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Professional Action Competences Through Experiences With Augmented Reality

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ABSTRACT

This empirical study presents university students' perceptions of professional competences through the use of such technologies as Augmented Reality (AR). The possibilities offered by this technology allow designing educational environments with different contexts that involve non-traditional practices. An online questionnaire was used to gather the data about their opinions of the use of the AR and the factors supporting the development of good professional practices. The sample consisted of 1920 students from the departments of Early Childhood Education, Primary Education and Pedagogy in the 2015/16 and 2016/17 academic years. To analyse the data, the statistical software SPSS 23.0TM was used. Descriptive, inferential and multilevel analyses were conducted. Three researchers analyzed and categorized the students' comments, suggestions, opinions and critics before and after the teaching intervention with the AR. Then, Cohen's kappa of 0,70 coefficient was used to calculate interrater reliability value. The results indicate that we must improve our learning design by incorporating simplicity and flexibility to it. On the other hand, we have managed to activate the professional skills of our students. We propose improvements in relation to the activity that should be intuitive, comfortable and easy. We add that personalized work is a very relevant aspect.

Keywords: Augmented reality, good educational practices, higher education, inclusive ecosystem, teaching attitudes.

INTRODUCTION

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The future of professional development, in this century, has been becoming an exciting adventure thanks to emerging technologies, especially Augmented Reality (AR) and Virtual Reality (VR). This issue yields to two crucial questions 'What are they?' and 'How do they impact these days?' Because these concepts 'AR and VR' are educational trends in the Horizon Report (Johnson, Adams, Cummins, Estrada, Freeman, & Hall, 2016); both of these technologies act as keys for the professional future.

AR is an emerging technology that enhances reality, combines real elements with virtual elements, and interacts real time through 3D (Azuma, 1997; Radu, 2012). Thus, an increase in human perception within additional information potentially improves the performance of a task or experience (Cuendet, Bonnard, Do-Lenh, & Dillenbourg, 2013). In this field, numerous studies have identified how students can face, interpret and understand the reality when working with this technology (Munnerley, Baconb, Wilson, Steele, Hedberg, & Fitzgerald, 2012). The interaction between real and virtual elements takes place in real time, and requires the participation of the user by producing different levels of involvement. Also, it allows to combine information within different symbolic systems and resources (e.g., video files, podcasts, PDF documents, websites, 3D animations, simulations, etc.) to create different information layers on the real object. When using educational material regularly in the classroom, such as video, audio podcast, or a textbook, a great change occurs when the AR is applied. The main reason lies in the motivational effect it causes on students. They can manipulate and vary the training itinerary. They become active actors in the learning process that is occurring at the time. We want to underline that AR also affects the learning objects themselves, the explanation is that this emerging digital tool provides students with different layers of complementary and meaningful information that helps them accelerate the comprehension process. (Di Serio, Ibáñez, & Delgado, 2013; Cabero, & García, 2016; Schmalstieg, & Höllerer, 2016). Lastly, Extended Reality (XR), as a concept, comprises and integrates all of the aforementioned systems and resources (Qualcomm Tecnologies, 2017).

International observatories have published the updated guidelines in their reports, such as Horizon and Educational Trends, as well as other related researches (Cabero, & Fernández, 2018). The researchers have interested in exploring the identification, significance and impact of the use of applications on educational contexts (Van Krevelen, & Poelman, 2010; Saltan, & Arslan, 2017). Their results and implications have showed significant positive impacts, such as motivation, degree of satisfaction and academic performance. On the other hand, some authors have stated the need for improving the techniques and their accessibility (Akçayir, & Akçayir, 2017; Hantono, Nugroho, & Santosa, 2016). Therefore, there is enough evidence that AR impacts education. Hence, future studies should determine how future teachers integrate these technologies into their teaching careers.

In this sense, several disciplines (i.e., natural sciences, biology, mathematics, physics, statistics and informatics, medicine, architecture, history, foreign languages, visual arts education etc.) have already exploited these technologies. However, there is no consensual answer to the question 'Do these technologies offer educational possibilities?'. Further, the relevant literature indicates an extraordinary bridge between reality and fiction. Therefore, they offer other possibilities for the professional development. For example; teacher education literature shows the impacts of the AR and VR on educational practices.

