Designing a virtual environment for teacher training: Enhancing presence and empathy

Kalliopi Evangelia Stavroulia
Visual Computing Media Lab
Cyprus University of Technology
Limassol
3036
Cyprus
kalliopi.stavroulia@cut.ac.cy

Evangelia Baka
MIRALab
University of Geneva
Carouge
1227
Switzerland
ebaka@miralab.ch

Andreas Lanitis
Visual Computing Media Lab
Cyprus University of Technology
Limassol
3036
Cyprus
andreas.lanitis@cut.ac.cy

Nadia Magnenat-Thalmann
MIRALab
University of Geneva
Carouge
1227
Switzerland
thalmann@miralab.ch

ABSTRACT

Virtual Reality(VR) is still an emerging technology in terms of recognizing its full potential in education and specifically in teacher education. A key issue of a VR-based approach for teacher training, is the level of presence along with the empathy inflicted on the trainees that will allow them to experience realistic and emotion-rich classroom situations in a virtual environment. This paper describes an experiment that aims to assess the influence of the graphical realism of a virtual classroom to the levels of presence and development of empathy skills for trainee teachers. Moreover, a second objective is to investigate whether there are significant differences between training in a VR classroom and a real physical classroom and how this affects the trainee teacher. The overall conclusion of the experiment is that the design of the VR classroom environment influenced the levels of immersion and presence. Moreover, according to the results there are serious indications that the VR system provided users the immersion necessary for the development of embodied thinking skills and thus of empathy in relation to multiculturalism.

KEYWORDS

Virtual reality, presence, empathy, teacher training

CGI 2018, June 11–14 2018, Bintan Island, Indonesia
© 2018 ACM. 978-1-4503-6401-0/18/06...$15.00
https://doi.org/10.1145/3208159.3208177

ACM Reference format:

Kalliopi Evangelia Stavroulia, Evangelia Baka, Andreas Lanitis and Nadia Magnenat-Thalmann. 2018. Designing a virtual environment for teacher training: Enhancing presence and empathy. In *Proceedings of Computer Graphics International 2018 (CGI 2018). ACM, New York, NY, USA, 11 pages.* https://doi.org/10.1145/3208159.3208177

1 INTRODUCTION

The objective of this research is to present new opportunities for improving teacher education via using a virtual reality (VR) based framework. Research revealed several advantages of using VR in education with the most important one being the ability of such an environment to mimic real-world situations allowing the users to experience realistic learning experiences that are transferrable to the real world. VR can provide teachers an absorbing, realistic and interactive virtual classroom, allowing them to engage in realistic interactions with virtual students. The sense of presence plays a key role for the success of such a VR environment, as it helps the users to evaluate their experience within it.

The current research aims to utilize VR technology for providing teachers the opportunity to live the life of someone else, and more particularly the life of their students, allowing them to experience different perspectives that will help them understand their students' point of view. In an attempt to create real-life class situations, the scenarios of the VR application were formulated based on an extensive literature research, survey and interview with experts of education. The ultimate aim is to target the cultivation of teacher's empathy skills by providing them the opportunity to take the perspective of the student, but without losing the integrity of their own existence. Even though research relative to the use of VR in education is constantly growing, most of the studies focus on the use and impact of this technology on the students. Research on the implementation of VR in teacher training is still at its infancy providing little insight into their impact in the preparation of teachers. Addressing the lack of research in the use of VR in teacher education, this paper describes an experiment that aims to investigate whether the design and the graphical realism of a virtual classroom for teacher training affected participants' sense of presence and cultivation of empathy, in order to help us understand whether there are specific parameters that need to be considered when designing a VR system for this specific target group [1, 2]. For this reason, two different VR systems were developed, one based on real classroom appearance and one based on an imaginary class, in order to compare users' experiences in the different VR environments and investigate possible differences. Moreover, as part of the experiment there was also a group that was trained in real time in a real classroom, in order to compare the differences among the three groups regarding presence and identify whether teacher training via VR is more effective when compared to simulated training in a real classroom.

The present study contributes to existing literature regarding the use of VR in the field of education and specifically teacher education providing new insights and posing new challenges for further research. The results obtained contribute to the process of designing an optimum virtual classroom environment for teachers that caters for the pedagogical needs of the trainees [3]. For this reason, equal emphasis was placed both in the graphical representation of the virtual class world and in the scenario of the application. Along these lines, the scenario of the application should reflect real problems and needs of teachers in order to motivate them to get engaged with the application. Moreover, the proposed VR application aims to address the cultivation of empathy skills to teachers, something that has not been done before with this specific target group in VR environments. Empathy is a skill that is considered of paramount importance for teachers yet has been neglected by most competence models [4, 5]. For the needs of the experiment, user responses were recorded using questioners and EEG signals. However, in this paper emphasis is given to the analysis of questioner-based responses.

2 LITERATURE REVIEW

To clarify the scope and the objectives of this research, this a short description of the problem of teacher training, that the proposed VR system aims to address, is presented.

2.1 VR for Teacher Education

The quality of teacher training has received significant attention within Europe's Strategy 'Education and Training 2020', as teachers are a key component in shaping future generations of learners [6]. However, research results indicate several significant problems in teacher education that undermine the quality of teachers and thus of education itself. The most significant problem is the lack of practice in teacher education programmes. Most universities but also lifelong learning programs for teachers do not provide on the job experiences or practicum that would give teachers the opportunity to learn on the job through the experience of their colleagues, instead of using trial and error techniques in the classroom, risking harming the students [4].

