A 3D Virtual Environment for Training Teachers to Identify Bullying

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Abstract—**Incidents involving bullying in schools present a difficult challenge for educators who need to identify potentially dangerous behaviors in comparison to 'innocent' types of inter-student interactions. In this paper we investigate the use of a dedicated Virtual Reality application as a means of training educators to identify alarming bullying activities. The Virtual Reality environment simulates a typical middle school, where different bullying-related incidents take place. The virtual environment is visualized using a Virtual Reality headset in conjunction with eye tracking techniques that facilitate user interaction. In order to make realistic animations that resemble human motions, state of the art motion tracking equipment was used for generating realistic avatar movements. According to the scenario of the application, the user witness different types of student behavior and he/she has to take decisions on how to control and deal with the situation. The prototype was tested by active teachers who reported that the incidents within the simulation were similar to real life experiences and suggested that the application could be used in teacher training education providing inexperienced teachers feedback on how to recognize and manage bullying.**

Keywords—*bullying; virtual learning environments; teacher training*

I. INTRODUCTION

Violence in schools is a global, social and timeless phenomenon with multiple long-term effects on students' academic performance and well-being. One form of violence is bullying. Although bullying within the school setting is not a new phenomenon, the last few years it has received a lot of attention from the educational world as school bullying incidents are increasing and can no longer be ignored. Research reveals that bullying has several negative effects on the students-victims including behavioral, physical, social, emotional and mental-health problems including low self-esteem and depression, decrease of academic performance and school avoidance [1][2]. Moreover, research results indicate that bullying is responsible for suicidal thoughts and violent behaviors of revenge that in some cases can be extreme [3]. In recent years, there have been many school shooting incidents mostly in the United States of America but also around the world and some of the attackers had been identified as victims of bullying and harassment [3].

Teachers are responsible with the crucial role of preventing and confronting school bullying incidents in order to provide to students a safe school environment. However, teachers and especially new teachers lack education on bullying issues and feel unprepared to deal with management issues and behavior problems [4]. Moreover, research related to the ways that teachers confront bullying events is still at its infancy [5] [6]. Furthermore, teachers sometimes instead of confronting bullying incidents tend to cover them in order not to stigmatize the students, leading to the perpetuation of the problem [7]. Teachers are in a difficult position when bullying incidents take place as they are not properly trained to deal with them. It is essential that they are informed about the dimensions of the phenomenon and be trained in order to be able to identify, respond appropriately and reduce bullying incidents.

In this paper we present a Virtual Reality (VR) application that can be used for training teachers to identify alarming bullying behavior. As part of the work a VR simulation of a typical school was designed so that users have the ability to view different types of in-class and outdoors student behavior related with bullying. The user has to assess the situation and provide feedback concerning the required actions for dealing with different incidents. The overall operation of the application was tested using a number of teachers who provided feedback related to the potential of using this application and Virtual Learning Environments (VLEs) in general, as an educational tool for training teachers on how to deal with bullying.

In the remainder of the paper we present a literature review on school bullying and previous attempts to deal with bullying using virtual environments, describe the design of the system, and present an experimental evaluation. A discussion of the findings, conclusions and plans for future work are presented in section V.

II. LITERATURE REVIEW

Bullying is defined as the use of force, threat, or coercion to abuse, intimidate, or aggressively dominate others and it is usually a repeated behavior. 'A student is being bullied or victimized when he or she is exposed, repeatedly and over time, to negative actions on the part of one or more other students'[8]. Bullying is an aggressive behavior that is against one person or a group of persons, it is a deliberate, unprovoked, unwanted and repetitive action that aims to cause physical or emotional pain to the victim [9].

Bullying is categorized into direct and indirect. Direct bullying happens when the target person is present and usually takes the form of teasing, hitting and stealing. Indirect bullying has to do with spreading false and malefic rumors when a person is not present [3].

