

A SYSTEMATIC VIRTUAL REALITY-BASED APPROACH TO SUPPORT THE PROFESSIONAL DEVELOPMENT OF TEACHERS

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Abstract

The purpose of this paper is to present a virtual reality (VR)-based approach to teacher in-class training that will allow teachers to experience an entirely new way of training. The proposed virtual reality tool aims to provide strong support for teachers' professional development through dedicated applications that address real training needs. The overall concept of the VR tool is to address specific teachers' competences, defined based on an extensive documentation of existing teachers' competence models and significant guidance by experts. The implementation of the VR application followed a full design cycle, a five-phase process like that of the ADDIE model, targeting mainly the cultivation of empathy and reflection skills among the users. After conducting several experiments with in-service and pre-service teachers, promising results regarding the cultivation of empathy and reflection skills were observed.

Keywords: Virtual reality, teachers, teacher training, empathy, reflection

Introduction

During the last few years, teachers experienced unprecedented class management challenges that make a necessity investment in their professionalism by upgrading their skills and competencies. Lately, teachers' professional development has become a top priority for the European Union (EU), and special emphasis has been given within the European agenda. 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 the virtual reality technology, it is possible to provide in-service and pre-service teachers a safe environment, within which they are able to experiment and make mistakes but without the risk of harming real-life students. The proposed virtual-reality framework is an instrument that can be used to support teachers' continuous professional development through systematic individualized learning. The aim of this paper is to present the use of VR in teacher education through a five-phase methodological framework approach based on the ADDIE model, 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.

Research results so far indicate that VR is a promising training method for teacher education, which entails a large educational potential. 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 and real teachers' problems and requirements derived from an extensive literature analysis, survey and interviews.

Moreover, the implementation of the VR application followed a full design cycle, a five-phase process based on the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The VR tool addresses specific teachers' competences as outcomes, after an extensive documentation of existing teachers' competence models and significant guidance by experts who pointed to specific competencies of primary importance to teachers.

Literature Review

Problems and Challenges in Teacher Education

The most significant problem in teacher education is the lack of practice in teacher training programmes. Most universities and also lifelong learning programs for teachers rely on theoretical teaching that lacks a strong interaction with the school environment (Hagger & McIntyre, 2006). Thus, those programs do not provide job experiences or practicum that would give teachers the opportunity to learn on the job through the experience of their colleagues, instead of using trial and error techniques in the classroom that may negatively affect the students (Darling-Hammond, 2006). Hence, there is a theory-practice gap that needs to be addressed to lead to high-quality and well-trained teachers leading to high-quality education. Experiential learning can bridge the gap between theory and practice and virtual reality (VR) could offer an effective way for this type of training. Thus, priority should be given to "the classroom teaching expertise" (Hagger & McIntyre, 2006, p. 20), and VR can offer teachers engaging and immersive experiences, allowing them to experience real world classroom situations, reflect on their practice becoming "practically wise" and make the choices that best fit to their educational needs (Caena, 2014). Moreover, the development of 'extreme' scenarios will allow teachers to be trained via simulated stressful conditions that would be impossible to simulate in a real classroom setting.

Virtual Reality in Teacher Education

The last few years, the use of virtual reality environments in education to foster learning has attracted the interest of the scientific community due to its significant benefit to provide users the opportunity to "live and experiment situations that cannot be accessed physically" (Freina & Ott, 2015, p. 6). 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 transferrable to the real world. This fact makes the VR learning environment a suitable tool that can be used for the professional development of teachers. However, despite the extensive use of virtual technology in fields such as medicine and the military, to the best of our knowledge in the field of teacher education its use is extremely limited.

However, preliminary investigations revealed that the use of such a methodology in teacher preparation has considerable potential (Manouchou et al., 2016; Stavroulia et al., 2016). A key point of VR-based teacher training is that within the virtual environment teachers can make mistakes and learn from them but without influencing real students. By the same token, virtual classroom environments aim to provide an innovative training tool that can be used for constant professional development and updating teachers' skills so that teachers can remain productive. Furthermore, the use of virtual environments will allow teachers to take control of their own learning, monitor their progress and thus learn more.

Methodology

Research Question and Approach

The main research question that constitutes the fundamental core of this research is: Can a virtual reality-based learning paradigm be used for the professional development of teachers?

To answer the research question, a systematic approach including five phases was formulated based on the ADDIE model traditionally used by instructional designers and training developers (Molenda, 2003). The ADDIE model was used as a process for the development of the VR training tool. The five phases –Analysis, Design, Development, Implementation and Evaluation– represent a dynamic, flexible guideline for building effective training and performance support tools. Those five phases constitute a set of steps with specific outcomes that work together to enhance the overall outcome of the proposed VR-based approach. A description of the actions taking place in each phase follows.