Hence, there is a theory-practice gap that needs to be addressed that will lead to high-quality and well-trained teachers leading to high-quality education [7]. Virtual Reality (VR) could offer an effective way for experiential learning that bridges the gap between theory and practice towards this end. VR can offer teachers engaging and immersive experiences, allowing them to experience real world classroom situations which require rapid thinking and quick analysis for effective management. VR-based learning can be the way to develop teachers' professional knowledge, skills, and competencies, whilst protecting students from unnecessary risks. A suitable virtual-reality framework can be used to support teachers' continuous professional development through systematic individualized training. By taking advantage of virtual reality technology, the proposed framework will provide in-service and pre-service teachers a safe virtual classroom environment, within which they will be able to gain classroom teaching expertise, through experimentation but without the risk of harming real-life students.

The last few years, the use of virtual reality environments in education to foster learning has attracted the interest of the scientific community [8, 9, 10]. The most significant benefit of using virtual reality environments in learning is that they provide users the opportunity to experience situations that cannot be accessed physically [11]. Moreover, virtual reality environments increase learner's involvement and motivation while the support many different learning styles [11].

Despite the extensive use of virtual technology in fields such as medicine and military, in the field of teacher education its use is extremely limited. However, preliminary investigations revealed that the use of such a methodology in teacher preparation has considerable potential. Previous research results indicated the positive impact of VR training in teachers' ability to understand and detect students' possible disorders such as vision disorders [12] or identify and deal with bullying-related issues [13]. Constant training within the virtual environment will better prepare teachers and will ensure their survival in todays' digital and multicultural classrooms.

By the same token, virtual classroom environments aim to provide an innovative training tool that can be used for constant professional development and update of teachers' skills so that teachers can remain productive [14]. Furthermore, the use of virtual environments will allow teachers to take control of their own learning, monitor their progress and thus learn more. Equally important is that the virtual environment will provide immediate feedback and data that in an actual classroom would be difficulty to identify [14].

2.2 Empathy and Presence in VR Training Tools

Empathy is considered a skill of paramount importance for teachers especially nowadays that they are dealing with a multicultural student population with different needs that must be addressed equally.

Empathetic teachers can better understand the needs and individualities of students [15]. Additionally, empathy skills allow teachers to put themselves in pupil's position, understand their psychology and behavior that will not only help them establish a strong relationship with the students but also help them maintain student's attention and motivation within the classroom [15]. Skills of empathy can promote the development of a strong relationship between teachers and their students. Consequently, this relationship can promote students' motivation, especially of diverse students, and their openness and attentiveness, but also can help teachers adjust their teaching practice and strategies to meet the needs of their culturally diverse classroom [16, 17]. Therefore, it is essential that teacher education programs promote the development of empathy skills, to enhance teachers' ability to manage effectively the needs of the diverse student population [17].

Even though empathy skills are considered of significant importance in teacher training, to the best of our knowledge they are not included in most teacher education competence models. Empathy is considered a key competence to the model developed by the National Institute of Education (NIE) in Singapore [7]. This lack of empathy to European competence models in conjunction with advice by experts of education formed the basis for investigating the possibility of enhancing teachers' empathy skills via VR-based training. VR offers the users the opportunity to live the life of someone else getting an idea of what someone else's life might be like [18]. This fact makes VR a potential future tool in the cultivation of teachers' empathy skills by allowing them to experience the viewpoint of their students.

According to Carey et al. [19], VR is considered to be an empathy-inducing medium. VR experience provides the user the immersion necessary for the development of embodied thinking skills and thus of empathy [19]. An immersive virtual environment can surround the user leading to high levels of presence, which means that the users feels being there inside the virtual world [8]. To achieve embodiment in a VR system it is essential to achieve a sense of presence in a VR system that has been achieved when the users report a sensation of being in the virtual world ('you are there') [20].

Lombard and Ditton [21] argue that a strong sense of presence can be achieved if human senses are activated. The more senses are activated the stronger the sense of presence is. Therefore, senses of smell, body movement and touch in a VR system is more likely to contribute to a stronger sense of presence. Moreover, Lombard and Ditton indicate several factors that can contribute to a stronger sense of presence but at the same time they point out that further research is required to the field. One factor seems to be visual displays, like the quality of the image or the viewing distance, the color or the movement of images, the third dimension of depth, the camera's point of view can affect participants feeling of being a part of the environment and thus can affect the levels of sense of presence. Important seems also to be user's movement as the body movement in the physical world can affect presence. Equally important is the interaction of the user in the VR environment and the response of the system in the users' input can also affect presence.

One significant aspect of VR systems is that they provoke presence that affects positively skill training. This is a significant advantage of VR systems and for this reason they are used for training purposes even in fields such as military, surgery and pilot training, as they are more beneficial than low presence media such as textbooks. Thus, the sense of presence plays a key role in a VR system. Several studies have been conducted on the topic of presence, however, further research is required to investigate presence in relation to our application of teacher training [20, 21].

3 EXPERIMENTAL SETUP

In this section we describe the experimental set up used as the basis of our investigation that aims to assess the suitability of VR for training teachers to deal with multi-cultural classes.

3.1 Classroom Scenes

As part of the experiment three different class scene settings were used:

- Virtual Environment with Realistic Appearance: An important aspect that had to be taken into consideration for the design of the virtual classroom was the resemblance of the scene to a real classroom, to create the users a strong sense of presence in the virtual environment. For this reason, the 3D models of the virtual classroom were designed based on real classrooms (see figures 1 and 2).

Figure 1: Real classroom environment

Figure 2: The Virtual environment with realistic appearance in Unity

- Virtual Environment with Imaginary Appearance: As system design requires considering the target group, during the development of the VR system and after discussion with education experts, some expressed the opinion that the virtual world should have different appearance than a real classroom setting. Therefore, a second imaginary virtual environment was developed (see figure 3).