Bullying takes many forms and the most common are physical, verbal, relational and property damage. Physical bullying involves using of physical violence towards the target person, including hitting, kicking, thrusting and inappropriate sexual gestures [5][9]. Verbal bullying includes taunts, insults, threatening and insulting messages, inappropriate sexual comments, verbal threats and disrespectful comments about someone's appearance, religion, ethnicity, disability etc. [9]. Relational bullying involves behaviors that aim to hurt the reputation of the target person and his/her relationship with other people [9]. Relational bullying is direct when the target person is being isolated, ignored or obstructed from interacting with other people. It is indirect when the victimizer spreads false and damaging rumors, or writes disparaging comments in public places, or sends images of the target person in physical or electronic space without his/her permission [9]. Another form of bullying is the destruction of the property of the target person by the victimizer in order to cause damage including theft, destruction of personal belongings or deletion of personal information [9]. Bullying incidents take place in several locations within the school environments including the classroom, canteen, playground and toilets.

Undoubtedly, teachers play a key role in the management and reduction of bullying incidents not only due to their constant interaction with the students during the school day but also because the presence of an adult reduces the occurrence of the phenomenon [9]. However, research reveals that teachers' intervention towards those incidents is quite ineffective and thus they fail to provide students a safe school environment. Moreover, due to teachers' ineffectiveness to deal with bullying behaviors the students do not approach them for help [10] [11]. Equally significant is the fact that teachers and especially new teachers feel unable to confront bullying due to the lack of knowledge, training and skills [6]. As a result, without training 'teachers have a poor understanding of bullying and how to manage it'.

Therefore it is of paramount importance to educate inexperienced teachers regarding the types, signs and consequences of bullying and equip them with the necessary skills that will allow them to intervene and prevent those behaviors. The first and most important step for the prevention and reduction of the phenomenon is teachers' ability to recognize whether a behavior is bullying or not [12]. Although educational policies and standards have been legislated regarding bullying and schools have developed numerous anti-bullying rules and instructions for teachers on how to deal with those events, what new teachers lack is the practical experience that will allow them to recognize bullying behaviors [13].

The last few years the evolution of technology such as Virtual Reality has allowed the development of new and innovative learning tools. VR environments allow the users to feel a sense of presence, a sense of being part of the virtual environment, an experience that cannot be obtained within the traditional formal education [14]. Thus, VR environments can be used as a potential tool for the training of teachers on issues of bullying management. VR environments that represent the school context have been developed for the treatment of exams anxiety, students' mental disorders, learning difficulties like dyslexia or special needs like autism [15]. Moreover, a virtual environment called FearNot was developed in order to enable children to explore school bullying issues from the view point of the invisible friend of the victimized character [16]. Mii School was another VR school environment that was developed for the detection of drag abuses, bullying and mental disorders in adolescents [15].

Unlike the aforementioned efforts, the proposed application specifically addresses the lack of practice and skills in teacher training related to bullying identification by providing a framework for allowing educators to experience real-life situations that would be impossible to face as part of a training program. By using the proposed application trainee teachers will be able to experience bullying incidents and make the appropriate course of action in order to prevent this behavior.

III. SYSTEM DESIGN

A. Preliminaruy Investigation

As the aim of our application is to address the lack of practice in teacher training in school bullying, there was an effort to record real life incidents that could be incorporated in the scenario of the application. For this reason a group interview took place with experienced teachers and school counselors in order to obtain information about real life bullying incidents that they had encountered. The experienced teachers and school counselors provided multiple examples of school bullying incidents and they suggested that the most important aspect for new teachers is to to be able to differentiate bullying incidents from simple teasing incidents among the students. In addition they stressed out that usually bullying is a repetitive action and thus teachers must observe carefully the behaviors and those students involved in order to identify bullying activities. As part of a possible application for teaching related on how to cope with bullying, trainees should be presented with different incidents involving bullying and non-bullying behavior, so that they learn to separate between the two and take appropriate actions based on the good practices provided by the school administration. Indicatively the necessary actions may be to remain indifferent (in the case that an action is classified as simple teasing), to approach/advise the victim or victimizer or to report the event to the school counselor/principal.

