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Assessing the emotional impact of virtual reality-based teacher training

Kalliopi Evangelia Stavroulia and Maria Christofi
Cyprus University of Technology, Lemesos, Cyprus
Evangelia Baka
Universite de Geneve, Geneva, Switzerland
Despina Michael-Grigoriou
Cyprus University of Technology, Lemesos, Cyprus and
RISE Research Centre on Interactive Media,
Smart Systems and Emerging Technologies, Nicosia, Cyprus
Nadia Magnenat-Thalmann
Universite de Geneve, Geneva, Switzerland, and
Andreas Lanitis
Cyprus University of Technology, Lemesos, Cyprus and
RISE Research Centre on Interactive Media,
Smart Systems and Emerging Technologies, Nicosia, Cyprus

Abstract

Purpose – The purpose of this paper is to propose the use of a virtual reality (VR)-based approach to improve teacher education and life-long professional development. Through constant training in real-life based situations but within a safe three-dimensional virtual school environment, teachers are given the opportunity to experience and learn how to react to different types of incidents that may take place in a school environment.

Design/methodology/approach – The current paper presents the design cycle that was followed for the implementation of the VR teacher training system. The effectiveness of the proposed approach is demonstrated with a case study that aimed to promote teachers' understanding of student's problematic situations related to substance use. As part of the experimental investigation, the impact of the VR system on participants' emotions and mood states is evaluated through Electroencephalogram (EEG) measurements, heart rate (HR) recordings and self-reported data.

Findings – Results indicate significant changes to participant's negative emotional and mood states, suggesting that the scenario and the VR experience had a strong impact on them. Moreover, participants' HR was increased during the experiment, while the analysis of the EEG signal indicated that the participants experienced a stressful situation that could justify the change in their negative emotions and mood states.

Originality/value – The proposed VR-based approach aims to provide an innovative framework to teacher education and the related training methodology. In the long-term, the proposed VR system aims to form a new paradigm of teacher training, an alternative safe method that will allow user-teachers to learn through trial and error techniques that reflect real-life situations within a three-dimensional school space and without the risk of harming real students. To the best of our knowledge this is one of the first systematic attempts to use a VR-based methodology to address real teachers' needs. The development of the VR application is linked to both strong theoretical foundations in education derived from the literature but also from real teachers' problems and requirements derived from an extensive literature analysis, survey and interviews with experts including teachers, school counselors and psychologists. The VR tool addresses specific teachers' competences as outcome, after an extensive documentation of existing Teachers' Competence Models and significant guidance by experts who pointed specific competencies of primary importance to teachers.

Keywords Virtual reality, Emotions, Substance use, Teacher training, Mood states

Paper type Research paper

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1. Introduction

The last few years the educational systems throughout the world have experienced radical changes and enormous challenges that formed the basis for a necessary change, transformation and modernization. Together with changes within the educational systems, the traditional role of teachers inevitably changed and investment in their professional development has become a necessity and a top priority in the strategic agenda of the European Union (EU).

In line with EU objectives, this paper aims to propose the professional development of teachers using a contemporary virtual reality (VR)-based approach. There is a lack of research in the use of VR in teacher education and thus this research aims to fill this gap. By taking advantage of VR technology, it is possible to provide teachers a safe virtual training environment, within which they can construct their knowledge through active involvement and then transfer this knowledge gained in their real classroom. The proposed VR framework aims to support teachers' continuous professional development through systematic individualized learning improving the quality of teacher education and practice. Moreover, this paper presents the proposed VR approach through a five-phase methodological framework, which includes the pedagogical framework, the development of the scenarios followed by the development of the VR application and the evaluation of the impact of the proposed approach. The proposed VR-based approach aims to provide an innovative framework for teacher education and the related training methodology. In the long-term, the proposed VR system aims to form a new paradigm of teacher training, an alternative safe method that will allow user-teachers to learn through trial and error techniques that reflect real-life situations within a three-dimensional educational-related space (e.g. school, classroom, etc.) and without the risk of harming real students. To the best of our knowledge, this is one of the first systematic attempts to use a VR-based methodology to address real teachers' needs. The development of the VR application is linked to both strong theoretical foundations in education derived from the literature but also from real teachers' problems and requirements derived from an extensive literature analysis, survey and interviews with experts including teachers, school counselors, academics and psychologists. The VR tool addresses specific teachers' competences as an outcome, in line with existing Teachers' Competence Models (Darling-Hammond and Bransford, 2005; European Commission, 2011; McDiarmid and Clevenger-Bright, 2008) and significant guidance by experts who pointed specific competencies of primary importance to teachers.

2. Literature review

2.1 VR: the next step in education

VR is an interactive experience within a computer-generated three-dimensional environment that can be a representation of either a real-life or an imaginary environment (Freina and Ott, 2015; Ke *et al.*, 2016). The term "virtual" means computer-generated, while the term "reality" refers to the similarity of objects or of the environment to the physical world (Cheng, 2014). A VR environment is presented to the users in a way that they accept it as a real environment, within which they can navigate and interact with objects or other avatars in the same way they would experience real-life situations (Ke *et al.*, 2016).

Recently, there has been a major shift in the field of education toward the implementation of more immersive and innovative computer-based educational tools that promote knowledge acquisition through active involvement. VR technology has risen as new and innovative teaching technique that allows interactive and immersive activities turning the experience into learning and learning into an exciting experience (Marks *et al.*, 2017). Moreover, it has lifted the use of modern techniques to support learning purposes, such as serious games or simulations, to a new level. Apart from the fact that VR is designed for human interaction, it is also used as a learning and teaching instrument due to its ability to

stimulate motivation, which is one of the most significant challenges that teachers face in today's dynamic and digitalized classrooms (Freina and Ott, 2015).

Another significant advantage of VR technology is that it allows the creation of virtual worlds that mimic real-life situations and events, not otherwise possible to simulate, offering users a safe space with room for error to be trained and learn. For instance, simulating in physical space fire situations, earthquakes or terroristic attacks is impossible due to the high danger and cost (Bailenson *et al.*, 2008; Freina and Ott, 2015; Shu *et al.*, 2018). However, using VR technology, it is possible to offer the opportunity to develop a virtual world that represents real-life events, allowing firefighters or terrorism response units to be trained in dealing with chaotic crisis within a safe yet stressful environment (Bailenson *et al.*, 2008; Freina and Ott, 2015). Most importantly VR offers the possibility of visualizing events and situations, allowing the users to step inside the event or situation and examine it from different perspectives, maximizing in-depth understanding of the conceptual framework (Marks *et al.*, 2017). VR technology not only allows to make the unseen visible (Marks *et al.*, 2017) but also makes possible to overcome the restrictions of time and physics and be transferred for instance to the past experiencing historical eras such as the world wars (Eschenbrenner *et al.*, 2008).

An important aspect of using VR-based training systems is the fact that knowledge acquired within a VE can be applied to the real context but also the opposite (Eschenbrenner *et al.*, 2008; Huang *et al.*, 2013; Parsons, 2016; Ragan *et al.*, 2010). Equally important is the fact that VEs allow the users to experience an event from multiple different perspectives, understanding in that way different aspects of a situation (Bailenson *et al.*, 2008). Additionally, the performance of the users during a virtual experience can be monitored providing feedback that allows reflection and maximization of learning (McComas *et al.*, 1998; Rizzo *et al.*, 2009). Furthermore, VR can promote creativity, communication, collaboration and social skills of the users (Bailenson *et al.*, 2008; Eschenbrenner *et al.*, 2008; McComas *et al.*, 1998).

