A VIRTUAL REALITY ENVIRONMENT SIMULATING DRUG USE IN SCHOOLS: EFFECT ON EMOTIONS AND MOOD STATES

Kalliopi Evangelia Stavroulia, Cyprus University of Technology
Cyprus

Evangelia Baka, University of Geneva, Switzerland

Maria Christofi and Despina Michael-Grigoriou, Cyprus University of Technology, Cyprus

Nadia Magnenat-Thalmann, University of Geneva, Switzerland

Andreas Lanitis, Cyprus University of Technology, Cyprus

Abstract

Virtual Reality (VR) can be exploited as a teacher-training tool promoting understanding of students' problematic situations. This paper aims to investigate the potential of using VR for teacher training related to substance use by students. During the experiment participants were exposed to a virtual environment showing drug addicted students. Changes in participants' emotional states before and after the exposure to the virtual environment were recorded using EEG measurements, heart rate recordings and self-reported data. The results indicate significant changes to participants' negative emotional and mood states, suggesting that the VR experience had a strong impact on them.

***Keywords**:* Virtual reality, emotions, substance use, teacher education, empathy

Introduction

Substance use is not only a 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. As a result, teachers face similar situations with embarrassment, weakness and fear to face them, while at the school level when such an incident occurs, the usual solution is the transfer of students to another school so as to transfer the problem elsewhere.

Considering all the above, substance use issues in schools is an enormous and challenging problem and it is everyone's duty, especially teachers', to act instead of being idle waiting for things to change or by transmitting the problem elsewhere. Teachers need to act, become more sensitive and deal responsively with students experiencing these disorders. The first step for changing teachers' attitude towards the problem and at the same time cultivating their care, compassion and empathy towards problematic students, is to put them in the position of the student facing the problem, in an effort to make them understand and change their behavior for the well-being of the student. Thus, we propose a novel Virtual Reality (VR) application that could be used to support the cultivation of teachers' empathy skills regarding substance use in schools, which, to the best of our knowledge, has not been done before. Literature regarding the use of VR in teacher education is extremely limited, while substance use related training scenarios have not been used as part of teacher preparation. Using VR based methodology will allow teachers to put themselves in the position of a student that faces substance use problems, in order to understand in depth, the problem raising their awareness. Another significant point is that the proposed VR approach addresses a real problem of inadequate practical training in teacher education, while the scenario is based on real-life incidents and real teachers' needs. In the long-term we aim to develop a VR tool that could be implemented as part of teacher education within universities or other organizations.

The paper describes an experiment that aims to investigate the possibility of cultivating empathy skills to in-service and potential teachers using VR methodology. Moreover, the experiment aimed to investigate participants' emotional states before and after the use of VR. This was essential, as Virtual Reality Environments (VREs) can represent real-life situations, and thus emotions have an integral part to play during the experience of the users. Additionally, investigating participants' emotional experiences is essential to further investigate whether those states affect presence levels within the VR environment and whether some of the states might be used as parameters in order to design the scenario within a VR system for training purposes related to the specific group of teachers. Although presence was also an integral part of the current experiment along with the cultivation of empathy, the results are still under analysis. Therefore, only the results regarding participants' emotional states will be presented in this paper.

Related Work: Emotions and VR

Over the years, emotions have caught the interest of the scientific community. Nevertheless, there is a wide range of scientific opinions regarding the role of emotions. There are scientists who argue that people are always experiencing some emotions. Others claim that emotions do not play a significant role to the

behavior of human, and still others claim that emotions are the primary motivational system of humans and that emotions play a key role in motivation (Izard, 1991). There is a need to investigate emotional experiences in VR environments as there is a lack of research regarding the emotional experiences of users (Felnhofer et al., 2015). The question that arises is why to investigate emotional experiences in VREs. This derives from the fact that emotions "are implicated in our phenomenological understanding of the physical world" (Morie, Williams, Dozois, & Luigi, 2005, p. 1). Media such as books or television can provoke emotions (Reiners et al., 2014). Thus, as VREs can represent real-life situations, emotions have an integral part to play during the experience of the users. Moreover, as Morie et al. (2005, p.2) argue "emotions cannot be easily dismissed when focusing on pedagogical goals."