B. Scenario

Based on the feedback received by experienced teachers and school counselors the following scenario was drafted in order to fulfill the needs of required application. The user of the application observes three different incidents involving bullying or 'innocent teasing'. For each of the incidents the user can select one of a series of choices related to the appropriate actions that need to be enforced for each incident. Two incidents take place in the classroom when the teacher enters that classroom and the lesson begins.

According to the scenario (see figure 1 for a graphical illustration) in the first incident some of the students laugh and tease each other making noise. In this case teachers can choose to a) ignore the problem, b) call the principle, c) criticize the entire classroom or d) criticize the students making noise. In the second incident, one student starts throwing papers repeatedly to another student who is sitting in front. During this incident teachers can a) do nothing, b) send the student to the principle, c) talk to the students separately or d) inform the school consultant. The bell rings and the teacher supervises the playground. The student, who was throwing papers during the lesson, approaches the same target person and pushes him causing the victim to spill a bottle of milk. During this incident teachers can a) do nothing, b) isolate the students and talk to them, c) report to the consultant or d) punish them.

Typically the second and the third incident constitute bullying as it is a repetitive action from the victimizer to the same target person. The user must observe carefully the behaviors that take place and the students involved in order to recognize bullying. It should be noted that for each incident the correct interpretation and correct set of actions needed were recorded based on the views of trained counselors.

Figure 1: Typical Screenshots of the application showing different incidents

C. Application Development

The application was developed as a first person 3D virtual environment using the 'Unity3D' game engine. The avatars used in the virtual environment were created with the Maya Autodesk Character Generator student version and were imported in the Unity3D game engine. The classroom models were also developed with Maya Autodesk student version. The school and the playground were downloaded from a free source online (http://studiomugenjohncel.tumblr.com/) and then they were modified using the Google Sketch Up program to suit the needs of our project. Once the avatar models were developed we proceeded to the animation. In order to achieve higher level of realism in avatar movements, motion capture techniques that involved the use of a motion tracking suit in conjunction with multiple infrared cameras, were used in order to record human movements that were used to animate the avatars (see figure 2). Head Mounted Displays and specifically Oculus Rift and

headphones were also used in order to provide teachers a more immersive virtual experience.

An important and innovative aspect of the proposed application is the use of eye tracking package for the Oculus Rift. Although so far research has identified the significance of using eye tracking in 3D environments, eye tracking technologies are not used often in applications. The use of eye tracking in the proposed application allowed the participants to achieve hands free interaction with the environment without having to press the keyboard or hold a joystick. Participant's actions were controlled totally by their eye movements using the focus of the gaze allowing them to concentrate on the application itself so that users were offered a more authentic emotional experience within the virtual environment. The problem with using eye tracking technique was that every time the user focus on a choice either deliberately or incidentally the option will be activated. To solve this problem a dwell-clicking technique [17] similar to the one used in contact-less mouse control was used. .

Figure 2: Recording movements with motion capture

IV. EXPERIMENTAL EVALUATION

The aim of the experimental evaluation was to investigate the usefulness of the virtual reality application for the training of teachers to identify bullying-related activities.

A. Participants

In total ten school teachers, (five male and five female) aged from 20 to 45 years old, participated in the pilot test of the application. Nine of the participants were secondary education teachers and one was a primary education teacher. Five of the participants had six to ten years of teaching experience, two had one to five years of experience, two had eleven to twenty years of experience and one had over twenty years of teaching experience. All of the participants agreed that innovative applications must be implemented in education. The participants rated their computers knowledge from good to excellent. All of the participants claimed to be familiar with the term virtual reality and seven of them reported having used a VR application in the past.