The last decades, there is a growing interest in using VR for educational purposes in different disciplines and the results seem promising. VR has been widely used in the medical sector for training purposes (Marks *et al.*, 2017) and as part of chemical engineering education (Bell and Fogler, 1995). Additionally, VR has been used for pedestrian safety training (Schwebel *et al.*, 2016), for job interview training (Kwon *et al.*, 2013; Smith *et al.*, 2015), for training adults with intellectual disabilities to improve Spatial Perspective Taking skills (Freina *et al.*, 2016), for supporting children with attention-deficit/hyperactivity disorder (Parsons *et al.*, 2007; Rizzo *et al.*, 2009), Autism Spectrum Disorders (Parsons, 2016) and in cases of children facing severe disabilities (McComas *et al.*, 1998).

2.2 VR in teacher education: related work

Although a rising body of work related on the use of VR for educational purposes has grown, research regarding the use of VR in teacher education is extremely limited (Freina and Ott, 2015). The last few years, the use of VR environments in education to foster learning has attracted the interest of the scientific community, as VR environments can provide an alternative effective strategy leading to high-level training and qualified teachers in every classroom.

An extensive literature review research revealed as one of the most common and significant problems in teacher education the lack of practice in the school setting. Most universities but also life-long learning programs for teachers rely on theoretical teaching that lacks strong communication and collaboration channels with the school environment (Caena, 2011; Darling-Hammond, 2006; Hagger and McIntyre, 2006). Thus, those programs do not provide 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 their

own classroom that may affect negatively the cognitive, social and psychological development of the students (Chiero and Beare, 2010; Darling-Hammond, 2006). Hence, there is a theory-practice gap that needs to be addressed so that teachers are also provided with high-quality practical skills required for supporting high-quality education.

This gap between theory and practice can be bridged by experiential learning and VR could offer an effective way for this type of training by providing engaging and immersive experiences that reflect real-world classroom situations (Caena, 2014). The last few years, the use of virtual reality environments (VREs) in education to foster learning has attracted the interest of the scientific community; nevertheless, its use remains extremely limited especially in teacher education (Freina and Ott, 2015). The significance of using VR in teacher education lies in the fact that VR mimics real-world situations allowing the users to experience realistic learning experiences that are transferable to the real world. Another key advantage of VR-based teacher training is the ability for experimentation within a safe environment, where teachers can make mistakes and learn from them but without influencing real students (Lugrin *et al.*, 2016). This fact makes VR learning environment a suitable tool that can be used for the professional development of teachers. Furthermore, the development of "extreme" scenarios can allow teachers to be trained via simulated stressful conditions that would be impossible to simulate using traditional teacher training methodologies in a real classroom setting. Equally important is the fact that the constant technological advancements make VR technology more a more immersive, providing a new level of experience to the users making the simulated world seem like the reality and removing the distractions of the physical environment.

Overall, VR can provide several positive aspects to education not only for the student but can also foster the professional development of the teacher. VR can offer teachers a safe environment within which they are able to be trained and learn what to do and do not do, in order to control an event or a situation in the classroom instead of struggling to find out a solution in a real classroom that is out of control. Thus, within a virtual classroom space, teachers can experience situations that the theory cannot cover and learn how to manage them but without the real-life dangers. Hence, a VR-based approach can provide teachers with the skills necessary for dealing with the classroom requirements. Yet, another significant aspect that should be emphasized is that VR provides a good strategy for the safety of the students, as the virtual students cannot be harmed, while teachers' training within the virtual world will maximize their development, preparedness and response to classroom incidents.

In relation to traditional teaching and learning methods, a VR-based approach can have several advantages. Previous research results indicate that the use of VR compared to the traditional methods (e.g. lecturing) has more effect on participants' performance (Brinson, 2015; Guedes *et al.*, 2018). For instance, VR can be used to support the method of role-play by providing the users the simulated virtual environment and the avatars in the role of actors, while the use of VR devices such as headsets the users see the scene from a first-person perspective view, whereas in the traditional setting materials to compose the scene and actors would be needed (Park *et al.*, 2011). Role-play is considered to be an effective strategy for the professional development of teachers fostering active-learning, reflection and knowledge construction (Crow and Nelson, 2015; Gartmeier *et al.*, 2015). Role-play has been introduced to the classroom long enough allowing the students to take the role of another person, feel, think and act like another person, an experience that allows the expression of true feelings and understanding how one behavior can affect another person (Chesler and Fox, 1966). There are indications that role-play technique is more effective than traditional methods such as lectures (Hogan *et al.*, 2015). Research results also indicate that role-play method using VR was effective enough compared to traditional role-play training (Park *et al.*, 2011), making it a valuable tool for teacher education as one of the methods proposed

as part of teacher training is a simulation and role-play (United Nations, 2004). Nevertheless, it should be noted that the scenario described as part of the experiment analyzed in the current paper is not a role-play type but promotes perspective-taking allowing the users to enter the role of another person and experience different perspectives in an effort to understand the problem depicted in the scenario. The introduction of role-playing in VR-based teacher training will be the subject of our future research activities.

The last few years some attempts have been made in the preparation of teachers via virtual training environments. A virtual environment named STAR Simulator was developed aiming to simulate an urban classroom of diverse virtual students in order to provide rich experiences to the participating teachers through interactions with the virtual students (Dieker *et al.*, 2007). The results revealed that teachers found the virtual classroom realistic enough, while the experience enhanced their knowledge and classroom management skills. Another mixed-reality environment called TeachMe was developed, focused on behavior and classroom management aspects and the goal was to train beginning teachers before entering in the classroom for the first time (Andreasen and Haciomeroglu, 2009). The results of the research on the use of TeachMe were also positive indicating the potential of training teachers on classroom management issues via a simulated classroom environment.

Another study suggested the use of a mixed-reality learning environment using OpenSimulator and implementation of Kinect in order to train teaching assistants regarding gesturing for lecturing (Ke *et al.*, 2016). Teaching assistants service is critical within the University, yet they usually receive minimal training regarding their role, while they also constitute the future generation of teachers. The results indicated the possibility to create a mixed-reality learning space that enabled embodied presence and gesturing during the virtual teaching practice. Furthermore, TLE TeachLivE™ is another mixed-reality classroom aiming to enhance the development of teacher's pedagogical practice and skills (Dieker *et al.*, 2015). TLE TeachLivE™ has been used in different studies and the results indicate the effectiveness of the tool in the development of the teaching skill that can be transferred and applied in a real classroom (Dawson and Lignugaris/Kraft, 2017) or its potential to be used for the confrontation of teacher's anxiety (Eisenreich and Harshman, 2014) and gesture movements improvement (Barmaki and Hughes, 2015).