Phase 1 – Analysis and investigation of Teacher's Needs

Apart from an extensive literature review research, a survey was conducted in Cyprus and Greece in order to register teachers' real training needs. 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, one focus group interview with five 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 training programs and the significance of implementing practice and on the job training within university studies.

Teachers reported that their training is mostly theoretical while it lacks practice, mentoring and counselling. 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

Nowadays, teaching standards are higher than in the past and the teacher's role involves more than simply preparing the lesson and lecturing. Hence, teacher competencies need to be set in a wider context. 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 & Bransford, 2005; European Commission, 2005; McDiarmid & 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 to today’s classroom challenges. Although the models that exist have identified the most significant competencies and skills for teachers it is impossible to address them all within the frameworks 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 application aims to strengthen ensuring optimum teachers’ professional development. The proposed framework of competencies includes two key competencies that are: empathy and reflection.

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 students’ satisfaction and involvement in the educational process (McAllister & Irvine, 2012; Stojiljković, Djigić, & Zlatković, 2012). Additionally, interviews with Greek and Cypriot experts (including teachers, special education teachers and academics) identified empathy as a high-priority skill for teachers. 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 competences only in a model developed by the National Institute of Education (NIE) (2009) in Singapore.

This gap regarding empathy in 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. Stojiljković et al. (2012) argue that there are two major components of empathy, the cognitive and the affective. The cognitive component deals with the ability of an observer to take another person’s perspective, and the affective deals with the ability of an observer to understand another person’s emotional state. For the purpose of the current research only the cognitive component is being addressed in order to investigate the possibility for a teacher to understand a student’s problem (e.g., autism, myopia, etc.) by putting him/herself into the position of this specific student. VR offers the users the opportunity to

experience the viewpoint of someone else, getting an idea of what his/her life might be like (Axelrod, 2014). This fact makes VR a potential future tool in the cultivation of teachers' empathy skills by allowing them to experience the perspective of their students and possible problems that they are facing.

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 that will improve the quality of their work and themselves. 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 & 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 face difficulties in critically reflecting on their teaching practices. Thus, it is essential to address the cultivation of reflective skills via VR.

Phase 3: Designing the Scenarios

Application scenarios were chosen and developed after the extensive literature review, survey and interviews with education experts in an effort to reflect real-life circumstances. The first scenario deals with students' vision disorders. One of the students has myopia, but he feels embarrassed to wear his glasses in the classroom, as he is afraid of being victimized. The student sits away from the blackboard, and the teacher, unaware of his problem, asks him to read the equations written in the blackboard. The student cannot read without his glasses, and the teacher believes that the student is indifferent during the lesson ignoring the myopia condition. As part of the application, users are given the opportunity to see the virtual class through the eyes of the myopic student allowing them to experience the problem (Manouchou et al., 2016).

The second scenario had to do with bullying in schools. During the design process, experts provided multiple examples of school bullying incidents, and they suggested that the most important aspect for the teachers is to be able to differentiate bullying incidents from simple teasing incidents among the students. Within the scenario, the user 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 (Stavroulia et al., 2016).

The third scenario had to do with multiculturalism and verbal bullying in a typical school classroom environment represented within the virtual world. The scenario begins with the teacher inside the classroom together with five students. The teacher introduces a new foreign student called Lynn to the classroom. Following her introduction to the class, Lynn receives verbal bullying from her Caucasian classmates. The user-teachers were given the opportunity to view the same incident in the virtual class from two different perspectives: the participant-teacher views the scene from the eyes of Lynn and the participant-teacher views the scene from the eyes of the teacher (see Figure 1).



Figure 1. The two different perspectives within VR. Through teacher's eyes on the left and through the student's eyes on the right.

The fourth scenario was inspired by a real incident, and has to do with the use of substances given to a 12-year-old student by his classmates (Kounou, 2017). The incident takes place in the school outdoors space during break time. A female student (named Anna) is watching her classmate (Nikos), who is sitting on a bench, having done substance use. The second classmate in the scene (Kostas) is trying to pressure Anna to take and smoke a cannabis cigarette while the teacher approaches them. The user-teachers were given the opportunity to view the experience from three different perspectives: teacher perspective, student-drug user perspective and healthy female (Anna) student perspective (see Figure 2).



Figure 2. The three different perspectives within VR. Through teacher's eyes on the left, through the student drug user's eyes in the middle and through a healthy student's perspective on the right.