B. Experimental Procedure

Two questionnaires were used for recording the opinions of the participants. The questionnaires consisted of closed-ended five-point Likert scale questions. The first questionnaire aimed to collect demographic dataand general information relative to teaching experience, use of new technologies etc. and was completed before the experiment. The second questionnaire was completed after the use of the virtual environment and aimed to collect data relative to participants' experience in the

VR environment and the usefulness of the VR application as a training tool for teachers. For each participant his/her ability to recognize and apply the correct actions for different incidents encountered in the virtual environment was also recorded.

Before taking part in the experiments all volunteers had to read and sign the consent document that provided general information about the research. In particular, volunteers were informed that the experiment involved a school virtual environment and that they would have to deal with various incidents and take the appropriate course of action. In the instructions given, no direct mention to bullying was stated, so that teachers had to identify without any given hints bullying activities. At the start of the experiment instructions of how to use the application and the actions they had to do were explained to the participants but without providing information relative to the behaviors that they would have to deal with. Additionally, it was explained that the interaction with the virtual environment was based on eye tracking and gaze direction. The actual exposure to the virtual environment was approximately 5-10 minutes for each participant. At the end of the experiment the participants had to complete the second questionnaire. Figure 3 shows participants during the experiment.

Figure 3: Images of participants during the data collection phase

V. EXPERIMENTAL RESULTS

Through the analysis of the questionnaires it was evident that the majority of the participants consider bullying a serious problem within the school environment. Two of the participants assessed bullying as a moderate problem, three assessed it as a very serious problem and five assessed it as an extremely serious problem. The majority of the participants reported that they were not trained on identifying and dealing with bullying-related issues during their university studies. Seven of them reported that they were trained on bullying issues after the completion of their studies while three of the participants reported that they have never received training on bullying.

According to the results teachers believe that they are able to recognize school bullying incidents. Two of the participants assessed their ability to recognize bullying as 'fair', seven as 'very good' and one participant reported an 'excellent' ability to recognize bullying (see figure 4). Moreover, according to the results most participants claimed that in case they recognize a bullying behavior, they will be able to deal with it effectively (see figure 5). Although the participants felt confident on identifying and dealing with bullying issues, the majority expressed the opinion that they need further training in order to enhance their skills relative to the recognition and confrontation of bullying incidents (see figure 6) .
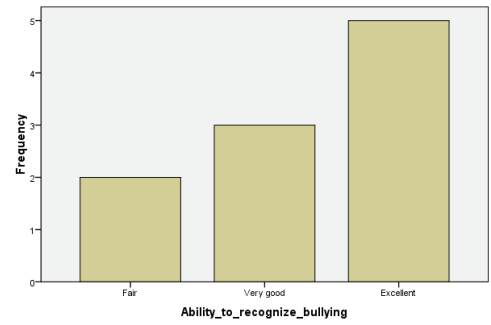

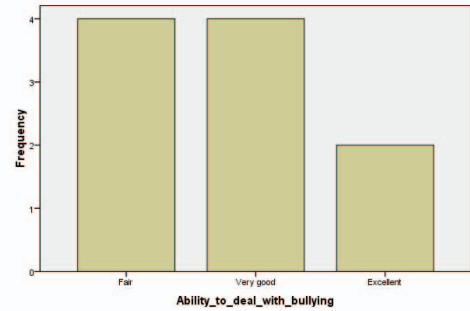*Figure 4*: Participants' ability to recognize bullying incidents

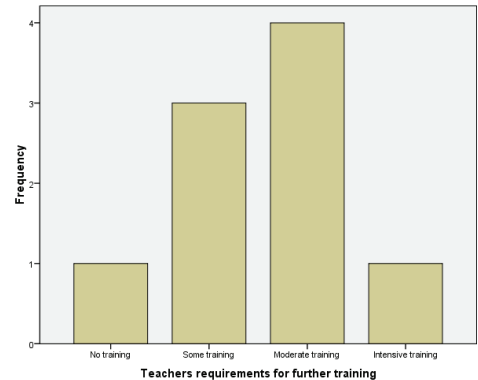*Figure 5:* Participants' ability to deal with bullying incidents