It is interesting to note that virtual training environments such as STAR Simulator or TeachMe are screen-based training tools, belonging to the category of desktop VR and are not highly immersive applications. In some of the abovementioned cases, monitors are used so as for the trainee teachers to see the virtual classroom, while there are virtual students who are controlled by actors. In other cases, 3D virtual worlds such as second life are used as a tool to enhance classroom management practice and skills (Mahon *et al.*, 2010). The present study proposes the use of a virtual school environment within which the trainees are immersed using Head-mounted display (HMD) equipment such as Oculus Rift and 3D controllers, while there is no need to embody the virtual students with actors. The use of VR special electronic equipment, such as VR headsets (e.g. Oculus Rift, HTC Vive) will allow users to interact with the virtual environment, experience a first-person view and take a 360 degree look inside the virtual space and thus look at any direction as in the physical world (Desai *et al.*, 2014) so that the overall experience is highly realistic.

Using VR as part of teacher education is still at its infancy. Some first attempts using VR technology and equipment seem promising and indicate the usability of such a tool in the field of teacher education. Homework assignments can provide practice for teachers, but VR can provide the ability to step inside the virtual space experiencing different events and situations and multiple different perspectives of a particular event. As an illustration, a prototype VR classroom offered teachers the opportunity to experience

students' vision disorders and specifically myopia, in an effort to raise their awareness and maximize their skills in identifying similar vision problems by placing them to the position of a visually impaired student (Manouchou *et al.*, 2016). The results revealed teachers' problematization toward the specific disorder and a change of attitude regarding identifying students having this particular disorder in their classroom. Another attempt aimed to train teachers in bullying-related issues and help them identify bullying issues and distinguish them from simple teasing between the students (Stavroulia *et al.*, 2016). The results indicated in-service teacher's feel that they already possess the knowledge needed to manage bullying events, yet they failed to distinguish within the virtual world the bullying from the teasing incidents.

The problem of enhancing teachers' empathy and reflection skills within a multicultural classroom setting and investigate possible differences regarding training in a physical real space or in a virtual classroom space, was also investigated (Baka *et al.*, 2018; Stavroulia and Lanitis, 2018; Stavroulia *et al.*, 2018). Within this context, participants were able to experience two different perspectives, as a teacher and as a foreign student. The different perspectives allowed the participants to enter the body of the foreign student and experience verbal bullying by the classmates but also experience the same incident through the eyes of the teacher. The results revealed participant's preference of using VR as part of their training, while there were indications that training using VR helped the participants cultivate their empathy and reflection skills, while the experience provoked to them many emotions and mood states.

One more immersive VR system developed is "Breaking Bad Behaviors" that aims to train teachers to manage disruptive behavior in the classroom enhancing their classroom management skills (Lugrin *et al.*, 2016). The system was implemented as part of a seminar for primary and secondary teachers, with the trainee teachers entering the virtual world and the instructor controlling the tasks and monitor teacher's performance providing feedback. The results indicate that the VR system was beneficial and could potentially be used as part of teacher training, while the virtual environment and student avatar behaviors elicited stressing situations for the trainees. Moreover, this particular VR system was used as part of an experiment regarding potential differences between training via using a VR system and via using videos and the results revealed that the performance of the VR group was higher than the group that used the video (Luqrirr *et al.*, 2018).

Bailenson *et al.* (2008) conducted a number of experiments using VR and HMD equipment to investigate whether social behaviors such as head movements, spatial proximity and the presence of virtual others have an impact on learning. The investigation of how participants' visual field of view while teaching a room of virtual students affects the virtual students indicated that the participants tended to ignore the students in the periphery than in the center. Moreover, when the participants did not look at the virtual students there was a notification that helped them distribute their gaze more equally among the students. The investigation also revealed that students learn better when sitting in specific privileged seats as for instance in front of the teacher than when sitting in the periphery. Finally, it was proved that the number of virtual co-learners also affected the learning performance.

Taking all the above attempts of using VR as part of teacher training the results seem to be promising. However, there is need for new and more practical training activities in teacher education in conjunction with VR environments that have the unique ability to place the trainees inside the virtual environment can enhance teacher training. Nevertheless, further research is required to determine the value of VR in teacher training. This paper aims to fill this gap and provide insights of added value to the literature on the topic. First of all, the current research is differentiated from the research studies belonging to the category of desktop VR, as by using HMDs the VR environment under evaluation an immersive

experience that disconnects them from the real world and allows them to enter the virtual space making them feel as if they are part of it. Moreover, the significance of the current research lies in the fact that the development of the virtual environment and of the scenarios was not just based on literature review research but on close collaboration with teachers, school counselors and other experts including psychologists. For this purpose, a systematic data gathering process through surveys and interviews was staged, in an effort to identify and address real teacher's needs as they are shaped today. Additionally, the current paper presents one part of the research that deals with the investigation of participant teachers' emotions and mood states within a virtual school setting that has not been investigated so far at least to the best of our knowledge concerning this specific target group. The proposed VR system aims to cultivate empathy and reflection skills (Stavroulia *et al.*, 2017), thus, one of the first goals was to investigate possible differences before and after the experiment regarding participant's emotional reactions that are an integral part of the process of cultivating empathy.

2.3 Emotions and VREs

Over the years, emotions have caught the interest of the scientific community. There is a need to investigate emotional experiences in VREs as there is a lack of research regarding user's emotional experiences (Felnhofer *et al.*, 2015). The question that arises is why to investigate emotional experiences in VREs, which derives from the fact that emotions are involved in the way we understand the natural world (Morie *et al.*, 2005). Thus, as VREs can represent real-life situations, emotions have an integral part to play during the experience of the users in VREs. There is a lack of research regarding the assessment of emotional experiences of users within VREs as only few emotions have been investigated so far including relaxation, joy, sadness, anxiety, anger and boredom (Felnhofer *et al.*, 2015). Anxiety is one emotion that has been addressed in many researches in the context of using VR for mental health problems and psychological treatment (Bouchard and Labonté-Chartrand, 2010). Thus, as the goal of the proposed VR system is to train teachers, their emotional state within the VRE during their training cannot be ignored.

There are several methods for the recognition of emotions in VR that include skin conductance and heart rate variability (HRV) in order to capture the responses of the autonomic nervous system (Baumgartner *et al.*, 2006; Kim *et al.*, 2014). Moreover, electrodermal activity has recently been tested as a reflection of the sympathetic activation of the autonomic nervous system (Felnhofer *et al.*, 2015). Electroencephalogram (EEG) has also been used to capture the brain signal and its possible alterations as well as self-reports (Menezes *et al.*, 2017; Rodríguez *et al.*, 2015). For the purpose of the current research, a multimodal approach was used, combining HRV, EEG, self-reports and head movement detection in order to be able to determine the emotional state of the user. The use of this multimodal approach was adopted in order to achieve higher reliability of emotion recognition.

3. Methodology

3.1 Research question and approach

The main research question that constitutes the fundamental core of this research:

RQ1. Whether a VR-based learning paradigm is more effective for the professional development of teachers?

To answer the research question, a systematic approach including five phases was designed influenced by the ADDIE model used by instructional designers and training developers (Molenda, 2003). The proposed five phases – analysis of the needs, design of

the competence model and scenario, development of the VR system, implementation and evaluation – represent a dynamic, flexible guideline for building an effective training and performance support tool for teacher education (see Figure 1).

The five phases as illustrated in Figure 1 constitute a set of steps with a specific outcome that work together to enhance the overall outcome of the proposed VR-based approach. The outcomes of phase 1 formed the basis for the design of the competence model during phase 2 that resulted in the selection of the scenarios during phase 3 targeting specific competencies as outcomes. Phases 3, 4 and 5 are circular, as after the initial scenario that was designed in the VR system and evaluated, more scenarios were developed based on the outcomes of the evaluation process each time. More specifically, the outcomes of the evaluation of the first scenario resulted in the development of the second scenario that after its evaluation formed the basis for the new scenario and further modification in the VR system. A description of the actions taking place in each phase is presented below.