Despite the fact the VR environments "provide the unique possibility of creating rich and interactive true-to-life replications of emotionally charged scenarios and stimuli," the manipulation of the data regarding emotions from researchers is problematic (Felnhofer et al., 2015, p. 48). Felnhofer et al. argue that limited emotional experiences have been investigated in VR use including relaxation, joy, sadness, anxiety, anger and boredom. Anxiety is one emotion that has been addressed by many researchers in the context of using VR for mental health problems and psychological treatment (Bouchard, 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 the emotions in VR. First of all, skin conductance has been used, as well as heart rate variability (HRV) in order to capture the responses of autonomic nervous system (Baumgartner, Valko, Esslen, & Jäncke, 2006; Kim, Rosenthal, Zielinski, & Brady, 2014). Moreover, electrodermal activity (EDA) has recently been tested as a reflection of the sympathetic activation of the autonomic nervous system (Felnhofer et al., 2015). Lastly, EEG has been used in order to capture the brain signal and its possible alterations as well as self-reports (Menezes et al., 2017; Rodríguez, Rey, Clemente, Wrzesien, & Alcañiz, 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 intention of the user. The use of this multimodal approach was decided in order to achieve higher reliability of the results based on the outcomes of each instrument.

Methodology

The Scenario

The scenario was inspired by the real incident that took place in 2017 in a school in Cyprus which had to do with 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 Country Drug Report of Cyprus and Greece, cannabis was the most commonly used illicit substance in these two countries, and its use was concentrated among young adults aged 15-34 years (EMCDDA,

2017). The scenario that was designed takes place in the school outdoor space during break time. A female student (named Anna) is watching her classmate (Nikos), who is sitting on a bench, having done substance use and is experiencing the so-called bad trip (all hallucinogenic, psychedelic drugs including others like marijuana and cocaine can produce intense and distressing effects like frightening hallucinations and delusions) (Hartney & Gans, 2017). Anna is asking another classmate (Kostas) for explanations and after admitting substance use by the student (Nikos), he is trying to pressure her to smoke a cannabis cigarette. Anna refuses and being threatened by Kostas and because of fear she remains indifferent when finally, the teacher approaches asking questions about the student drug user.

The Virtual Environment

The VR system that was used for the experiment included the Head Mounted Display (HMD) Oculus Rift CV. 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 school environment is presented in Figure 1.

Figure 1. The virtual school in unity and the student's avatars.

The Research Tools

A combination of tools 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 participants' demographic data, participants' empathy skills and participants' mood states. The empathy scale used was based on already existing and validated scales with many modifications so as to meet the needs of the current research and in close collaboration with an expert psychologist on drug issues. The mood states scale was based on the Positive and Negative Affect Schedule (PANAS), which comprises of 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' heart rate, and the 14-channel wireless EEG EMOTIV EPOC+ for the recording of the brain signals. Furthermore, user statistics, recorded from users' head movement through Oculus, was recorded real time through the VR application and was used to track where the user was looking throughout the procedure.

The Sample

A total number of 25 participants (n=25) took part in the experiment with 88% (n=22) coming from Cyprus, one participant from Greece, one from Serbia and one from Ukraine. Among the 25 participants, 52% experienced within the VR the perspectives of the teacher and the student drug user, and 48% experienced the perspectives teachers and student Anna. Of participants, 72%

(n=18) were female, and 28% (n=7) were male. Most of the respondents were from 18 to 39 years old (84%), 8% were from 40 to 49, and 8% were from 50-59 years old. Of the participants, 64% of the participants were active teachers, while 36% were not currently working as teachers. The results indicated that 36% of the participants had no teaching experience; 20% reported to have teaching experience between 5 to 10 years, 16% reported less than 1 years' experience; 12% reported experience between 11 to 20 years, 12% reported experience between 1 to 4 years and 4% reported over 20 years of experience. The results indicated that 36% of the participants currently serve in secondary education, 36% do not serve as teachers, 24% serve in higher education, and 4% in primary education. Regarding participants' teaching specialty, the results indicate a variety of fields including computer science (20%), multimedia and graphic arts (16%), mathematics (12%), literature (12%), foreign language (8%), primary school teacher, physical education (sports), sociology, speech pathology, and web design. Regarding participants' experience in the use of VR environments, the results indicate that most of the participants were not familiar with the use of virtual reality as 36% claimed to have never used VR in the past, 32% claimed to have 'a little' experience in the use of VR, 12% claimed to have 'moderate' experience, 12 claimed 'much' VR experience, and 8% claimed to be 'very much' familiar with the use of VR.

