rank 4 | Rank 5 |
|---------------------------|--------|--------|--------|--------|--------|
| Natural sciences          | 28.05% | 18.29% | 28.05% | 14.63% | 10.98% |
| Engineering courses       | 25.93% | 29.63% | 17.28% | 14.81% | 12.35% |
| Humanities                | 9.76%  | 10.98% | 21.95% | 24.39% | 32.93% |
| Foreign languages         | 15.85% | 14.63% | 12.20% | 32.93% | 24.39% |
| Experimental practicums   | 21.69% | 26.51% | 19.28% | 12.05% | 20.48% |

At the same time, 57 respondents (66%) are ready to study at the university with the use of VR tools with the following priorities as for the course taught through VR technologies (see Table 2): engineering courses top the list followed by natural sciences, experimental practicums, foreign languages, and humanities. 59 respondents
(67%) think that VR tools will improve the efficiency of their education. Thus, the majority of students are ready for infusing VR tools into their university education.

The overall analysis of the survey results revealed that the students have a limited experience of using VR in any applications. Only half of them are willing to own VR devices at home, but over 65% of the students are ready to infuse VR into their university classes. Students are more likely to assume that VR can be useful in engineering courses rather than in humanities. Nevertheless, as much as 72% of the respondents understand the importance of the English language in using VR tools, although only 16% of the survey participants consider foreign languages as the top priority for studies with the use of VR.

3.2 Draft Course Development

Based on these interpretations of the survey results, the authors proceeded to develop a draft course to introduce elements of VR into EFL teaching for engineering students. Alongside with VR, the course uses the recent approaches to development of communicative competences in a foreign language [22–24]. This VR based course will be introduced into the curriculum in the next academic year.

The VR course was inspired by similar experience of the university international partner in the USA. This university opened the VR learning center for students who study English, Spanish, Chinese, Japanese and Russian as foreign languages.

The course content is based on several technologies, which can be used to create a VR learning environment. First, a VR station was purchased: a VR headset with 4K video capabilities and a computer that supports a VR environment. The VR station is also equipped with a projector and a projection screen. The basic idea behind this VR station is that every student in a language learning group (10–15 students) can experience VR immersion during a class, which usually lasts two academic hours. Other students stay also involved into this student’s current VR experience by watching the respective video on the screen.

The software selected for the introduction of EFL students to VR is Google Earth VR. The advantage of this free software is that students can get a truly immersive experience of virtual visiting almost any space in the world and feel the language environment around them. Such virtual visits to London or New York can be accompanied with teacher’s comments in English or publicly available tour guide audio materials.

Another important consideration behind this draft course is to provide opportunities for students themselves to be involved into the course content development. The course equipment also includes a 360 VR video camera, which students can use to make their own immersive videos with comments in English or conversations with native speakers. Such videos were first shot and tested by the project team and turned out to be efficient tools for EFL learning with VR.

The course, therefore, includes 3D videos made by the students in the potential work setting environment. For example, such videos include visits to innovative parks with chemical laboratories, production facilities and administrative offices. With a VR headset on, a student can take a tour of this work setting, listen to the employees describing their responsibilities, or practice his English to describe the environment.
The third technology is based on modern software that can generate virtual environment. The project team processed 360 panoramic photos and videos with Adobe Creative Cloud software (Adobe Photoshop for images and Adobe Premiere Pro for videos) to add learning components such as vocabularies into a VR environment.

The course will be taught as a semester-long discipline in a special room, which has been modified to accommodate a VR station for a group of EFL students. The course consists of several consecutive steps. First, the teacher introduces VR learning materials to students and provides basic instruction of how to use VR for learning (2 academic hours). Then, students get familiar with VR first with Google Earth VR (4 academic hours). The further step is watching VR-videos with comments of native speakers and developing skills of listening, comprehension, and interpreting (10 academic hours). The next stage is focused on VR visits to professional business or research facilities, such as innovative parks and/or chemical laboratories (12 academic hours). The final stage is the student EFL project: students make a VR-video presentation in English and show it to their groupmates with the VR station (8 academic hours for preparation and presenting by all students in the group).

Students can also use the VR content (videos and images) privately with their smartphones and compatible VR headsets as part of their extracurricular activities. The project team, however, preferred modern high-quality desktop-based VR headset as it provides a truly immersive experience, so we can feel the advantages of the VR-based learning.

4 Conclusions

The authors draw on a conclusion that VR is inevitable in higher education, engineering degrees in particular. The popularity of distance learning programs contributes to the need of using virtual reality techniques in both engineering courses and humanities.

These techniques create a new game like learning environment for the digitally native students and encourage them to invest more time and effort into developing soft skills. The English language virtual reality resources develop intercultural communication skills of the students in any courses learned.

Survey results and the experience of university partners in implementing similar projects resulted in development of a VR EFL course for engineering students. This course uses several key VR technologies available for universities, such as VR headsets, panoramic VR cameras and software for creating and processing the VR content.

An important component of an EFL course with VR technologies is involvement of students in development and/or upgrading the course content. It is recommended for VR course developers to consider adding student projects to the course curriculum, so students can develop their own VR content with available technologies. For EFL, such an approach provides additional motivation for students to learn English in an immersive environment offered by virtual reality.
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