3.2 The five-phase model for the development of the VR system

Phase 1: analysis and investigation of teacher's needs. Apart from an extensive literature review research, a survey was conducted in order to register teacher's real training needs (Stavroulia *et al.*, 2017). The results of the survey provided critical information regarding teachers' real needs and this identification was taken into consideration for the development of the scenarios. Moreover, a focus group interview with in-service high-school teachers took place in order to reinforce the identification of the most important required aspects of teacher education. The results indicate the lack of practice in teacher education and the significance of implementing practice and on the job training within the university studies. Teachers reported that their training is mostly theoretical while it lacks practice, mentoring and counseling. Regarding the most important training needs, teachers reported the need of training related to dealing with students with special learning needs, students with disorders (vision, hearing and speech disorders), behavior management issues, classroom diversity, individualized learning and classroom management.

Phase 2: designing the competency framework for the proposed virtual reality-based investigation. The term teacher competencies refer to the "teacher professionalism," to "the multi-faceted roles of the teacher on multiple levels of the individual, of the school, of the local community and of professional networks" (European Commission, 2011, p. 7). There are several recent approaches regarding teacher competencies and several models have been developed (Darling-Hammond and Bransford, 2005;

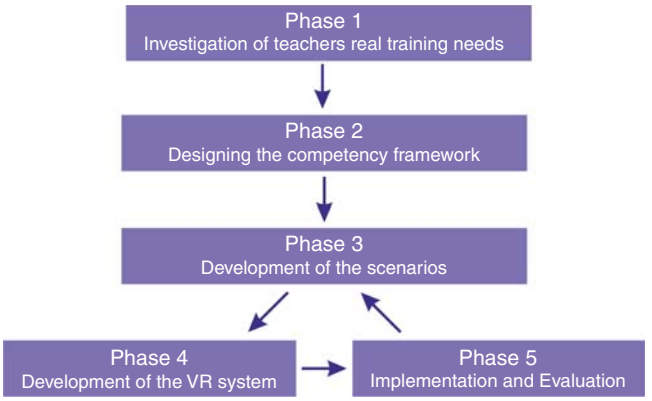

Figure 1.
The five-phase model used for the development of the proposed VR system

European Commission, 2011; McDiarmid and Clevenger-Bright, 2008). Despite the differences among the various models, there are several sets of competencies that are common including pedagogical content knowledge, issues of inclusion and diversity, use of technologies, reflection, research and collaboration skills, and adaptability. Although the models that exist have identified the most significant competencies and skills for teachers, it is impossible to address them all within the framework of the current research. Therefore, a specific selection had to be made based on the needs of the current research. A competency framework has been developed to describe the professional standards that the proposed VR system aims to strengthen ensuring optimum teachers' professional development. The proposed framework of competencies includes two key competencies that are: empathy (Christofi and Michael-Grigoriou, 2017) and reflection (Hammerness *et al.*, 2005).

Empathy. Empathy is considered a skill of paramount importance for teachers, as it can foster the establishment of strong communication channels with the students promoting the development of a good classroom climate and student's satisfaction and involvement in the educational process (McAllister and Irvine, 2002). The cultivation of empathy skills is the only way for teachers to really understand their students, embrace their problems and take the necessary course of action for their well-being. However, despite the significance of empathy skills, most teacher education competence models do not include empathy as a key competence. An extended literature review revealed that empathy is included among key competence only to a model developed by the NIE (2009) in Singapore. This gap regarding empathy to European competence models in conjunction with the indications by the interviewed experts formed the basis for addressing the cultivation of empathy skills to the current research.

Reflection. The development of critical reflection skills is essential for teachers (Hammerness *et al.*, 2005). Through reflection, teachers have the ability to evaluate their teaching practice and experience, re-examine and criticize it, aiming to make the necessary changes for self-improvement and improvement of the quality of their work. Thus, the ability to reflect is considered an integral part of teacher professionalization and one of the basic standards that teacher candidates must develop in order to achieve self-development (Lai and Calandra, 2007). Unfortunately, research results indicate that teachers do not possess the ability to reflect even after receiving relevant education and as a result, they faced difficulties in critically reflect on their teaching practices. Thus, it is essential to address the cultivation of reflective skills via VR.

Phase 3: designing the scenarios. The design of the scenarios was based on the previous phases and the directions provided by experts. Until now, different scenarios have been developed and tested related to student's vision disorders, bullying, multiculturalism and bullying used in the school environment (Baka *et al.*, 2018; Manouchou *et al.*, 2016; Stavroulia *et al.*, 2016; Stavroulia *et al.*, 2018; Stavroulia and Lanitis, 2018).

Phase 4: development of the application. Following the different scenarios considered, dedicated VR applications were developed using the Unity3D© game engine. In order to create a realistic immersive experience for the participants, an Oculus Rift VR headset was used as a means of viewing the application (see Plate 1). The 3D avatars (teachers and students) were created using the online software Autodesk® Character Generator.

Phase 5: implementation and evaluation. The evaluation stage aimed to evaluate the effectiveness of the VR application, providing the information regarding its impact on the professional development of teachers. The assessment of the effectiveness of the VR-based training and the data gathered provided significant insights regarding the impact of VR approach in teacher education leading to the development of a tool to

Plate 1.
One of the participants during the experiment wearing Oculus Rift

support for the professional development of teachers and thus the quality of education. The results so far demonstrate strong potential in the use of VREs in teacher education. The experience within the VR system can raise teacher's awareness and understanding of student's problems including vision disorders (Manouchou *et al.*, 2016), bullying incidents (Stavroulia *et al.*, 2016) and multiculturalism (Baka *et al.*, 2018; Stavroulia *et al.*, 2018). The next subsection presents the results of the experiment related to substance use in the school environment.

4. The experiment: substance use related scenario

4.1 The research questions

The main research questions that constitute the fundamental core of this particular experiment are the following:

RQ2. Does the use of VR impact participant's emotional and mood states?

RQ3. Does the use of VR affect participant's heart rate (HR)?

4.2 The scenario

The scenario that was chosen for the experiment relates to substance use. The scenario was inspired by a real school incident related to the use of substances given to a 12-year-old student by his classmates, in the form of pills and after threats (Kounnou, 2017). The substance that is portrayed in the scenario is cannabis (also mentioned as marijuana in the scenario) and it was chosen because according to the 2017 European Drug Report, cannabis was the most commonly used illicit substance in Europe and its use was concentrated among young adults aged 15–34 years (EMCDDA, 2017).

Substance use is not only major societal concern but also a serious problem within the school environment. Research results concerning drug use in schools indicate cause for concern as there are many cases recorded, even in primary education. Thus, substance use in schools is a fact and a real problem and not a possibility and as such should be treated. However, this specific type of problem has always been a taboo subject and neglect has been an ongoing challenge as the school and the teachers are afraid to deal with it. It is essential that educational staff is in the position to realize that students dealing with drug use disorders are not the problem, but they are facing a problem. Additionally, it is of paramount importance that teachers are not only open to accept this type of student disorder that might occur in their school or classroom, but also be able to detect possible symptoms of students associated with such disorders (such as aggression towards teachers or classmates, indolence, sleepiness, etc.), as their role is significant to the promotion of preventive actions and raising students' awareness. However, preventive actions by teachers are unclear and teacher training in issues concerning substance use in school is missing.