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 Figure 3).



Figure 3. The participants during the experiment wearing Oculus Rift.

Phase 5: Implementation and Evaluation

The evaluation stage aims to evaluate the effectiveness of the VR application, providing the information regarding its impact in the professional development of teachers. The assessment of the effectiveness of the VR-based training and the data gathered will provide significant insights regarding the impact of the VR approach in teacher education leading to the development of a tool to support the professional development of teachers and thus increasing the quality of education

Findings Derived from the Experimental Evaluation

In this section the main conclusions derived from the experiments are presented.

Experiment 1 – Vision disorders/myopia scenario. During the VR application teacher-users could see through the eyes of a visually impaired student in order to raise their awareness towards students' eye conditions and to help them identify students with myopia symptoms. Questionnaire-based results indicated that teachers who participated in the experiment reported that they entered the students' position and understand their vision disorder. Moreover, the scenario problematized the participants, and many admitted that it is highly possible that in some cases they had misjudged real-life students' participation in the lesson not because of indifference but due to a vision disorder.

Experiment 2 - Bullying scenario. The second experiment aims to assess the ability of teachers to identify and deal with bullying-related incidents. Within the scenario the teacher-users experienced different types of in-class and outdoors student behavior incidents, and they were asked to identify the bullying related incidents. The most significant result is that in-service and experienced teachers argued that training via VR cannot contribute significantly in the development of their skills as they already possess the skills necessary to confront bullying and proposed the use of the application for junior pre-service teachers. However, most of the teachers failed to recognize and distinguish the teasing incident from the bullying incidents indicating the need for further training.

Experiment 3 - Multiculturalism and bullying scenario. Three groups participated in the experiment, each consisting of 11 participants, and each experienced a different classroom setting among three: virtual environment with realistic class appearance, virtual environment with imaginary class appearance and physical setting in a real classroom (see Figure 4).



Figure 4. The three different classroom settings. From left to right: virtual class with realistic appearance, virtual class with imaginary appearance and real classroom.

The participants who used the VR system claimed that they would not prefer to be trained without the use of VR, while those who were trained with the physical (real) classroom setting claimed that they would prefer to be trained within a virtual classroom world. Concerning empathy, the results indicate cultivation of empathy skills. The participants of all groups claim the importance of entering the students' position to understand his/her perspective to take the proper course of action. The results also indicated the cultivation of reflection skills. There are indications that the VR system can help teachers change the way they will attend to the needs of the students and the way they

will react to disruptive behavior among the students. Moreover, the participants argued that the experience within the VR environment regarding multiculturalism and bullying challenged some firmly held ideas, and because of this experience they will support more students of other racial and ethnic groups, while they will change the way they attend to the needs of those students. Additionally, it seems that this VR experience helped teachers discover faults in their teaching style or in their interaction with students that they previously believed to be right. Finally, participants' emotional and mood states were also investigated, and the results indicated that all participants reported more positive than negative states with minor differences between the three groups, with the most important being that the participants who used the VR tool experienced positive states at a higher level than those who participated in the real classroom environment.

Experiment 4 - Drug use in schools. Twenty-five participants (n=25) took part in the fourth experiment. The results of this experiment are under analysis; however, initial results indicate that the participants felt part of the virtual school and that the scenario had a strong impact on their emotional and mood states. The context of the scenario seemed to have a strong impact on them, and the results revealed that although before the use of the VR the participants had not reported high levels of negative states, the use of VR elicited a statistically significant change in participants' negative mood states, indicating that the non-pleasant scenario "touched" the users. Concerning empathy, the results indicate that there are changes in participants' responses after the use of VR. After experiencing the scenario with the drug related incident, participants reported that they should try to understand the students better, see things from their point of view in order to understand their problem (in this case drug issue) and assist them effectively. However, it should be noted that few teachers who had experienced a drug issue in their classroom reported that they do not feel that they must assist a student with such a problem and that the only action they should do is report it to the principle in order to avoid the problem.

Discussion

The aim of the current paper was to present the initial results of an investigation regarding 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 a teacher training methodology that will allow in-service but also pre-service teachers to experience an entirely new side of training. The current research aims for the development of an integrated VR tool that will provide professional development to teachers, aiming particularly to cultivate empathy and reflection skills. To accomplish this aim, five phases have been identified based on the ADDIE model. The results so far based on the different scenarios that have been developed indicate the potential of using VR aiming to raise teacher's awareness and sensitizing them towards serious problematic conditions that they will encounter within their real classroom. The results indicate the possibility to cultivate empathy and reflection skills via an VR approach, allowing teachers to put themselves in the position of a student that faces various problems in the school environment, in order to experience the problem and raise their

awareness. Nevertheless, further research is required after the analysis of the results that will reveal other issues that need to be addressed. Moreover, a new scenario is under development combining elements from the previous research and after modifications that were suggested from the experiments conducted so far that will be tested by several expert teachers and also pre-service teachers in an effort to create a tool that in the long run could be utilized as part of teacher education.