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, there were preparations for the use of EMOTIV EPOC+, Oculus Rift and wristband to record the necessary data. The experiment then began within the virtual world. The exposure of the participants in the virtual environment lasted approximately 5 minutes, 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.

Results

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 alpha for the pre-test scale is 0.841>0.7 indicating high reliability of the variables. According to the results the overall alpha 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 participants' 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 6-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_{null}: There will be no difference in the rankings of participants regarding their positive and negative mood states before and after the use of VR.
>
> H_{alt}: 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 that some post-test scores were statistically significantly different than pre-test scores. Thus, some of participants' mood states were statistically significant different after the use of the VR (see Figure 2). More specifically, the use of VR elicited a statistically significant change in participants' state of fear (Z=-3.51, p=0.000). Indeed, median score rating for the state afraid was Mdn=6.0 (SD=1.05) before the use of VR and Mdn=4.0 (SD=2.05) after the use of VR. Thus, we reject the null hypothesis for the mood state of fear. The results indicate a change in participants' mood state of interest before and after the use of VR Z=-2.14, p=0.035. However, median score rating for the mood interest does not indicate a significant difference before (Mdn=5.0, SD=1.19) and after the use of VR (Mdn=5.0, SD=1.53). Participants tended to be more active before the use of VR (Mdn=5.0, SD=1.22), than after (Mdn=4.0, SD=1.50), Z=-2.43, p=0.015.

Moreover, the results indicate a statistically significant difference in participants' state of fear before and after the use of VR, Z=-2.31, p=0.21. Indeed, median score rating for the state nervous was Mdn=5.0 (SD=1.73) before the use of the VR and Mdn=3.0 (SD=1.99) after the use of VR. Thus, we reject the null hypothesis for the mood state nervous. Moreover, the results indicate that the use of VR elicited a statistically significant change in participants' state of sadness, Z=-2.94, p=0.003. The median score rating for the state sad was Mdn=6.0 (SD=1.55) before the use of the VR and Mdn=2.0 (SD=1.96) after the use of VR. Hence, we reject the null hypothesis for the mood state of sad. Furthermore, the results indicated a statistically significant change in participants' state upset, Z=-3.91, p=0.000. Indeed, the median score rating for the state upset was Mdn=6.0 (SD=0.91) before the use of the VR and Mdn=2.0 (SD=1.96) after the use of VR. Thus, we also reject the null hypothesis for the mood state of upset.

A Wilcoxon signed-rank test showed that the use of VR elicited a statistically significant change regarding participants' state of feeling ashamed before (Mdn=1.0, SD=1.11) and after (Mdn=2.0, SD=1.80) the use of VR, Z=-2.72, p=0.006. Additionally, there are indications for participants' fatigue after the use of the VR, since the median score rating for the state sleepy was Mdn=5.0 (SD=1.19) before the use of the VR and Mdn=3.0 (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 median score rating for the state downhearted was Mdn=6.0 (SD=1.12) before the use of the VR and Mdn=3.0 (SD=1.89) after the use of VR. Hence, we reject the null hypothesis for the mood states ashamed, sleepy and downhearted.

A Wilcoxon signed-rank test showed that the use of VR did not elicit a statistically significant change in participants' inspiration (Z=-0.25, p=0.79). Moreover, a Wilcoxon signed-rank test showed that the use of VR did not elicit a statistically significant change in the states of 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).