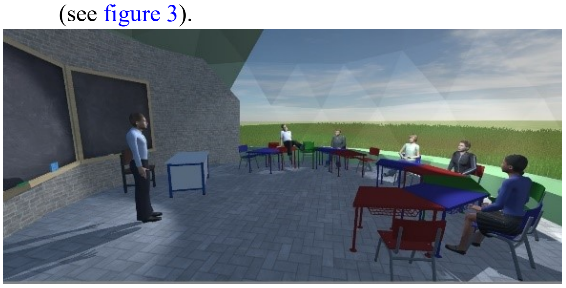

Figure 3: The imaginary virtual classroom environment in Unity

- Physical (Real) Class Environment: A physical classroom space with real students participating in the scene, was also used (see figure 4).

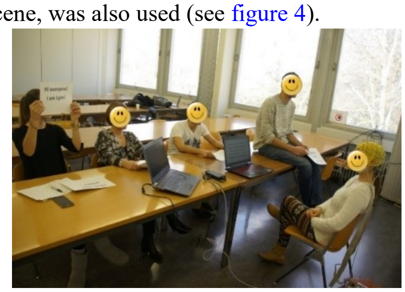

Figure 4: The real classroom setting during the experiment

Three groups participated in the experiment, each consisting of 11 participants and each experienced a different classroom setting among the three variations described above. The first group, Virtual Realistic group (VR.group) executed all the tasks in a Virtual Environment based on a real classroom setting. The second group, Virtual Imaginary group (VI.group) executed the tasks in the Virtual Imaginary classroom Environment. Finally, the third group, Physical Space group (PS.group) experienced the same scenario in a Physical classroom.

3.2 Scenario

The scenario of the application deals with multiculturalism and verbal bullying in a typical school classroom environment. According to the scenario, the teacher introduces a new foreign student called Lynn to the classroom. Following her introduction to the class, Lynn receives verbal bulling from her Caucasian classmates. The user-teacher was given the opportunity to view the whole experience in the virtual class from two different perspectives.

- Perspective I: The participant-teacher views the scene from the eyes of Lynn.
- Perspective II: The participant-teacher views the scene from the eyes of the teacher.

The scenario and the dialogues were the same at both perspectives, the only difference was the camera position allowing the user to observe the bulling incidents initially through the eyes of the student (Perspective I) and then through the eyes of the teacher (Perspective II). Examples of views from the perspective of the student and the teachers are shown in figures 5 and 6 respectively.

Figure 5: View through the eyes of the student in the imaginary virtual classroom environment

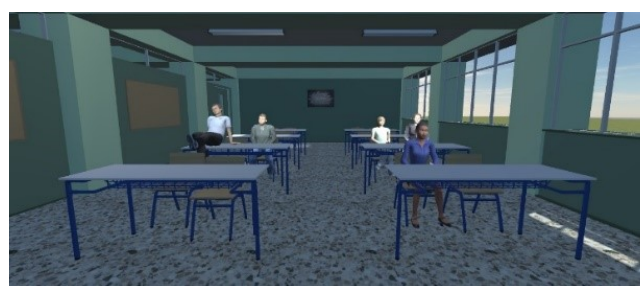

Figure 6: View through the eyes of the teacher in the realistic virtual classroom environment

3.3 Application development

The VR application was developed with the Unity© game engine. The 3D avatars (teachers and students) were created using the online software Autodesk® Character Generator. The VR system that was used for the experiment included the Head Mounted

Display (HMD) VIVE (see figure 7). Moreover, to maximize the sense of presence, users could see some part of their virtual selves, their hands, body and legs, to create a convincing illusion that they were part of the virtual classroom world.

Figure 7: One of the participants during the experiment wearing VIVE

4 METHODOLOGY

4.1 Participants

A total number of 33 participants (n=33) took part in the experiment all from higher education section. From the total number of the participants, 66.6% were male and 33.3% were female. Most of the respondents, 63.6%, aged from 25 to 29 years old. 27,3% aged from 30 to 39 years old, while two of the participants aged from 50 to 59 years old and one aged from 18 to 24 years old. Relative to teaching experience there are differences between the three groups. In the first group half of the participants (54.6%) had teaching experience from 1 to 2 years, while 36.4% claimed to have no teaching experience at all. On the contrary in the second group 72.8% of the participants claimed to have teaching experience from 1 to 5 years. As far as the third group is concerned 45.5% of the participants has teaching experience from 1 to 5 years, while 36.4% has experience from 6-10 years. Participants were not familiar with the use of virtual reality as half of the participants (57.6%) reported to have little experience in the use of VR.

4.2 Research Tools

Presence in VR systems is measured by dedicated questionnaires, which are beneficial to the development of the theories on presence [16]. However, questionnaires that have been used in presence research have been proven unreliable. For this reason, for the needs of the current research a reliable and validated questionnaire was used, named Igroup Presence Questionnaire (IPQ), that includes 14 items to measure presence (http://www.igroup.org). Moreover, for more reliable results EEG device was also used to measure the sense of presence, and more specifically BIOSEMI Active Two 64 channel amplifier system (www.biosemi.com). Active electrodes were used in association with a headcap, on which the 64 electrodes were attached. However, it is not the scope of this paper to present and analyze the results obtained through the recording of EEG signals. For the measurement of empathy a questionnaire was developed based on several validated empathy instruments, but several modifications had to be made as none of the already existing instruments responded to the needs of the current research.