The scenario that was designed takes place in the school outdoors space during break time. A female student (named Anna), the so-called scene observer, is watching her classmate (Nikos), who is sitting on a bench, having done substance use and is experiencing the so-called bad trip[1] (Hartney and Gans, 2017). Anna asks another classmate (Kostas) for explanations and he admits that Nikos used substances and at the same time Kostas tries to persuade Anna to smoke a cannabis cigarette. Anna refuses but because of fear, she remains indifferent when finally, the teacher approaches asking questions about the student drug user. The user-teachers were given the opportunity to view the experience from three different perspectives: teacher perspective (see Plate 2 top), student drug user perspective (see Plate 2 middle) and student scene observer perspective (see Plate 2 bottom).

4.3 The research tools

A combination of methods was used for the current research. Two questionnaires were used pre and post the experiment, including closed-ended Likert-scale questions. The questionnaire consisted of questions regarding participant's demographic data, participant's empathy skills and participant's mood states. The empathy scale used was derived based on already existing and validated scales with many modifications so as to meet the needs of the current research. Adjustments to the empathy scale used were carried out in close collaboration with an expert psychologist on drug issues. The mood states scale was based on the Positive and Negative Affect Schedule, which comprises two mood scales, one measuring positive affect and the other measuring negative affect. Moreover, the fitness wristband Fitbit charge 2 was used for the measurement of the participants' HR and the 14-channel wireless EEG EMOTIV EPOC+ for recording brain signals.

4.4 The sample

A total number of 25 participants ($n = 25$) took part in the experiment with 88 percent ($n = 22$) coming from Cyprus, one participant from Greece, one from Serbia and one from Ukraine. Among the 25 participants, 52 percent experienced within the VR the perspectives

Plate 2.
Experiencing the incident through teacher's eyes (top), experiencing the incident through the eyes of the student drug user (middle), experiencing the incident through the scene observer's eyes (bottom)

of the teacher and the student's drug user and the 48 percent experienced the perspectives teacher and student Anna. A total of 72 percent ($n = 18$) were female and 28 percent ($n = 7$) were male, mostly aged from 18 to 39 years old (84 percent). In total, 64 percent of the participants were active teachers, while 36 percent of the participants were not currently working as teachers. According to the results, 36 percent of the participants currently serve in secondary education, 36 percent do not serve as teachers, 24 percent serve in higher education and 4 percent in primary education. The participant's teaching specialty varies among fields including computer science (20 percent), multimedia and graphic arts (16 percent), mathematics (12 percent), literature (12 percent), foreign language (8 percent),

primary school teacher, physical education (sports), sociology, speech pathology and web design. In relation to the participants' prior experience in using VR applications, the results indicate that most of the participants were not familiar with the use of VR as 36 percent claimed to have never use VR in the past, 32 percent claimed to have "a little" experience in the use of VR, 12 percent claimed to have "moderate" experience, 12 claimed "much" VR experience and 8 percent claimed to be "very much" familiar with the use of VR.

4.5 The procedure

Initially, the participants were given a consent form with the instructions regarding the experiment. Then, they had to complete the pre-questionnaire and after the completion of the questionnaire the necessary equipment (EMOTIV EPOC+, Oculus Rift and wristband to record the necessary data) was attached on the user (see Plate 3). The exposure of the participants in the virtual environment lasted approximately 5 min, depending on the pace with which they were advancing the dialogues of the two scenes. After the end of the experiment, the participants were asked to complete the post-questionnaire.

Plate 3.
Preparing the user for the experiment within the VR system

5. Results

5.1 Positive and negative affect scale results

Reliability analysis was conducted on the variables of the positive and negative affect scale for both the pre and post questionnaires. According to the results, the overall α for the pre-test scale is $0.841 > 0.7$ and the overall α for the post-test scale is $0.864 > 0.7$ indicating high reliability of the variables. The results from the tests of normality (namely, the Kolmogorov-Smirnov Test and the Shapiro–Wilk Test) both in pre and post questionnaires, 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.

A Wilcoxon test was used to understand whether there was a difference in participant's positive and negative mood states before and after the use of VR. The response continuum for each positive and negative mood state scale is a six-point scale (not at all-low-a little-moderately-very-extremely) indicating the extent respondents agree or disagree with each mood state. For the problem above the null and alternative hypothesis were:

H_0. There will be no difference in the rankings of participants regarding their positive and negative mood states before and after the use of VR.

Ha. There will be a difference in the rankings of participants regarding their positive and negative mood states before and after the use of VR.

A Wilcoxon signed ranks-test indicated a statistically significant change in many mood states after the exposure to the VR environment (see Table I). More specifically, the use of VR elicited a statistically significant change in participants' state of fear ($Z = -3.51$, $p = 0.000$), as the mean score rating for the state afraid was $M = 5.52$ (SD = 1.05) before the use of VR and $M = 3.3$ (SD = 2.05) after. The results indicate a change in participants' mood state of interest (VR $Z = -2.14$, $p = 0.035$). However, mean scores before ($M = 4.6$, SD = 1.19) and after the use of VR (Mdn = 4.1, SD = 1.53) do not indicate a significant difference. Participants also tended to be more active before the use of VR ($M = 4.3$, SD = 1.22), than after ($M = 3.6$, SD = 1.50), $Z = -2.43$, $p = 0.015$.

Moreover, the results indicate a statistically significant difference in participants' state of being nervous before ($M = 4.6$, SD = 1.73) and after the use of VR ($M = 3.3$, SD = 1.73), $Z = -2.31$, $p = 0.21$. Moreover, the results indicate that the use of VR elicited a statistically

Emotions and mood states	*Z*	Asymp. Sig. (two-tailed)
1. Afraid (post) – 1. Afraid (pre)	−3.508	0.000
2. Interested (post) – 2. Interested (pre)	−2.144	0.032
3. Active (post) – 3. Active (pre)	−2.431	0.015
4. Nervous (post) – 4. Nervous (pre)	−2.310	0.021
5. Inspired (post) – 5. Inspired (pre)	−0.254	0.799
6. Sad (post) – 6. Sad (pre)	−2.940	0.003
7. Upset (post) – 7. Upset (pre)	−3.919	0.000
8. Calm (post) – 8. Calm (pre)	−0.826	0.409
9. Confident (post) – 9. Confident (pre)	−1.224	0.221
10. Tired (post) – 10. Tired (pre)	−0.470	0.639
11. Ashamed (post) – 11. Ashamed (pre)	−2.726	0.006
12. Sleepy (post) – 12. Sleepy (pre)	−3.140	0.002
13. Alert (post) – 13. Alert (pre)	−0.096	0.923
14. Downhearted (post) – 14. Downhearted (pre)	−3.199	0.001
15. Relaxed (post) – 15. Relaxed (pre)	−0.637	0.524
16. Determined (post) – 16. Determined (pre)	−1.403	0.161
17. Concentrating (post) – 17. Concentrating (pre)	−1.890	0.059

Table I. Wilcoxon Sign-Rank test indicating differences between pre- and post-test scores

significant change in participants' state of sadness, $Z = -2.94$, $p = 0.003$ (before the use of VR $M = 5.1$, SD = 1.55 and after $M = 3.2$, SD = 1.96). A statistically significant change in participants' state upset, $Z = -3.91$, $p = 0.000$ (before the use of VR $M = 5.6$, SD = 0.91 and after $M = 3.0$, SD = 1.96) was also observed

A Wilcoxon signed-rank test indicated that participants experienced shame conditions before the experiment before ($M = 1.6$, SD = 1.11) but after the experiment their feeling of shame were decreased ($M = 3.0$, SD = 1.80), $Z = -2.72$, $p = 0.006$. Additionally, there are indications for participants' fatigue after the use of the VR, since the mean score rating for the state sleepy was $M = 4.6$ (SD = 1.19) before the use of the VR and $M = 2.9$ (SD = 1.80) after the use of VR. Moreover, according to the results, the participants were more downhearted after the use of VR, $Z = -3.19$, $p = 0.001$. Indeed, the mean score rating for the state downhearted was $M = 5.1$ (SD = 1.12) before the use of the VR and $M = 3.7$ (SD = 1.89) after the use of VR.