Figure 6: Teachers requirements for further training

The effectiveness of the virtual environment has often being linked to the sense of presence. In order to measure the sense of presence participants were asked to define whether their experience in the virtual environment was just as an observer (like watching a video film) or whether they actually felt that they were physically present at the school virtual environment. From the total of ten participants, six felt that they were present in the virtual school while four of them felt as observers (as watching a video). Moreover, when the participants were asked to rate the level of presence, the majority of the participants felt like 'being there' during the experiment. For one of the participants the sense of presence was 'poor', for one was 'fair', four reported to have experienced a 'good' sense of presence, three a 'very good' sense of presence and three an 'excellent' sense of presence (see figure 7).
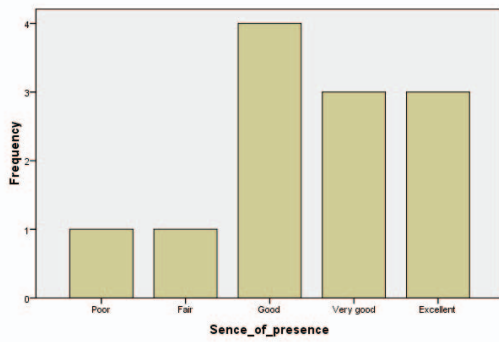
Figure 7: Participants' perceptions about 'being in the virtual environment

The participants were asked to evaluate the experience of bullying appeared in the virtual environment. For one of the participants the bullying experience within the simulated environment was 'poor', for two it was 'fair', for four it was 'good' and for three of the participants the bullying experience was 'very good'. The participants were also asked whether their reaction to the virtual world was similar to that of a real world bullying incident. Nine of the participants reported that their reactions during the simulation were similar to actions for similar real incidents. Just one participant reported that her reaction within the virtual environment was not at all similar to her reactions in real-life incidents.

As we were also interested to examine the use of eye tracking technique, participants were asked about the difficulty of selecting options through eye tracking. According to the results most of the participants were able to use eye tracking effectively during the simulation. The majority of the participants found eye tracking easy to use, with their responses ranging from 'easy' to 'very' easy. One of the participants found eye tracking technique 'very difficult' and one 'difficult' (see figure 8).
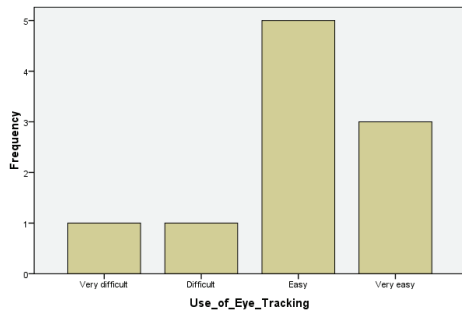

Figure 8: Participants' perceptions about using eye tracking for interacting with the virtual world

Participants reported that the virtual environment did not help them develop their skills on bullying recognition and confrontation to a large extend. One of the participants reported no impact on the development of bullying skills at all, another reported 'a 'poor' development of skills, six reported ''fair' impact of the virtual environment to the development of their skills and two reported that their skills were improved to a high degree. However, it must be noted that those participants who claimed that the virtual environment did not improve their skills also stated that their skills were not improved due to their experience on bullying incidents. Teachers also reported that they witness bullying behaviors similar to those of the simulation every day and thus they were familiar with the specific behaviors. What is important, is that experienced teachers noted that the behaviors within the simulated environment are similar to those of the real world; hence the proposed application provided a faithful experience in dealing with bullying-related activities.

Most of the participants stated that a simulated environment, similar to the application developed, can be very useful for teachers' training in order to help them learn how to recognize school bullying incidents. In particular three participants answered positively with their answers ranging from 'very' to 'very much'. Two of the participants believe that the help of such a tool is 'fair' and one that such a tool can provide no help at all. Nevertheless, it should be noted that all teachers emphasized that such a tool can be very useful for new teachers who did not have prior experience on bullying issues.