References

- Axelrod, J. (2014). A virtual reality means you don't have to be yourself. Retrieved from <http://www.pastemagazine.com/articles/2014/12/virtual-reality-means-you-dont-have-to-be-yourself.html>
- Caena, F. (2014). Initial teacher education in Europe: An overview of policy issues. Retrieved from http://ec.europa.eu/education/policy/strategic-framework/expert-groups/documents/initial-teacher-education_en.pdf
- Darling-Hammond, L. (2006). Constructing 21st-century teacher education. *Journal of Teacher Education*, 57(3), 300-314.
- Darling-Hammond, L., & Bransford, J. (Eds.). (2007). *Preparing teachers for a changing world: What teachers should learn and be able to do*. San Francisco, CA: Jossey-Bass.
- European Commission (2005). Common European Principles for Teacher Competences and Qualifications. Retrieved from <http://www.pef.uni-lj.si/bologna/dokumenti/eu-common-principles.pdf>
- European Commission. (2011). *Literature review: Teachers' core competences: requirements and development*. Author: Francesca Caena. Brussels, April 2011. Retrieved from http://ec.europa.eu/education/policy/strategic-framework/doc/teacher-competences_en.pdf
- Freina, L., & Ott, M. (2015, April). *A literature review on immersive virtual reality in education: State of the art and perspectives*. Paper presented at eLSE Conference, Bucharest, Romania. Retrieved from <http://www.itd.cnr.it/download/eLSE%202015%20Freina%20Ott%20Paper.pdf>
- Hagger, H., & McIntyre, D. (2006). *Learning teaching from teachers: Realizing the potential of school-based teacher education*. Maidenhead, United Kingdom: Open University Press.
- Hammerness, K., Darling-Hammond, L., & Bransford, J., with Berliner, D., Cochrane-Smith, M., McDonald, M., & Zeichner, K. (2005). How teachers learn and develop. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 358-389). San Francisco, CA: Jossey-Bass.
- Lai, G., & Calandra, B. (2007). Using online scaffolds to enhance pre-service teachers' reflective journal writing: A qualitative analysis. *International Journal of Technology in Teaching and Learning*, 3(3), 66-81.
- Kounnou, A. (2017, April 4). They gave substance to my 12-year-old son at school complains Father. *Reporter*. Retrieved from <http://www.reporter.com.cy/editors-choice/article/187411>
- Manouchou, E., Stavroulia, K. E., Ruiz-Harisiou, A., Georgiou, K., Sella, F., & Lanitis, A. (2016, April). A feasibility study on using virtual reality for

- understanding deficiencies of high school students. In *Electrotechnical Conference (MELECON), 2016 18th Mediterranean* (pp. 1-6). IEEE.
- McAllister, G., & Irvine, J. J. (2002). The role of empathy in teaching culturally diverse students: A qualitative study of teachers' beliefs. *Journal of Teacher Education*, 53(5), 433-443.
- McDiarmid, G. W., & Clevenger-Bright, M. (2008). Rethinking teacher capacity. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre, & K. E. Demers, (Eds.), *Handbook of research on teacher education: Enduring questions in changing contexts* (3rd ed., pp. 134-156). New York, NY: Routledge.
- Molenda, M. (2003). In search of the elusive ADDIE model. *Performance improvement*, 42(5), 34-37.
- National Institute of Education (NIE). (2009). A teacher education model for the 21st Century. Singapore: National Institute of Education. Retrieved from https://www.nie.edu.sg/docs/default-source/te21_docs/te21_executive-summary_14052010---updated.pdf?sfvrsn=2
- Stavroulia, K. E., Ruiz-Harisiou, A., Manouchou, E., Georgiou, K., Sella, F., & Lanitis, A. (2016, April). A 3D virtual environment for training teachers to identify bullying. In *Electrotechnical Conference (MELECON), 2016 18th Mediterranean* (pp. 1-6). IEEE.
- Stojiljković, S., Djigić, G., & Zlatković, B. (2012). Empathy and teachers' roles. *Procedia-Social and Behavioral Sciences*, 69, 960-966.

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