A Wilcoxon signed-rank test showed that the use of VR did not elicit a statistically significant change in the states of inspiration ($Z = -0.25$, $p = 0.79$), calm ($Z = -0.83$, $p = 0.41$), confidence ($Z = -1.22$, $p = 0.22$), tired ($Z = -0.47$, $p = 0.64$), alert ($Z = -0.09$, $p = 0.92$), relaxed ($Z = -0.64$, $p = 0.52$), determined ($Z = -1.40$, $p = 0.16$) and concentrating ($Z = -1.89$, $p = 0.59$).

In conclusion, the results indicate statistically significant differences between pre-test and post-test scores suggesting a significant change in mood states after the exposure to the VR environment. Thus, the null hypothesis is rejected, and an alternative hypothesis is accepted in its place. More specifically, according to the results, the VR experience elicited a statistically significant change in participant's negative mood states (see Figure 2) and did not affect that much their positive emotions and mood states (see Figure 2).

As shown in Figure 2, participant's scores before the experiment lean toward the negative answer scales (6 = Not at all, 5 = Low, 4 = A little), while after their experience within the virtual school world, their scores lean more toward a more central point of the scale (3 = moderately).

Figure 3 presents participant's scores related to their positive emotions and mood states before the experiment, leaning toward the positive answer scales (5 = Very, 4 = Moderately,

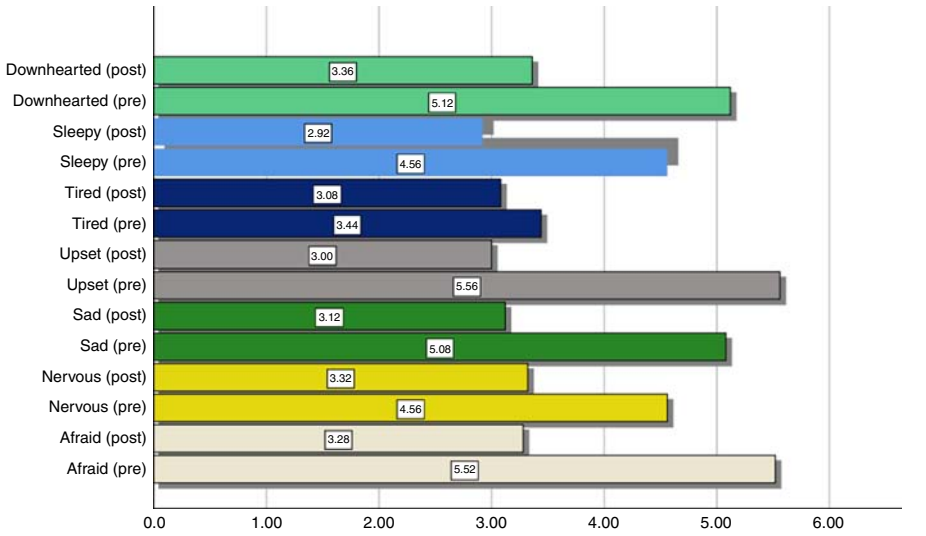

Figure 2.
Participant's negative mood states before and after the use of VR that were most affected

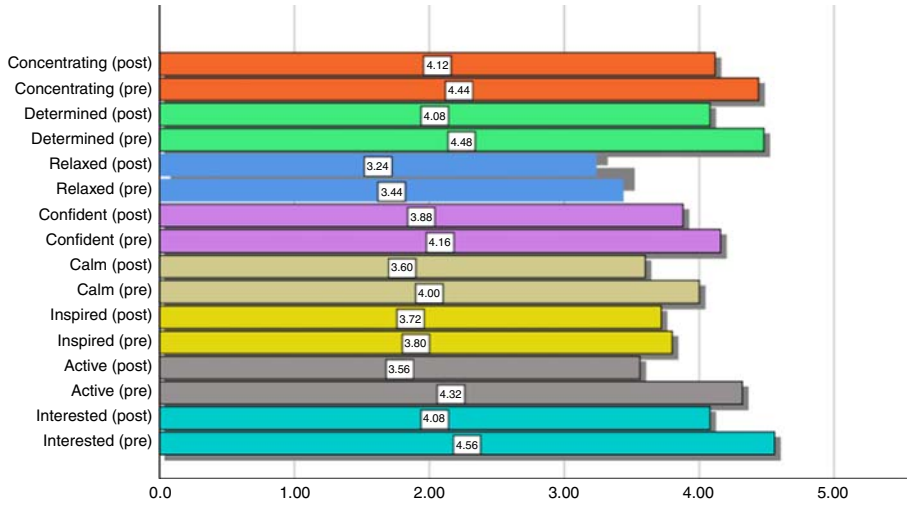

Figure 3.
Participant's positive mood states before and after the use of VR

3 = A little), while after their experience within the virtual school world, their scores were also affected but to lower levels that their negative emotions and mood states.

Another important outcome of the research is related to perspective differences. Mann–Witney test was used in order to investigate possible differences between the participants who experienced the perspective teacher-drug student and teacher-observer student Anna. The Mann–Witney test did not reveal any significant difference between the two groups regarding their mood states, as the p-value for almost all items was > 0.05 both before and after the use of VR. However, from the data, it can be concluded that for the mood state downhearted a statistically significant difference was recorded (p-value $= 0.006 < 0.05$) before and after the use of VR depending on the perspective participants experience. Indeed, the mean score rating for the state downhearted was $M = 5.25$ (SD = 0.96) before the use of the VR and $M = 4.41$ (SD = 1.67) after the use of VR for the group of participants who experienced the perspective teacher-student drug user, while the $M = 5.00$ (SD = 1.29) before the use of VR and $M = 2.39$ (SD = 1.56) for the group of participants who experienced the perspective teacher-Anna. The results indicate that the participants who experienced the scenario as observers where more downhearted that those who were placed in the position of the student with the drug disorder (see Figure 4).

