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Using virtual reality to learning in children with SEN.

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Abstract

Background: Over the years, the use of Virtual Reality (VR) in education has had a significant impact and a wide margin of application as VR environments can offer students more motivation, involvement and satisfaction, managing to promote learning more than to traditional contexts.
Methods: In this study, we wanted to compare two types of learning support in students with Special Educational Needs (SEN) related to socio-cultural disadvantage. History was chosen as a discipline and two groups were selected: one supported through special teaching procedures and the assistance of a specialized educator and a second group using VR with illustrative videos.
Results: Our results showed that the participants in both VR-training and individual training with the educator showed better learning than the starting condition. Furthermore, we highlighted how the group with training in VR achieved better results than the group that had followed a traditional training.
Conclusions: With this study, we have highlighted how students are intrinsically motivated when learning takes place using VR, and the result obtained is manifested in terms of higher learning than less motivated students (who followed traditional training).

Keywords: *Virtual reality, Children, Learning, Motivation, Special education needs, Socio-cultural disadvantage.*

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Introduction

Nowadays, our society is characterized by the continuous development of technology and its involvement into people's daily lives. Technological advances have succeeded in conquering many sectors (medicine, telecommunications, companies, etc...); but the greatest impact it has had is in the field of education. The essential aim of education is to prepare students for life and job career by developing knowledge and skills that are necessary in the society [1]. However, the school has changed considering the needs of students and the change in the business world [2]. The most recent solutions adopted were online courses and computer platforms [3,4].

The spread of hardware and software that have been successfully used in educational processes has shown that the hi-tech industry can improve learning outcomes for most students [5]. In addition, increasingly powerful technological tools have been proposed to help the needs of different student populations [6] notebooks, tablets or mobile phones with specific app have replaced the classic paper notebooks, online classrooms and a personalized learning approach have been used to adapt education both to the difficulties of an historical period and to the specific preferences of each student [7].

Recently, we have also seen how the use of technologies has improved students' attitudes towards learning [8]. In particular, the focus of Virtual Reality (VR) has shifted from videogames to professional development such as military, psychological, medical and educational applications. VR is a useful tool to support and facilitate learning and teaching processes [9]. Numerous researches show that most students remembered what they saw in virtual reality and concluded that VR is a more significant environment than classroom [10].

Therefore, classroom lessons could affect learners' knowledge and practice, which can lead to inability to respond to the challenges that will arise in future workplaces. VR can be used in every type of studying process. For example, tutors can actively participate in the teaching process. In this case, the lesson is conducted by a real person and VR serves as a tool that makes the lesson more interesting: an example is Google expedition. In another study Parkinson et al. examined the potential of VR during the course of geography lessons. More specifically; the teacher reported that students ask more questions than normal lessons. Due to numerous researches,

VR is considered one of the modern options that could add value to the learning path. In addition, it also makes the learning process more interesting and it could increase student's motivation [11].

VR and SEN

VR can also be seen as an assistive technology, its potential to minimize the effects of a disability and provide an alternative tool to perform a particular task makes it really efficient in the learning process [12].

It represents a way to provide opportunities for children with Special Educational Needs (SEN) who would not otherwise be able to experience. Special Education Needs (SEN) refers to particular educational needs that students may manifest even for short periods only: "for biological, physiological, psychological or social reasons, which it is necessary that schools offer adequate and personalized responses (direttivaministeriale del 27/12/2012). The SEN also includes students with problems related to social, economic, emotional, or difficulties due to lack of knowledge of Italian or students with problematic parents (not followed by the family, parents not present, depressed, separated or divorced, etc.).

According to Vauhkonen et al. because disadvantaged people do not have means to achieve goals that are considered valuable in society, they abandon those goals as well as the means to achieve them. Therefore, these students cannot be expected to create these experiences through the natural environment. Finally, VR-controlled environments could be used to ensure that children with SEN gain knowledge through first-hand experience. In this context, VR practices are thought to make an extraordinary contribution to special education [13].

In fact, VR learning environments can be customized to allow a child to focus on their strengths rather than their weakness and to handle a task. It also provides the opportunity to have control over the learning process. Therefore, in this study we selected children with SEN who had a socio-cultural disadvantage. The satisfaction of the needs, the development of skills and the use of appropriate educational environments of these children were taken as a basis for selecting the material and organizing the goals. It is essential considering that the performance of these children is very different from each other because of their individual differences [14].