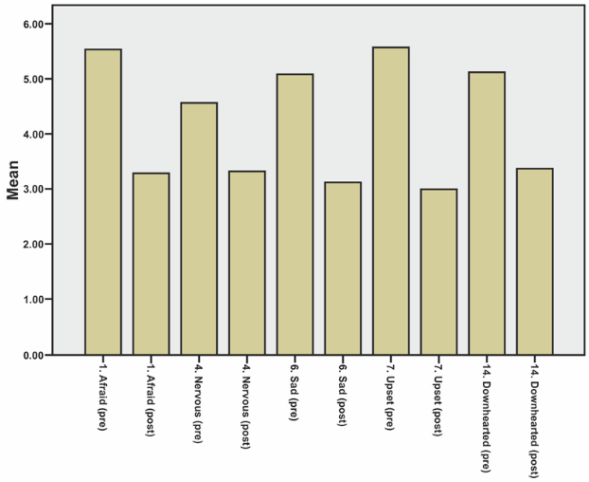

Figure 2. Participant's mood states before and after the use of VR that were mostly affected.

Head Movements

Data was collected regarding the head movements of the participants, and more specifically the objects/people they were looking at more. As mentioned before, all the participants in both groups experienced Perspective I (teacher), in which, 18 out the 25 participants, turned their gaze more times towards Kostas (the student/bully). In Perspective II (Student-drug user), 9 out of 12 participants also turned their gaze more times towards Kostas. In Perspective III (healthy female student) 8 out of 13 again turned their gaze more times towards Kostas. This can be explained by the fact that as observed by the video footage of the participants, they weren't moving their head or their body as much (or at all), and in all three perspectives in front of them was Kostas, so they were looking at him all the time.

Heart Rate and EEG Data

During the VR experience, the heart rate of the participants was measured. The results indicate a significant difference before and after the VR experience. HB1 represents the heart rate before the experiment (M=80.92 bpm, SD=10.59 bpm), while HB2 shows the heart rate after the experiment, (M=87.21 bpm, SD=10.97 bpm (see Figure 3).

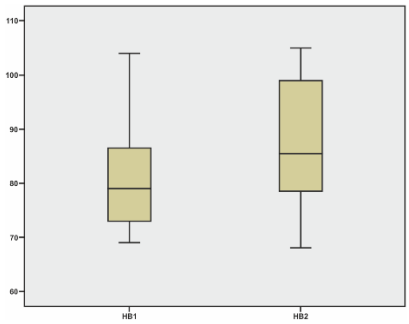

Figure 3. Participant's heart rate before and after the use of VR.

The EEG data are under analysis in EEGLab and NBT toolboxes of MATLAB. The results so far indicate a predominance of the alpha state in frontal and parietal areas for the perspective of the student (healthy or drug user), verifying the results of the questionnaire and the increase in the heart rate. Moreover, there seems to be a difference in the occipital lobe between the three perspectives that can possibly be explained by the intensity of the recruited visual attention.

Discussion

The aim of the current paper was to present the initial results of an investigation regarding the use of VR in teacher education regarding substance use related problems in the school environment. The results are still under analysis; however, the first results indicate that the use of VR elicited a statistically significant change in participants' negative mood states. It seems that the context of the scenario had a strong impact on participants' 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 of those states. Regarding the positive states no statistically significant changes were found after the use of VR. Thus, the scenario affected only the negative states that were absent before the experiment.

Further research is required to investigate participants' mood state changes with a different scenario, because it is possible that the context of the scenario with the drug use was indeed a taboo problem for the participants. Indeed, in-service and experienced teachers after the end of the experiment expressed strongly the opinion that it is not their responsibility to deal with students facing drug problems and their main concern must be to report the situation to the principal's office to transfer the responsibilities. What is interesting is that those teachers reported to have encountered such an incident within their classrooms but refused to act and preferred to ignore the student during the lesson. Thus, raising teachers' awareness and sensitizing them towards serious problematic conditions including substance use should become a priority in teacher training and VR can provide a training tool for this cause.

Nevertheless, this first preliminary investigation provided significant insights regarding the use of a VR based approach to teacher training in relation to substance use problems in the school setting and useful feedback was received

for future changes in the application. Moreover, 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.

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Author Details

Kalliopi Evangelia Stavroulia
kalliopi.stavroulia@cut.ac.cy

Evangelia Baka
ebaka@miralab.ch

Maria Christofi
mu.christofi@edu.cut.ac.cy

Despina Michael-Grigoriou
despina.grigoriou@cut.ac.cy

Nadia Magnenat-Thalmann
thalmann@miralab.ch

Andreas Lanitis
andreas.lanitis@cut.ac.cy