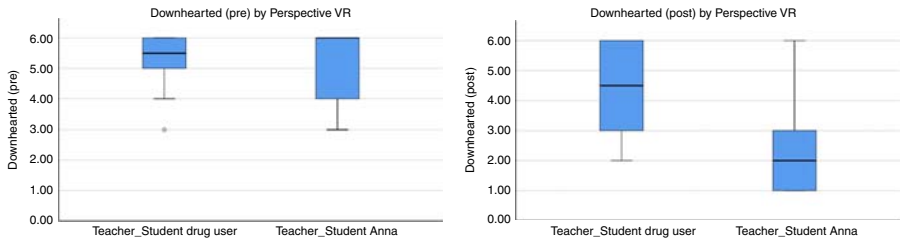

Figure 4.
Participants exposed to the perspectives of teacher-student Anna were more downhearted than those exposed to the perspectives (teacher-student drug user and teacher-observer student)

5.2 Heart rate and EEG signals

During the VR experience, the HR of the participants was measured. The results indicate a significant difference before and after the VR experience. HB1 represents the HR before the experiment ($M = 80.92$ bpm, SD = 10.59 bpm), while HB2 shows the HR after the experiment, ($M = 87.21$ bpm, SD = 10.97 bpm (see Figure 5). Comparing the HR values before and after the exposure to the virtual world using the Wilcoxon test indicated that post-HR scores were statistically significantly higher than pre-HR scores, $Z = -2.86$, $p = 0.004$. Additionally, comparing the HR values with the different perspectives before and after the experiment using a Mann–Witney test was not statistically significant although there are some indications regarding a possible difference between the perspectives ($p > 0.05$).

The EEG signals were analyzed using the MATLAB toolbox EEG Lab. The results indicate significant differences between the different perspectives (teacher-scene observer student drug user student) regarding participants' brainwaves including the alpha and the beta rhythm. The alpha rhythm (8.0–12.5 Hz) is associated with relaxation, while the beta one (12.5 and 30 Hz) is associated with an alert cognitive state, decision making and critical thinking (Ramirez and Vamvakousis, 2012). According to the results, alpha waves were detected only when the scene was viewed from the perspective of the students (both scene observer and drug user), while beta waves were detected in all perspectives (Christofi *et al.*, 2018). Alpha brain activation generation reflects a calm psychological state, while beta activity reflects a more stressful situation (Seo and Lee, 2010). Since the first perspective observed by all participants was that of the teacher, it is possible that they initially experienced increased anxiety and stress that was decreased over time after the familiarization with the virtual space, leading to an increase of the alpha activity during experiencing the perspective of the student. Moreover, beta activity in all perspectives reflects participants' attention and concentration but it could also reflect high levels of stress and anxiety.

The results obtained from HR and EEG signal analysis indicate that the participants were in an alert state during the experiment, while beta brainwaves and the increase of their heart rate can be translated into stress and anxiety. If the participants were happier and more relaxed then the brain would be in an alpha state of activity (Ashtaputre-Sisode, 2016). Looking at these results alone it is unclear if this change is related to the thematic area of the scenario that had to do with substance use or with the VR HMD equipment that was used. However, the combination of the HR and EEG with the questionnaire responses, reinforce the findings and provide strong evidence that the change in HR and EEG signal are induced by the exposure to the scenario rather than just the use of VR equipment.

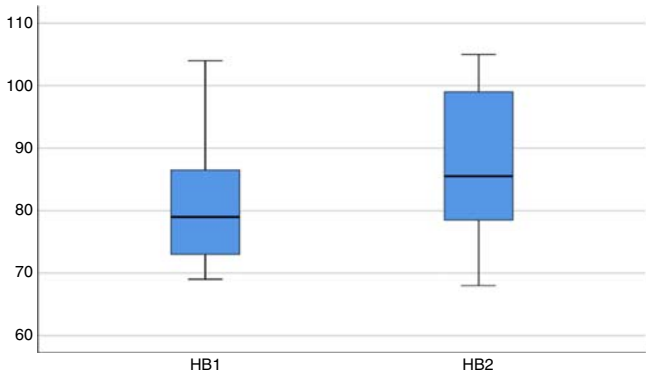

Figure 5.
Participant's heart rate before and after the use of VR

6. Discussion

So far, there have been few available research results on studies concerning the use of VR in teacher education and its effects on teacher training issues. Thus, discussing the results is difficult due to the lack of previous evidence from similar experiments concerning the use of VR in teacher education. The majority of the research so far concerns the use of desktop, large-screen displays and virtual 3D worlds such as second life as part of teacher training. The results seem promising regarding the development of a virtual environment that can provide teachers with realistic and compelling experiences as if they were in a real classroom with real students (Andreasen and Haciomeroglu, 2009; Barmaki and Hughes, 2015; Dieker *et al.*, 2007, 2015; Eisenreich and Harshman, 2014; Ke *et al.*, 2016).

The current study aims to take one step further the potential of providing teachers a virtual practicing environment via using HMD VR systems. HMD are a significant component of VR due to their ability to occupy the entire field of view of users maximizing their sense of immersion and presence related to traditional approaches (Fabroyir and Teng, 2018). This means that the users are placed in a virtual environment that with the use of HMDs replaces their real surroundings in a very convincing way giving the impression that they are really "there" as the virtual space feels to be "real" (Ragan *et al.*, 2010; Shu *et al.*, 2018). Moreover, the last few years improvements in HMDs (such as Oculus Rift and VIVE) have increased the performance of the devices maximizing the realistic experience of the users. Previous research by Shu *et al.* (2018) indicated that the use of HMD equipment was critical for the visual experience of the users resulting into higher levels of being in the scene than the desktop version of the virtual environment. Moreover, another research also showed that the use of HMD motivated and engaged more the users compared to conventional displays (Lhemedu-Steinke *et al.*, 2018).

In this study, the main aim was the investigation of the use of VR in teacher education. The proposed VR-based approach aims to present new opportunities for improving teacher training via using VR environments as part of teacher training methodology that will allow teachers to experience an entirely new side of training. The current paper presented one part of the research and particularly the experiment aimed to investigate participants' emotional experiences within the virtual school space related to a substance use scenario. Investigating participant's emotional experiences was essential as they are highly related to the sense of presence, the sense of being there (Felnhofer *et al.*, 2015; Morie *et al.*, 2005). VR is a medium that evokes many emotional reactions as books, pictures or films (Gorini *et al.*, 2009; Horvat *et al.*, 2018). The results obtained by Kim *et al.* (2014), also confirmed that the more immersive the virtual environment is, using VR equipment such as headsets, the more it evokes emotional responses compared to a desktop PC virtual environment. Thus, as there are indications that a headset used with VR systems is more effective than a desktop computer setting, the current research in an effort to offer the users a highly immersive experience and explore its impact to their emotional responses used VR headsets.

The results indicated that the use of the VR system elicited a statistically significant change in the participant's negative mood states. Before the use of VR participants did not feel fear, nervousness, sadness, upset, ashamed or downhearted. However, after the use of VR, the results indicate a significant change in those states. Regarding the positive states no statistically significant changes were found after the use of VR. One possible explanation for that might be that the relation of the scenario to substance use uses affected only participant's negative states that were absent before the experiment. Previous research by Ding *et al.* (2018) revealed that the use of VR and Oculus Rift headset to watch film clips provoke the participant's strong emotional experiences than those participants who saw the traditional 2D clips. Moreover, the results also revealed more negative emotions experienced by the participants due to a film story that was used in the virtual environment showing a little boy being attacked by a python and threatened by a monkey. Participants' increase in

negative emotions might also be related to the use of the HMD system. Previous research by Kim *et al.* (2014) revealed that the HMD system elicited higher levels of negative emotions that the desktop platform. Nevertheless, further research is required in order to determine the exact impact of the scenario on participants' mood and emotional states or the possible impact of the HMD.