Aim of the study

Specifically, we wanted to compare two types of learning support (including an average from VR) in students with SEN related to socio-cultural disadvantage. In particular, history was chosen as discipline to investigate and two groups were selected: one supported through special teaching procedures and the assistance of a specialized tutor and a second group supported through the use of VR with illustrative videos. By comparing the two types of support, we wanted to test which one would provide disadvantaged students with a better quality of learning. In particular, the hypothesis verified in the work is that the intervention based on the use of the VR could allow a faster and more stable acquisition.

Materials and Methods

Participants

The sample consists of 100 subjects aged between 9 and 10 years old selected from 12 schools in the province of Caserta. The inclusion criteria were as follows: a) Age between 9 and 10 years, b) Absence of a SLD, c) Absence of other childhood neuropsychiatric conditions present in comorbidity, d) IQ between 85 and 100, c) SES score ≤ that was indicative of socio-cultural disadvantage.

After evaluating the possibility of inclusion in the sample, we divided the subjects into two groups consisting of 50 subjects each one. All subjects were at a social and cultural disadvantage and classified as SEN. This disadvantage condition was detected through the administration of SES. This condition of disadvantage was detected through a questionnaire administered Social Economic Scale (SES) to teachers who reported the socio-cultural condition and the environment of each individual pupil. Questionnaire scores ranged from 1 (very low condition) to level 3 (very high level).

The average score obtained by Gr1 was 1.66 (SD=0.57), while the average score obtained by Gr2 was 1.33 (SD=0.60). The division into the two experimental groups was randomized: the subjects of both groups had the same inclusion criteria. The two groups have undergone two different types of treatment, as will be discussed in the next paragraph. The first experimental group consists of 50 subjects with an average age of 9.25 (SD=0.40) of which 32 males and 18 females. The second experimental group consists of 50 subjects with an average age of 9.50 (SD=0.36) of which 36 males and 14 females. Therefore, there were no age differences in the two groups.

The data were collected at the laboratory of neuroscience, learning processes and Immersive VR of the university of international studies of Rome by psychologists qualified in collaboration with the regional school office (USR) and with the Federico II University of Naples and the university of studies of Campania luigi vanvitelli.

Procedures and tasks

The subjects of this study were divided into two groups according to the type of learning training carried out. The first group performed training in history learning according to traditional methods: the subject was read by the student individually with the educator and the memorization was supported by a feedback process. At the end of the study, a questionnaire consisting of 10 questions was checked and a token economy was used for each correct answer reinforcing after 7 positive answers.

The second group performed a training to learn History through the use of VR. This procedure involved some videos of the topic to be studied in 3D using a dedicated viewer. At the end of the exposure of the video was also carried out an

assessment by a questionnaire and token as well. At T0, all the children had completed individual learning. At the end of the first four months they completed a History questionnaire composed by 90 items to assess the starting level during individual learning. During 4 months (September-December) children which were divided into two groups, performed the two trainings for the learning of History. At T1 (beginning of January) all the children carried out a new questionnaire composed by 90 items with History topics studied during the 4 months of training. It was possible to assess between T0 and T1 whether there were differences in the percentage of correct answers.

Methods

Data analysis was performed using the SPSS 26.0 statistical survey software (2019). Significance at the level of 5% ($p<0.05$) has been accepted. We named G1 (Group 1 that did a traditional learning training) and G2 (Group 2 that did a learning training with virtual reality). We named T0 the measure of the learning training and T1 the measure of the learning training taken after 4 months. We used the student's t test, a parametric statistical test that can be used when two groups in comparison are independent of each other. Specifically, we used the t Test to be able to make comparisons between groups (scores of correct answers) at T0 and to check whether both groups were homogeneous before doing the learning training.

Results

The results showed that the scores ($t(104)= -0.151$, $p=0.880$) were not significant; this indicates that the two groups at T0 (before learning training) were homogeneous (Table 1).

Groups	T0		t	p
	Means	SD		
1	49.15	1.92	-0.151	0.88
2	49.2	1.93		

Table 1. Comparison of two groups at T0. *: Statistical significance $p<0.05$.

We then compared Gr1 and Gr2 at T0 and T1 to assess whether there were improvements after learning training (variable within-time) and then compared both groups at T1 (variable between-group) to see which of the two treatments could allow a better acquisition. Therefore, we performed a two-way mixed ANOVA analysis 2*2: factor within the groups=time (T0 and T1) and factor between groups=group (Gr1 and Gr2).