4.3 Experimental process

The research took place in Geneva, in December 2017. Before taking part in the experiment all participants were informed about the experiment, especially about the process with the EEG device and were assured that they had the right to withdraw at any time and for no reason. After voluntary informed consent was obtained, the scenario was explained to the participants with more details and the experiment began. After the end of the experiment the participants were asked to complete the questionnaire.

5 RESULTS

After the data has been collected they were analyzed with the use of SPSS software (Statistical Package for Social Sciences). Before the presentation of the SPSS results there is a need to clarify the names of the groups. The coding name in the analysis is VR.group (Virtual Realistic group), VI.group (Virtual Imaginary group) and PS.group (Physical Space group). Moreover, the results of IPQ questionnaire concern only the participants who experienced the VR environment, thus only VR.group and VI.group are included. The result section is divided into two sub-sections, the first one presents IPQ results and the other presents the results of the empathy scale.

5.1: Presence Results

IPQ questionnaire was only administered to the participants who experienced the virtual reality environment. Therefore, the following results concern only the two groups: VR.group and VI.group.

Cronbach's Alpha coefficient of internal consistency shows that the IPQ instrument has good enough reliability in our sample: Alpha=0.715.

IPQ items are divided to different presence components that are one G=General item, five items for SP=Spatial presence (the sense of being physically present in the VE), four items for INV=Involvement (measuring the attention devoted to the VE and the involvement experienced), and three items for REAL=Experienced Realism (measuring the subjective experience of realism in the VE) that are presented table 1 below.

Table 1: The sub-categories of IPQ questionnaire

IPQ categories	IPQ question items
G1	8. In the computer-generated world, I had a sense of 'being there'
SP1	9. Somehow, I felt that the virtual world surrounded me.
SP2	13. I felt like I was just perceiving pictures.
SP3	6. I did not feel present in the virtual space.
SP4	3. I had a sense of acting in the virtual space, rather than operating something from outside.
SP5	10. I felt present in the virtual space.
INV1	1. How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?
INV2	7. I was not aware of my real environment.
INV3	11. I still paid attention to the real environment.
INV4	14. I was completely captivated by the virtual world.
REAL1	5. How real did the virtual world seem to you?
REAL2	4. How much did your experience in the virtual environment seem consistent with your real-world experience?
REAL3	2. How real did the virtual world seem to you?
REAL4	12. The virtual world seemed more realistic than the real world.

Based on the above categorization of the IPQ items the data analysis revealed that regarding the general item that had to do with the sense of being there, the results revealed that participants felt a sense of being there in both groups. However, VR.group reported higher levels of presence (M=4.4, SD= 1.29) than the VI.group (M=3.6, SD 1.86).

Regarding spatial presence, the results indicate that participants at both groups felt moderately that the virtual world surrounded them (VR.group: M=3.6, SD= 2.16 and VI.group: M=3.5, SD=1.64). The experience within the virtual world did not seem to the participants as simply perceiving pictures, as the mean scores indicate that the participants in both groups tend from disagree to strongly disagree (VR.group: M=3.3, SD=1.68 and VI.group: M=3.9, SD= 2.14). Although for the general item regarding the sense of presence the result revealed good levels of presence for both groups, the negative question 'I did not feel present in the virtual space' revealed lower levels of presence as participants tend from slightly to moderately feel of being part of the virtual space (VR.group: M=2.8, SD= 1.68 and VI.group M=1.6, SD= 1.51). It is possible that the negative question confused the participants as many of them asked for clarifications during the completion of the questionnaire. Moreover, according to the results the participants did not feel very active within the virtual world (VR.group M=2.2, SD=1.17 and VI.group M=2.7, SD= 1.43). Finally, for the last item of the spatial presence the results revealed that the participants of both groups felt present in the virtual space (VR.group M=3.8, SD= 1.74 and VI.group M=3.6, SD= 1.81).

Regarding involvement, as far as awareness of the real environment is concerned, the participants of the VI.group (M=2.3, SD= 2.24) tend to be more aware of the real environment than the participants of the VR.group (M=3.1, SD= 1.92). Moreover, the results indicate a difference between the two groups regarding paying attention to the real environment. The VI.group (M=4.7, SD=1.86) tended to disagree of paying attention to the real environment, while the VR.group (M=2.7, SD=1.57) tends to agree. Regarding participant's awareness of the real environment the VI.group (M=3.8, SD=2.10) reported higher levels of awareness of the real environment than the VR.group (M=2.5, SD= 1.75). Furthermore, the participants of the VR.group (M=2.7, SD= 1.29) tend to disagree that they were captivated by the virtual world, while the participants of the VI.group (M=3.2, SD= 1.89) tend to agree that their attention was captivated by the virtual classroom.

Regarding realism, VR.group (M=3.8, SD=1.62) reported that the virtual world was unreal, while the VI.group (M=3.1, SD=1.51) scored more neutral. Regarding whether the experience in the virtual world was similar to the real environment the participants of both groups tend to be moderately consistent (VR.group M=3.0, SD=1.58 and VI.group M=3.2, SD=1.40). Regarding the similarity of the virtual world to the real world, VR.group (M=2.2, SD=1.72) participants tend more to the edge of the imaginary world, while VI.group (M=3.0, SD=1.73) participants are more neutral. Finally, the virtual world did not seem to the participants more realistic than the real world (VR.group M=0.6, SD=1.21 and VI.group M=13.0, SD= 1.35).

The results from the tests of normality (namely the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test), revealed that most of the items are below 0.05, therefore, the data significantly deviate from a normal distribution and non-parametric tests were used for the analysis. Mann-Whitney test was used to investigate possible differences between the two groups that used the VR application regarding the sense of presence. The hypothesis used are:

- The null hypothesis H_o: The two groups represented (VR.group, VI.group) have the same distribution of scores.
- The alternative hypothesis H_1: The two groups represented (VR.group, VI.group) do not have the same distribution of scores.