After the completion of the questionnaires we asked teachers to identify which of the three incidents were bullying. Four of the participants answered that none of the behaviors during the simulation were bullying and six of the teachers answered that only the last behavior, where students were pushing another student, was bullying. The registered actions of the participants while they were using the application, revealed that despite the fact that the participants felt confident that they could deal correctly with bullying, on average they didn't select the most appropriate actions. In the first case where the students were laughing two of the participants ignored the behavior, five of the participants criticized the students and three of the participants criticized the whole class. In the second case where the student was throwing papers to another student, six of the participants had chosen to criticize the student that was throwing the paper and four criticized the whole class. Finally, during the last case where the student who was throwing the papers was pushing the same student, seven of the participants had chosen to isolate the students and talk to them, one ignored the problem and two reported the problem to the consultant.

VI. CONCLUSIONS

The current research aimed to investigate the potential of training teachers on bullying issues via 3D virtual environments. For the purposes of the investigation a dedicated virtual reality application was developed with the help of professional teachers and counselors. The application was evaluated by active and experienced teachers and the preliminary results revealed that such an application can be particularly useful for the training of new teachers in dealing with bullying related issues.

One significant insight is the fact that although most of the participants were over 40 years old they were able to handle the eye tracking system during the simulation without facing serious problems. Eye tracking made participants' interaction with the virtual environment hands free and thus allowed them a more authentic and real-life experience. Equally important is the fact that participants felt like being in a real school setting

as the sense of presence in the virtual environment was strong. Moreover, the participants reported that the behavior incidents that took place within the simulation were similar to their real life experiences.

What is interesting is the fact that teachers argued that training via a virtual environment cannot contribute significantly in the development of active teachers because they already possess the skills to confront bullying due to their everyday experience. They proposed the use of the application for the training of pre-service teachers who lack the experience to identify bullying. However, most of the teachers failed to recognize both of the bullying behaviors and failed to observe the movements of students that could have allowed them to recognize bullying. A careful observation of the incidents could have allowed the teachers to identify that the victim and the victimizer were the same student avatars, the action was repetitive and thus it was bullying. Moreover, the actions that some teachers had chosen for dealing with the simulated incidents were not those suggested by in-service teachers and counsellors as best practices. Therefore, despite the fact that in-service teachers believed that they can identify and deal with bullying, their actions in the virtual environment indicates that further training is required even for experienced teachers. On the other hand the inability of the participants to deal correctly with the depicted behaviors may be attributed to the fact that the participants operated in a 'new' environment with previously unseen students ('avatars') so it was not possible to use prior experiences of the students to assess their current behavior.

The overall results of our preliminary investigation proved that the initial concept has considerable potential to be used as a real-life training tool. In order to achieve this task we plan to further develop our system in order to include a wider category of bullying and non-bullying incidents, so that we cover most typical cases. The application will be developed as a serious game with instant feedback so that trainees will be able to assess their progress and learn from their misjudgments. In addition we plan to stage a more extensive evaluation that will include both pre-service teachers and experienced users so that based on the results of the evaluation we will be able to contribute to our ultimate aim of providing an effective tool that will help educators to deal with bullying in real life scenarios. Further research is also required in order to investigate whether the use of such an immersive technology in teacher training could result to different learning outcomes than the use of more traditional techniques (like the use of video). There is a need to identify whether VE and the use of 3D virtual glasses offer learners richer learning experiences that enhance their skills. Finally, in the future updated version of the application, users (teachers) will be able to experience bullying incidents not only from the perspective of the teacher but also from the students' viewpoint. Towards this end participants will be able to experience bullying in three ways: as observers, as perpetrators, and as victims enabling them to get a better understanding in relation to bullying activities.

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