This analysis showed the following results

Interaction time*group is significant ($F(1,104)=71.798$, $p<0.05$). This data indicates that there is a significant interaction between time and the type of treatment. More specifically, both treatments have a positive effect on the correct responses, but this is more significant for training with VR (Gr2) after training (T1) (Table 2 and Figure 1).

Time	Group 1		Group 2	F	p	
	Means	SD	Means	SD		
T0	49.15	1.92	57.75	2.68		
T1	49.2	1.93	70.58	10.6	71.798	<0.05*

Table 2. Interaction time*group. *: Statistical significance $p<0.05$.

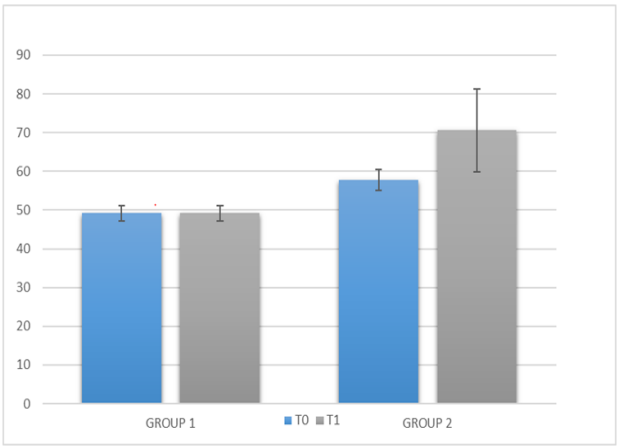

Figure 1. Comparison of two groups between T0 and T1.

Discussion

Numerous research has highlighted how new technologies, such as VR, could improve educational practices and education, especially regarding scientific topics [15]. Recent studies have compared VRLE with other learning contexts [16] and confirm that VRLE could be used in educational contexts because they offer great opportunities. In addition, regarding experimental learning, they are described as more motivating than traditional learning contexts [17]. Due to the immersion and the novelty effect of VRLE, the learning processes turn out to is even more stimulating [18]. One study found that students retain more information and can better apply what they have learned after participating in VR exercises [19].

Considering the potential improvement of learning using VR, it is clear why researchers, organizations and educators are

looking at this technology in recent times, trying to add an extra dimension to the class compared to both teaching and learning. Recently, the use of VR has found positive results in the field of inclusive education and with subjects with Special Educational Needs (SEN), such as children with ADHD, with Autism Spectrum Disorder (ASD), Children with Specific Learning Disorder (SLD) etc. [20].

However, VR-focused literature within the SEN involves little children from a worse sociocultural environment. Therefore, our study aims to implement VR within this specific category of social background [21-25].

With this study we propose a novelty respect to previous studies including a specific category of subjects (SEN) proposing a training in the learning of History using VR [26].

The aim of this study was to consider the effects of using VR for learning with children with SEN by comparing them with an individual learning training with the educator [27-30]. Our results highlighted how participants in both VR training and individual training with the educator showed better learning than the starting condition. In addition, it emerged that the Gr2 (training with VR) achieved better results than the Gr1 (training with the educator) [31-33]. Specifically, we noted an increase in the motivation of these children to learn, in particular the intrinsic motivation linked to the material used and the active participation in the learning context which was precisely greater in the Gr2 [34]. In fact, it emerged that what characterized the training VR was the aspect of active participation and direct involvement in the learning experience that favored an increase in motivation highlighted by the same subjects [35].

Conclusion

Studies on the use of VR in educational contexts have focused more on the assessment of environments and their construction [21] but they do not used to focus on how to learn with VR. With this study we have shown that students are intrinsically motivated and the result is manifested in terms of higher learning than less motivated students (who followed a traditional training). Based also on previous literature, it could be assumed that when the student is intrinsically motivated there is also a greater involvement of cognitive resources and this could lead to a higher learning outcome.

Extensive evidence also suggests that VR technology could increase and improve education in school. However, we only focused to immersive VR, but several have been used for educational purposes, such as 360-degree video, desktop VR, and mixed reality. These technologies may already have reached a higher level of maturity and have been successfully applied for educational purposes. This aspect has not been taken into account in our study and should therefore be further investigated. Moreover, the lack of follow-up on the maintenance of acquired knowledge limits the generalization of the study.

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