Mann-Witney test revealed a significant difference between the two groups regarding the time participants thought they interacted with the virtual world, as the p-value is $.012<0.05$. The participants of the VR.group (M=6.5, SD=2.42) through that their training within the VR environment lasted over 6 minutes, while the participants of the VI.group (M=3.8, SD=2.09) had the impression that their training within the VR environment lasted between 3 to 4 minutes. The results indicates that the participants of the VR.group were more immersed in the environment and though that they were within the virtual world more time than they actually stayed.

Regarding the perspective onto the virtual world (first person or third person) there are no statistically important differences between the groups. According to the results most of the participants (81.8%) understood correctly that within the virtual reality environment the users' viewpoint was first person perspective, while the 18.2% of the sample though that the users' viewpoint was third-person perspective.

Mann-Whitney test revealed that for nearly all items of IPQ the p-value is >0.05 and thus we accept the null hypothesis that there are no differences between the two groups that used the VR application concerning the sense of presence (see table 1 below). However, one item that is question 11 'I still paid attention to the real environment' has p-value .014<0.05, indicating a significant difference between the two groups.

Question 11 is related to participant's involvement to the VR environment and paying attention to the real environment. For the VR.group the mean is 2.6 (SD= 1.57) and for the VI.group the mean is 4.6 (SD 1.86). The mean values recorded, indicate that the participants of the VR.group tend to be 'moderately aware' of the real environment while they were using the VR application, while the means of the VI.group indicate that the participants tend to be 'slightly' to 'poor' aware of the real environment while they were using the VR. Therefore, there are indications that the participants of the VI.group were more immersed to the VR environment that the participants of the VR.group. However, this comes in contrast to the time participants though that they interacted with the virtual world as VI.group scored lower than VR.group.

A Spearman's rank-order correlation was run to determine the relationship between the items of IPQ for the two groups that used the virtual reality system. The results indicate that there is a moderate, positive correlation between the item 'experience in using virtual reality environments' and the item 6 'I did not feel present in the virtual space' (rs= .446, n=22, p= .038< .05). Thus, large values of experience in the use of VR are associated to large values of presence in the virtual space.

Moreover, the results revealed significant correlations among the 14 IPQ items. There is a strong positive correlation between the variable 8 'sense of 'being there' in the VR environment' and the variable 9 'Somehow, I felt that the virtual world surrounded me' (r_s=.698, n=22, p= .000< .01). Thus, large values of sense of 'being there' are associated to large values of sense of physical presence in the virtual space. There was significant evidence of a very strongly positive correlation between variable 8 and variable 10 'I felt present in the virtual space' (r_s=.882, n=22, p= .000< .01). There was also evidence that the sense of 'being there' is moderately positively correlated to variables 14 'I was completely captivated by the virtual world' (r_s=.566, n=22, p= .006< .01) and 2 'How real did the virtual world seem to you?' (r_s=.531, n=22, p= .011< .05), while there is also a moderately negative correlation to variable 5 'How real did the virtual world seem to you?' (r_s=-.591, n=22, p= .004< .01). Furthermore, there are evidence of a strong positive correlation between sense of 'being there' and variable 4 'How much did your experience in the virtual environment seem consistent with your real-world experience?' (r_s=.725, n=22, p= .000< .01).

There was also an evidence for a strong positive correlation between variable 9 'Somehow, I felt that the virtual world surrounded me' and variable 10 'I felt present in the virtual space' (r_s=.714, n=22, p= .000< .01), while there was also indication for a negative moderate correlation between variable 9 and variable 5 'How real did the virtual world seem to you?' (r_s=-.535, n=22, p= .010< .05).

A strong negative correlation exists between variable 6 'I did not feel present in the virtual space' and variable 11 'I still paid attention to the real environment' (r_s=-.605, n=22, p= .003< .01).

The results indicate a strong positive correlation between variable 3 'I had a sense of acting in the virtual space, rather than operating something from outside' and variables 10 'I felt present in the virtual space' (r_s=.720, n=22, p= .000< .01) and 7 'I was not aware of my real environment' (r_s=.688, n=22, p= .000< .01).

A strong negative correlation exists between variable 1 'How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?' and variable 11 'I still paid attention to the real environment' (r_s=-.609, n=22, p= .003< .01)

There are indications that there is a strong positive correlation between variable 14 'I was completely captivated by the virtual world' and variables 4 'How much did your experience in the virtual environment seem consistent with your real-world experience?' (r_s=.705, n=22, p= .000< .01) and 2 'How real did the virtual world seem to you?' (r_s=.605, n=22, p= .003< .01), while there is a strong negative correlation between variable 14 and variable 5 'How real did the virtual world seem to you?' (r_s=-.655, n=22, p= .001< .01).

There was significant evidence for very strong negative correlation between variable 5 'How real did the virtual world seem to you?' (real/not real) and variables 2 'How real did the virtual world seem to you?' (imagined/real) (r_s=-.961, n=22, p= .003< .01) and 4 'How much did your experience in the virtual environment seem consistent with your real-world experience?' (r_s=-.870, n=22, p= .000< .01), while there is also a strong negative correlation between variable 5 and variable 12 'The virtual world seemed more realistic than the real world' (r_s=-.679, n=22, p= .001< .01).

Finally, there are indications for a strong positive correlation between variable 4 'How much did your experience in the virtual environment seem consistent with your real-world experience?' and variable 2 'How real did the virtual world seem to you?' (r_s=.818, n=22, p= .000< .01).

