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DIVEMIX: PERCEPTIONS OF MIXED REALITY IN SECONDARY EDUCATION IN SPAIN

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Abstract

The growth and rapid development of virtual reality in the last decade has made its inclusion in classrooms of any stage of education to become a latent and patent reality. With the passing of time, virtual reality resulted in the creation of an augmented reality, which further advanced the immersive learning proposed by its predecessor. With technological growth, further advances in this technology were made, to what is known today as mixed reality, yet another step in the immersion of learning. The DIVEMIX project intends to bring to the table the transfer of the creation of materials based on this technology, to further develop the curriculum of the secondary education stage. Focusing our attention on the use of MR in the context of Biology and Geology teaching, and considering the current regulations in Spain as a frame of reference and starting point, we present the perceptions of pre-service secondary education teachers on the usability of this resource for teaching class content. The main result obtained was the lack of training and resources to be able to implement innovative actions in the classroom with MR. It was also determined that gender was not an element that determined the differences associated with the possession or not of knowledge that would allow teachers to use it in the classroom.

Keywords: *Mixed reality, teacher training, pre-service teachers, secondary education.*

1. Introduction

There is an imperative need to make advances in the field of education, as indicated in official documents from many countries.

Focusing on the so-called emergent technologies (Becker et al., 2018; Brown et al., 2020; Pelletier et al., 2021), and more specifically in virtual reality (from here on VR), augmented reality (from here on AR), and mixed reality (from here on MR), we corroborate that their inclusion in classrooms at different stages of education will not only be contingent upon the availability of the resources themselves, but also to the beliefs and experiences of the educators who will determine their use in the development of the curricular content (Black, et al., 2016; Bower, DeWitt & Lai, 2020; Tzima, Styliaras & Bassounas, 2019).

MR is another step in the area of emerging technology, given that it is the combination of VR and AR. Through the use of holograms in a virtual environment (Kumar et al, 2020; Magallanes et al., 2021), users, in this case students, can participate in the development of content, as shown in the study conducted by Palomo (2020). MR "refers to the superimposing of virtual objects on top of a real environment, which allows the user to interact in the real world, and at the same, with virtual images" (Encarnación de Jesús & Ayala, 2021, p. 3). Therefore, it is the blend of both realities, so that the immersion achieved is deeper. Ultimately, the perception of the user changes (Leonard & Fitzgerald, 2018).

Rosati-Peterson, Piro, Straub and O'Callaghan (2021) state that being able to interact with avatars allows students to put into practice strategies and skills that are without consequences in this scenario, beyond what is learned after making a mistake, so that the pressure of not making a mistake is lessened or almost null. Thus, the use of holograms in education environments provides students with a "hands-on" scenario that is safe (Kumar et al., 2020).

2. Method

The present work, under the auspices of the R+D+I Design, Implementation, and Evaluation of Mixed Reality materials for learning environments (PID2019-108933GB-I00), is framed within a quantitative study with a descriptive and correlational design, with an ex post facto method (Jorrin et al, 2021).

The starting objective was to determine the knowledge possessed by Spanish secondary school teachers about the use of Mixed Reality in this educational stage. The following working hypothesis were posited from this general objective:

1. Female secondary school teachers possess more knowledge that the male teachers about MR.
2. Geology teachers have more knowledge on the use of MR in the secondary school stage.
3. Younger teachers have more knowledge on the use of MR in the secondary school stage.

2.1. Procedure

The data was collected through the use of the online questionnaire during academic year 2021-2022, with the use of the Google Forms platform.

2.2. Instrument

The instrument, designed ad hoc, was framed within a more extensive one from the project cited above. In this sense, the intention was to study the dimension (or factors) that referred to knowledge and use of MR in secondary education environments, with this dimension (or factors) composed by two blocks. The first of these blocks encompassed the demographic variables: age, gender, subject taught, and years of professional experience. The second block was composed by 14 items that referred to the knowledge and use of MR in the secondary school stage. A Likert-type response scale was utilized, where 1 indicated complete disagreement, and 5 complete agreements.

The Cronbach's alpha test of the entire instrument provided a value of .955, which is considered very high. In order to verify if the elimination of a specific item would change the reliability of the instrument, an item-by-item discrimination was performed, which resulted in a range of alpha values between .950 and .956, thus confirming the reliability of the instrument (Ventura-León & Caycho-Rodríguez, 2017).

To verify the validity of the instrument, an Exploratory Factor Analysis was performed, which distributed the items into 1 factor, and which explained 65.367% of the variance. The extraction method utilized was unweighted least squares (ULS), with a Kaiser normalization with oblimin rotation. The values obtained for the Kaiser-Meyer-Olkin (KMO) test was .845, and for the Bartlett's sphericity test (X^2 (91) = 335.866 with a significance at $p<0.000$). Thus, considering these parameters, the factorial structure was accepted (Ferrando & Anguiano-Carrasco, 2010). The reliability test was performed again, with the same initial values obtained.

Table 1. Exploratory factor analysis.