Previous research results indicate that the use of the VR environments elicit higher levels of emotional responses compared to a regular desktop computer setting (Estupiñán *et al.*, 2014). Moreover, the reproduction of sounds from the real world by recording the voices for the avatars might have also increased the realism of the virtual environment and provided participants a rich and immersive emotional experience (Västfjäll, 2003). What is more, the emotional experiences of the users within a virtual environment have to do with the content of the experience (Slater, 2003). It should also be noted that there were participants who were opposed to the use of the specific scenario and argued that teachers should not be responsible to deal with this specific disorder but instead report to the director in order to transfer the problem elsewhere. Moreover, there were few participants who mentioned to have encountered such an incident within the classroom but chosen not to take any course of action during the lesson until the break time in order to mention and transfer the responsibility to the director. It seems that drug-related disorders are indeed a taboo problem for education and VR could provide a training tool that could contribute to raise awareness and sensitize people toward serious problematic conditions.

Previous research by Felnhofer *et al.* (2015) investigated five different scenarios each related to a different emotional state (joy, anger, boredom, anxiety and sadness). In each scenario there were differences in the design elements (e.g. lights and sound) in order to provoke the desirable emotional state. The results of their research indicated that although each scenario was linked to a specific emotional state, to some level in all cases other emotional states were also provoked. Similar to Felnhofer *et al.* (2015), Riva *et al.* (2007) investigated the possibility to induce specific emotional states to the users by manipulating the virtual environments and the results indicated that participants experienced the expected emotional states. Bouchard and Labonté-Chartrand (2010) also tried to manipulate the emotions and induce participants to an emotional state (positive and negative) before the use of VR and the manipulation of emotions was successful before the use of VR. The current research did not aim to produce specific emotional responses but to explore the emotional reactions that the virtual school environment and the scenario elicited to the participants. The proposed VR-based approach is to gain knowledge and experience that is transferable to a real classroom setting. Allowing the users to freely express themselves emotionally within a VR school space might help them control their emotional reactions in a similar situation in their real classroom. In any case, the factors that elicit participant's emotional responses within virtual environments are still unclear (Gorini *et al.*, 2009).

The analysis of the results also indicates a change in participants HR before and after the experiment, with the HR values being higher after the use of the virtual environment. Additionally, the analysis of the EEG signal indicated that the participants experienced a stressful situation that could justify the change in their negative emotions and mood states. It is possible that the scenario which was related to substance use might have affected the participants. Another possible explanation for the increase of participant's HR might be related to the use of the VR headset, Oculus Rift. Available reports of previous researches concerning HR changes while using VR indicate participants' exposure to fear conditioning tasks within VR increased their HR and the increase was higher to the high symptom group than in the low symptom group (Roy *et al.*, 2013). In the study by Malińska *et al.* (2015), the results also revealed that the HR of the participants who experienced the virtual world was higher than those who watched a stereoscopic movie. Guger *et al.* (2004) found that participant's HR decreased in time from the moment the participants were exposed to the

training phase so as to be familiar with the virtual world until the experiment phase. The study also revealed that participant's HR was increased after conversation with the avatars. Furthermore, research by Ding *et al.* (2018) also revealed that HR was higher to the group that used VR.

The increase in participants HR indicates that they experienced a stressful condition as there was also an increase of their negative emotions and mood states. This might be associated to participant's unfamiliarity with VR and the equipment used. It is possible that the participants felt uncomfortable using the headset and in time they did not relax that could have caused a decrease in their HR. It is also possible that the scenario itself was a stressful condition for them as substance use is still a taboo subject that tends to be ignored within the school. Another possible explanation could be the first-person perspective. Slater *et al.* (2010) in their study found that the participants who saw the first-person perspective had higher HR scores that those who saw the scenario from the third-person perspective.

In summary, the results from the present study demonstrate that the virtual school environment and the drug-related scenario affected strongly the emotional experiences of the participants. Using a VR-based approach as part of training provoked strong emotional reactions compared to more traditional approaches. The current findings mark a further step toward understanding the use of VR in teacher education, nevertheless, further research is required as there are many issues that still need to be addressed and will determine the way that such a technology can be implemented in teacher education curriculum.

7. Limitations and further research

This current research contributes to the existing literature regarding the use of VR in the field of education and more specifically in teacher education, providing significant data for the literature. Nevertheless, there are several limitations that need to be addressed in the future. First of all, this research collected data with a relatively small sample of educators, therefore our results can only be seen as a first attempt and therefore should not be generalized. Another limitation of the study was the target group. Teachers are very difficult target group to approach due to their professional and family obligations and the fact that they had to come to a specific place for the experiment due to the equipment that was used, made their attendance difficult. Moreover, experienced and in-service teachers in some cases are skeptical toward the use of such technology within their training as they are also not very familiar with it. Their unfamiliarity with this technology might also affect the results as feeling uncomfortable during the experiments will not allow to express themselves. Thus, their familiarization with such a technology is a necessity in an effort to make them understand its positive effected and change their attitude toward its use. Moreover, their familiarization with the use of VR will also enable them to use this technology as part of their own teaching training their students.

VR use in teacher education and training is still at its infancy and further research is required to determine the exact impact of implementing a VR-based methodology. The current experiment provided significant data that will be used for future experiments. Regarding the effects of cannabis on a user, further research is required, and interviews will be conducted with ex-cannabis users, so that the virtual effects depicted are as close to reality as possible. Additionally, after feedback from some of the teachers/participants, the drug incident would be more likely to take place in the bathrooms of the school and not in an open space like the schoolyard in the future version of the application. Moreover, to further investigate the effects of using VR in teacher education another scenario was designed and will soon be implemented in order to further explore participant's emotions and enhancement of skills in a different scenario involving students with vision and movement disorders, multiculturalism and weight-related problems. What is more, this new experiment targets also pre-service teachers in order to investigate whether the use of

VR can maximize their skills during their training, leading in the long-run to the implementation of this technology as a practical training part of the initial teacher education programs. Furthermore, another goal of the future experiment will be to investigate the use of role-playing technique via using VR technology and see the possible differences compared to traditional training methods.

8. Conclusions

The use of VR has been proposed as part of teaching and learning regarding student learning, but there has been little evidence regarding its use in teacher preparation and development. A part of the current study we aimed to investigate potential differences to the participant's emotional and mood states before and after the use of VR and the results indicated that using VR as part of teacher training can provoke rich emotional experiences to the users, which is very important for their immersion and presence to the environment and their sense of being a part of the virtual world that will maximize the effectiveness of the experience and the outcomes targeted. Additionally, the experiment showed an enormous change in participants' negative emotions and mood states along with a change to participants' HR, yet it is unclear if this change is related to the thematic area of the scenario that had to do with substance use or with the VR HMD equipment. Based on the promising findings of the experiment, further research is required related to the use of VR in teacher education that will determine the effectiveness of such a technology and will develop a pedagogical framework toward its use.

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Note

1. All hallucinogenic, psychedelic drugs including others like marijuana and cocaine can produce intense and distressing effects like frightening hallucinations and delusions.

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Corresponding author
Kalliopi Evangelia Stavroulia can be contacted at: kalliopi.stavroulia@cut.ac.cy