5.2 Training via VR versus Physical Training

Within the questionnaire there was a question regarding the type of training participants would prefer after the experiment concerning the use of virtual reality or not. The question posed to participants used virtual reality was:

- 'Would you prefer your training within a real classroom setting without any technology instead of a virtual classroom?'

The question posed to the participants of the physical group was:

- 'Would you prefer your training within a virtual classroom (with the use of Virtual Reality technology) instead of a real classroom?'

The results indicate that for VR.group half of the participants 54.5% would not prefer training without the use of virtual reality technology. 27.3% would prefer not to be trained via virtual reality and two of the participants are undecided. Regarding VI.group 36.4% of the participants prefer training via VR, 27% of the participants would prefer training without the use of VR and a significant number of participants 36.4% are undecided. As far as the PS.group is concerned, the results indicate that more than half of the participants 54.4% strongly agree that they would prefer training with the use of VR technology. 27.3% of the participants would not prefer to be trained via VR, while on participant was undecided.

5.3 Empathy Results for the Three Groups

Cronbach's Alpha coefficient of internal consistency shows that the empathy scale has good enough reliability in our sample: Alpha=0.71. The mean scores indicate small differences between the three groups regarding empathy. Regarding their ability as teachers to predict the feelings of their students the participants of all the groups tend to agree with the PS.group scoring higher M=5.09,SD=0.83 (VR.group M=4.64, SD=.81 and VI.group M=4.91 SD=1.38). Participants tend to agree that they are be able to spot when a student is feeling awkward or uncomfortable, with the VI.group scoring higher and with a tendency to strongly agree M=5.64, SD=.51 (VR.group M=5.36 SD=.51, PS.group M=5.18 SD=.41). Moreover, the results indicate that participants tend to agree that as teachers should try to look at every student's side of a disagreement before making a decision (VR.group M=5.27 SD=.47, VI.group M= 5.09 SD=.83, PS.group M=5.18 SD=.60). Participants of all groups tend to agree that as teachers they should try to understand the students better, by imagining how things look from their perspective, with the VI.group scoring higher and with a tendency to strongly agree M=5.64, SD=.51 (VR.group M=5.27 SD=.47, PS.group M=5.27 SD=.65). Regarding their ability as teachers to see things from the student's point of view, the participants of the VR.group tend from undecided to agree (M=4.55, SD=1.37), the participants of the VI.group tend to agree (M=4.91, SD=1.45) and the participants of the PS.group tend to agree (M=5.09, SD=.83). The results indicate that as far as emotional involvement with students' problems, the participants of the VR.group tend to be from undecided to agree (M=3.82, SD=1.32) and the participants of the VI.group (M=4.18, SD=1.54) and PS.group (M=4.09, SD=1.30) tend to agree. The participants of all groups believe that as teachers they should try to imagine how they would feel in the students' situation, with the VI.group scoring higher M=5.27, SD=.79 (VR.group M=5.09 SD=.83, PS.group M=5.18 SD=.41). Regarding teacher's support of students of other racial and ethnic groups, the participants of all groups tend to agree, with VI.group scoring higher M=5.36, SD=.67 (VR.group M=5.09, SD=.83, PS.group M=4.91 SD=.70). Finally, the results indicate a significant difference among the groups regarding teachers' ability to put himself/herself in the position of someone who is racially and/or ethnically different, as the participants of the VR.group tend from disagree to undesided M= 3.56, SD=1.13, participants from VI.group also tend from disagree to undecided M=3.64, SD=1.43, while the participants of the PS.group tend from undecided to agree M=4.73, SD=.91.

The Kruskal-Wallis H test showed that between the three groups there was no statistically significant difference regarding most of the items of the empathy scale, as the p-value for is in almost all cases >0.05. However, there is one item, question 11 'It is difficult for a teacher to put himself/herself in the position of someone who is racially and/or ethnically different', that seems to statistically differ between the groups as the p-value is 0.027<0.05. According to the mean scores in the table below, the mean score of the VR.group is 3.55 (SD 0.13), the mean score for the VI.group is 3.64 (SD= 1.43) and the mean score for the PS.group is 4.73 (SD= 0.91). Therefore, the results indicate that the two groups that used the VR environment tend to be from undecided to disagree that it is difficult for a teacher to put himself/herself in the position of someone who is racially and/or ethnically different', while the PS.group that did not used the VR environment tend from disagree to strongly disagree. Mann-Whitney test confirmed that the difference between VR.group/VI.group and the PS.group that did not used the VR. According to the Mann-Whitney test the p-values between the VR.group and the VI.group is 0.68>0.05 suggesting that there is no difference between the two groups. On the contrary, the Mann-Whitney test between the VR.group and the PS.group revealed a p-value 0.011<0.05 and between the VI.group and the PS.group revealed a p-value 0.034>0.05 indicating the statistically significant difference between the groups.

6 DISCUSSION

The analysis of the data revealed that the participants of both groups that used the VR system felt a sense of being there, thus, a sense of presence. According to the general item of IPQ questionnaire that had to do with the sense of being there, the participants of the virtual environment with realistic appearance tend to claim higher levels of presence than the participants of the virtual environment with imaginary appearance. Therefore, both groups report good levels of presence. Although the presentation of the EEG results were beyond the scope of this particular paper, it is essential to report that the EEG device results indicate similar results as the participants of the VR groups managed to be synchronized in the alpha state after around 38 seconds, whereas the physical group was maintained in the beta state. Thus, both groups that used the VR system developed levels of presence.