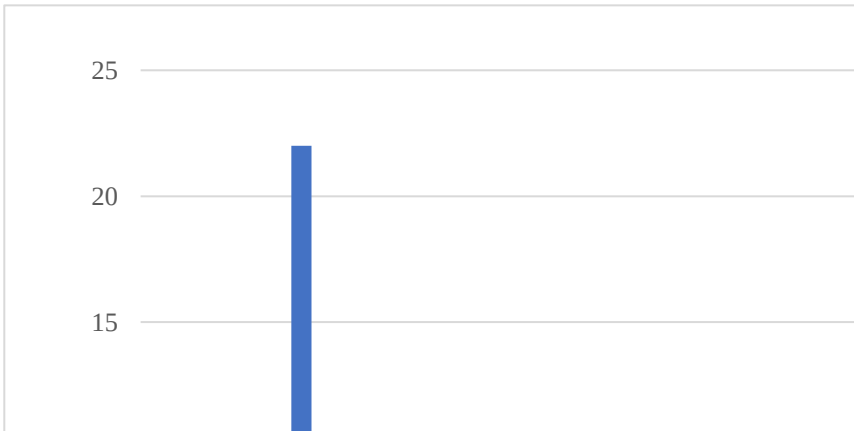
	Factors	
	1	2
I know about MR dioramas	.897	-.070
I know how to use the movement controllers for using MR	.882	-.005
I know about the holographic devices for using MR	.867	-.225
I know the safety, privacy, social, ethical, and moral implications of the use of MR technology	.866	-.099
I know MR portals	.861	-.087
I know about MR holograms	.858	.047
I know how to use immersive devices (goggles/headset) for using MR	.842	.080
I know the computer characteristics needed for using MR	.837	-.231
I know the terminology specific for the MR environment	.834	-.021
I am able to promote learning through the use of MR	.795	.037
I know the technological support necessary for the use of MR in an educational environment	.783	.121
I am familiarized with the variety of applications and programs available for creating virtual spaces in MR	.773	.464
I know about immersive devices (goggles/headsets) necessary for the use of MR	.592	.578
I know how to create virtual spaces for their use in the subject(s) I teach	.541	-.552

2.3. Sample

The starting population was composed by Geology and Biology teachers from the province of Cordoba (Spain), for a total sample of 59 individuals. The sample was obtained through the use of a random, convenience method. Of these, 49.2% taught Geology, and 50.8% Biology.

The distribution of the participants as a function of gender showed that 42.4% were men and 55.9% women, with a mean age of 31.39 (SD = 9.780) (see figure 1).

Figure 1. Distribution of the sample according to age.



3. Results

An initial overview of the results showed that the Biology and Geology teachers who participated in the study had a great lack of knowledge about mixed reality and associated aspects.

Table 2. Descriptive study.

	M.	SD
I am familiarized with the variety of applications and programs available for creating virtual spaces in MR	2.37	1.230
I know the technological support necessary for the use of MR in an educational environment	2.27	1.172
I know how to create virtual spaces for their use in the subject(s) I teach	2.54	1.317
I know about immersive devices (goggles/headsets) necessary for the use of MR	2.51	1.135
I know about the holographic devices for using MR	1.92	.896
I know how to use immersive devices (goggles/headset) for using MR	2.12	.984
I know how to use the movement controllers for using MR	1.90	.941
I know about MR portals	1.93	.980
I know about MR dioramas	1.83	.968
I know about MR holograms	1.85	.979
I know the computer characteristics needed for using MR	1.95	1.074
I know the safety, privacy, social, ethical, and moral implications of the use of MR technology	2.24	1.179
I know the terminology specific for the MR environment	2.03	1.159
I am able to promote learning through the use of MR	2.59	1.275

A Student's t test for independent samples was conducted to corroborate if hypothesis 1, which referred to gender, could be accepted or not. The results did not show any differences in this variable, so it was rejected.

Likewise, the same test was performed to determine if there were differences according to the subject taught. The results showed that it could be partially accepted in 8 out of the 14 items that shaped the questionnaire (see table 3).

Table 3. Student's t-test according to the subject taught.

	Subject	N	M.	SD	p.	t.
I know about immersive devices (goggles/headsets)	Geology	29	2.86	1.246	.031	2.459
necessary for the use of MR	Biology	30	2.17	.913		
I know how to use immersive devices	Geology	29	2.45	1.088	.022	2.659
(goggles/headset) for using MR	Biology	30	1.80	.761		
I know about MR portals	Geology	29	2.31	1.105	.008	3.126
	Biology	30	1.57	.679		
I know about MR dioramas	Geology	29	2.28	1.131	.01	3873
	Biology	30	1.40	.498		
I know about MR holograms	Geology	29	2.21	1.114	.020	2.950
	Biology	30	1.50	.682		
I know the computer characteristics needed for using	Geology	29	2.45	1.242	.000	3.922
MR	Biology	30	1.47	.571		
I know the safety, privacy, social, ethical, and moral	Geology	29	2.79	1.320	.000	3.991
implications of the use of MR technology	Biology	30	1.70	.702		
I know the terminology specific for the MR	Geology	29	2.55	1.325	.000	3.730
environment	Biology	30	1.53	.681		

Lastly, and to provide an answer to the third hypothesis (The younger teachers have greater knowledge on the use of MR in the secondary school stage), an ANOVA was performed to compare the means. The results indicated the non-existence of differences between the teachers according to the variable age.

4. Discussion and conclusions

Making advances in knowledge in general, and in the area of education in particular, implies being in a constant process or learning and re-training on new knowledge, methodologies, and processes, etc.

The teachers who took part in the present study were mainly unaware about the basic computer characteristics needed for using MR, as well as the dioramas, holograms, and MR generator portals, just as in the work by Marín-Díaz and Sampedro-Requena (2023)

Just as in the works by Bursztyn et al. (2017) and in contrast to the work by Marín, Sampedro and Vega (2023), as of today, the variable gender did not lead to differences in the knowledge of emergent technologies, when referring to teachers who teach Biology and Geology. Also, it must be indicated that age did not result in differences in the possession of specific knowledge for the use of MR (Marín-Díaz & Sampedro-Requena, 2023)

It can be concluded that training is needed on the use of MR for Secondary Education teachers in general, and Biology and Geology in particular, for them to increase their knowledge that will allow them to include this technology as a resource in the classroom.

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