What is interesting is that to the question 'I did not feel present in the virtual space' which was one of the items to measure spatial presence, the results revealed that participants of both groups reported low levels of presence in the virtual world and more specifically the group that experienced the virtual environment with imaginary appearance reported very low levels of presence. It should also be noted that Spearman's correlation regarding this question revealed that a moderate, positive correlation between this question and participants' experience in using virtual reality environments. Thus, there are indications that the more experienced participants are in the use of VR the higher levels of presence they experience. This confirms Lombard's and Ditton's [21] arguments according to which when a user is unfamiliar with the use of an advanced medium capable of generating a sense of presence, such as virtual reality, then this unfamiliarity is likely to discourage sense of presence, however, as the user becomes more expert at using VR system than the levels of presence raise. Moreover, it should be noted that during the completion of the questionnaire, most of the participants asked for explanations regarding this question because it was a negative one and they were not sure how to answer it. Therefore, it is possible that they were confused with the Likert scale in answering the question resulting in the difference between question six and the general item that measured sense of presence. Nonetheless, it seems that training on the use of VR technologies is essential for a target group as teachers, so that they can use more effectively VR based training applications.

Regarding spatial presence, the results indicate that participants at both groups felt moderately that the virtual world surrounded them, however, the virtual world did not seem as simply perceiving pictures. Nonetheless, the participants did not feel very active within the virtual world, which is probably related to the fact that the scenario was not very interactive as for the current experiment the primary aim was to test the virtual environments from the perspective of the graphics. Lombard and Ditton [21] argue that the primary cause of presence is the ability to interact with a virtual environment, while body movement seem also likely to contribute to a strong sense of presence. Presence could have been enhanced if the participants were able to move their body in the physical space. However, due to the use of EEG device this was not possible as the 64 electrodes were very sensitive and the slightest participants' movement had significant impact to the recording of the signals.

As far as involvement is concerned there are indications that participants were not fully disconnected from the physical world. Moreover, the results indicate a significant statistical difference between the two groups regarding paying attention to the real environment as non-parametric test indicate that the participants of the VR.group tend to be more aware of the real environment that the participants of the VI.group who claimed to be more slightly aware of the real environment. This is a significant insight as there are strong indications that the design of the VR system is correlated to the levels of presence. Büscher et al. [22] argues that the development of a VR environment based on cultural expectations can maximize the level of sense of presence. Moreover, Heeter [23] argues that it is possible when the virtual world gives the user a sense of déjà vu it can maximize the users' feeling of being in the virtual world. Therefore, we would expect that the design of the VR environment based on real classrooms and on the specifications provided by the responsible institutions would create a sense of déjà vu to the users that the imaginary virtual environment. However, the results revealed the exact opposite and the imaginary environment generated higher levels of presence to the participants. This result seems to confirm Heeter's [23] position according to which a virtual world that responds exactly like the real world could affect negatively the sense of presence.

Another important outcome of the results has to do with participants' preference regarding the type of training. Half of the participants who used the VR system would not prefer to be trained without the use of VR, while a significant percentage were undecided maybe due to their inexperience and familiarization to such a technology. Moreover, half of the participants who were trained to the physical (real) classroom setting claimed that they would prefer to be trained within a virtual classroom world, although they were also unfamiliar to such technology. Thus, there are strong indications that VR has the potential to become a training tool at the disposal of teachers.

Concerning empathy, the results indicate cultivation of empathy skills. What is important is that the participants of all groups claim the importance of entering the students' position to understand his/her perspective. There are no significant differences between the three groups except from one variable that relates with teachers' ability to put himself/herself in the position of a student who is racially and/or ethnically different. The results revealed a significant difference between the participants that used the VR system and those who were trained in the physical environment as those experienced the virtual world claimed that teachers can put himself/herself in the position of someone who is racially and/or ethnically different, while the physical group tend to disagree. Thus, there are serious indications that embodiment was achieved, and the VR system provided users the immersion necessary for the development of embodied thinking skills and thus of empathy in relation to multiculturalism [19]. However, further research is needed to investigate the impact of VR based training in the cultivation of empathy skills.

7 CONCLUSIONS

The results of the current research are promising regarding the potential of using VR methodology in teacher training. Since the results indicate that the design of the VR classroom environment affects the levels of presence, more experiments will be conducted to identify possible specific parameters that must be taken into account when designing a VR training tool for teachers. Also, the results of the questionnaires will be compared with the results of the EEG signals so that more concrete conclusions are derived. This first experiment provided significant insight regarding possible changes in the VR application that might also maximize levels of presence, as for instance the use of sound and body movement.

Acknowledgements

Authors acknowledge funding from the European Union's Horizon 2020 Framework Programme through NOTRE Project (H2020-TWINN-2015, Grant Agreement Number: 692058).

References

[1] Joung H. Kwon, John Powell, and Alan Chalmers. 2013. How level of realism influences anxiety in virtual reality environments for a job interview. International journal of human-computer studies, 71 (10), 978-987. DOI: https://doi.org/10.1016/j.ijhcs.2013.07.003

[2] Mel Slater, Martin Usoh, and Anthony Steed. 1994. Depth of presence in virtual environments. Presence: Teleoperators & Virtual Environments, 3(2), 130-144. DOI: https://doi.org/10.1162/pres.1994.3.2.130

[3] Chwen J. Chen. 2006. The design, development and evaluation of a virtual reality based learning environment. Australasian Journal of Educational Technology, 22(1). DOI: https://doi.org/10.14742/ajet.1306

[4] Linda Darling-Hammond. 2006. Constructing 21st-century teacher education. Journal of teacher education, 57(3), 300-314. DOI: https://doi.org/10.1177/0022487105285962

[5] European Commission. 2011. Literature review. Teachers' core competences: requirements and development. (April 2011). Retrieved from http://ec.europa.eu/education/policy/strategic-framework/doc/teacher-competences_en.pdf

[6] European Commission/EACEA/Eurydice. 2015.The Teaching Profession in Europe: Practices, Perceptions, and Policies. Eurydice Report. Luxembourg, Publications Office of the European Union.

[7] National Institute of Education-NIE. 2009. A Teacher Education Model for the 21st Century. National Institute of Education, Nanyang Walk, Singapore. Retrieved from https://www.nie.edu.sg/docs/default-source/te21_docs/te21_executive-summary_14052010---updated.pdf?sfvrsn=2

[8] Jeremy N. Bailenson, Nick Yee, Jim Blascovich, Andrew C. Beall, Nicole Lundblad and Michael Jin. 2008. The use of immersive virtual reality in the learning sciences: Digital transformations of teachers, students, and social context. The Journal of the Learning Sciences, 17 (1), 102-141. DOI: https://doi.org/10.1080/10508400701793141

[9] Maria Roussos, Andrew Johnson, Thomas Moher, Jason Leigh, Christina Vasilakis, and Craig Barnes. 1999. Learning and building together in an immersive virtual world. Presence: Teleoperators & Virtual Environments, 8(3), 247-263. DOI: https://doi.org/10.1162/105474699566215

[10] Yiyu Cai, Ruby Chiew, Zin Tun Nay, Chandrasekaran Indhumathi, and Lihui Huang. 2017. Design and development of VR learning environments for children with ASD. Interactive Learning Environments, 25(8), 1098-1109. DOI: https://doi.org/10.1080/10494820.2017.1282877

[11] Laura Freina and Michela Ott. 2015. A literature review on immersive virtual reality in education: state of the art and perspectives. In *The International Scientific Conference eLearning and Software for Education*, vol. 1, 133-141. Carol I National Defence University, 2015.

[12] Elena Manouchou, Kalliopi-Evangelia Stavroulia, Antri Ruiz-Harisiou, Kyriakos Georgiou, Francesca Sella, and Andreas Lanitis. 2016. A feasibility study on using virtual reality for understanding deficiencies of high school students. In Electrotechnical Conference (MELECON), 2016 18th Mediterranean, 1-6. IEEE. DOI: 10.1109/MELCON.2016.7495418

[13] Kalliopi-Evangelia Stavroulia, Antri Ruiz-Harisiou, Elena Manouchou, Kyriakos Georgiou, Francesca Sella, and Andreas Lanitis. 2016. A 3D virtual environment for training teachers to identify bullying. In Electrotechnical Conference (MELECON), 2016 18th Mediterranean, 1-6. IEEE. DOI: 10.1109/MELCON.2016.7495417

[14] Lisa Dieker, Michael Hynes, Charles Hughes, and Eileen Smith. 2008. Implications of mixed reality and simulation technologies on special education and teacher preparation. Focus on Exceptional Children, 40, 1-20.

[15] Mihaela P. Lăzărescu. 2013. The Structure and Dynamics of the Teacher's Empathic Behavior. Procedia-Social and Behavioral Sciences, 78, 511-515. DOI: https://doi.org/10.1016/j.sbspro.2013.04.341

[16] Marina Goroshit, and Meirav Hen. 2014. Does Emotional Self-efficacy Predict Teachers' Self-efficacy and Empathy?. Journal of Education and Training Studies, 2(3), 26-32. DOI: https://doi.org/10.11114/jets.v2i3.359

[17] Gretchen McAllister and Jacqueline J. Irvine. 2002. The role of empathy in teaching culturally diverse students: A qualitative study of teachers' beliefs. Journal of Teacher Education, 53(5), 433-443. DOI: https://doi.org/10.1177/002248702237397

[18] Jared Axelrod. 2014. A Virtual Reality Means You Don't Have To Be Yourself. (December 2014). Retrieved from http://www.pastemagazine.com/articles/2014/12/virtual-reality-means-you-dont-have-to-be-yourself.html

[19] Kate Carey, Emily Saltz, Jacob Rosenbloom, Mark Micheli, Judeth Oden Choi, and Jessica Hammer. 2017. Toward Measuring Empathy in Virtual Reality. In Extended Abstracts Publication of the Annual Symposium on Computer-Human Interaction in Play, ACM, 2017, 551-559. DOI: 10.1145/3130859.3131325

[20] Martijn J. Schuemie, Peter Van Der Straaten, Merel Krijn, and Charles Van Der Mast. 2001. Research on presence in virtual reality: A survey. CyberPsychology & Behavior, 4(2), 183-201. DOI: https://doi.org/10.1089/109493101300117884

[21] Matthew Lombard and Theresa Ditton. 1997. At the heart of it all: The concept of presence. Journal of Computer-Mediated Communication, 3(2). DOI: https://doi.org/10.1111/j.1083-6101.1997.tb00072.x

[22] Monika Büscher, Jon O'Brien, Tom Rodden and Jonathan Trevor. 2001. "He's Behind You": The Experience of Presence in Shared Virtual Environments. In Elizabeth F. Churchill, David N. Snowdon, Alan J. Munro (Eds.) Collaborative Virtual Environments. Computer Supported Cooperative Work. Springer, London. DOI: https://doi.org/10.1007/978-1-4471-0685-2_5

[23] Carrie Heeter. 1992. Being there: The subjective experience of presence. Presence: Teleoperators & Virtual Environments, 1(2), 262-271. DOI: https://doi.org/10.1162/pres.1992.1.2.262