Educational practices aim at professionally developing future teachers' skills. This objective is closely linked to the concept of educational quality. These practices, which are engraved within an educational context, face students with problematic situations, and measure the quality of their solutions. In this sense, these studies have used AR to determine the quality of the practice (Segovia, Ramírez, Mendoza, Mendoza, Mendoza, & González, 2015).

What quality indicators have been considered? Varied academic disciplines have attended their own contents, and added AR into the designed teaching materials. Learning disciplines such as mathematics or engineering should not dispense with the use of RA and RV.

For instance, AR is a key element for the acquisition of abstractions in mathematics (Sommerauer, & Müller, 2014; Manwaring, Larsen, Graham, Henrie, & Halverson, 2017). Similarly, astronomy, architecture and aeronautic employ such abstractions to develop an evaluation process (Zhang, Sung, Hou, & Chang, 2014). The use of AR in making high-quality industrial pieces (Ayer, Messner, & Anumba, 2016) can enable trainees/students to improve their professional competences. The explanation is the following: for example, welders can practically use AR in electronics training. Thereby, when they are repairing faults, they can also use an interactive guide that provides educational supports and directions. This aspect is very valuable for their safety while handling very dangerous materials. Creating scientific laboratories with these characteristics engages students in these essential study fields, and changes their attitudes toward practical type(s). Also, it and enhances the effectiveness of the use of AR in the designed materials, adaptability of the content, self-assessment and multisensory stimuli (Akçayir, Akçayir, Pektaş, & Ocak, 2016; Díaz, Hincapié, & Moreno, 2015).

Moreover, context-based learning may be added throughout the use of mobile devices and the design of specific applications. That is, it is now very easy to obtain a location using AuGeo, which integrates QR codes, or location options with AR. For example; gymkhanas or games for children integrate aspects of art education and the importance of this support into language learning or learning animals (Hsu, 2017; Zarzuela, Pernas, Martínez, Ortega, & Rodríguez, 2013; Chou, & ChanLin, 2014).

Immersion, as another important aspect, is allowed by these technologies. This characteristic has an important effect on the incorporation of other students with learning difficulties and the empathy that someone can feel for the other, i.e., classmates or teachers. In this sense, the authors reviewed the related literature to highlight how to achieve cultural and inclusive competences (Huang, Li, & Fong, 2016; Yoon, & Wang, 2014; Novotný, Lacko, & Samuelčík, 2013). For example; in the case of cyber bullying, it is possible to test the capacity to handle stress and solve problems in chaotic situations by developing training simulations, and keeping people out of danger. AR and VR help people identify any improvement area and generate their own knowledge via previous mistakes.

How do future teachers perceive the use of AR in educational centers?

Including technologies into learning processes requires to take the roles and demands of the 21st century into account. Today's society needs to transcend the traditional paradigms and search for new teaching ways.

One of the most important ideas in educational centers/systems is to search for justice and equality. The existing literature on emerging technologies and revising the teachers' opinions states that this idea can be achieved through the use of technologies. It is increasingly obvious that teachers and places or contexts negatively influence the completion of the student learning.

When implementing these training experiences, it is important to consider their impacts on the immersion processes for acquiring significant learning. Moreover, the researchers wanted to highlight how they created and developed collaborative work groups. This situation would support the development of virtual proposals that can be efficiently integrated in educational ecosystems. AR, as a tool, helps not only developing different active methodologies, such as problem-based learning and case studies, but also promoting collaborative learning. Hence, AR mobilizes all these methodologies (Wojciechowski, &

Cellary, 2013; Abdurrahman, Setyaningsih & Jalmo, 2019). As previously mentioned, breaking the limits between formal and informal education includes virtuality in education (Pérez-Sanagustin, Hernández-Leo, Santos, Delgado Kloos, & Blat, 2014). The number of studies about the advances in the use of mobile devices have currently been booming (Chang, Wu, & Hsu, 2013), and providing information about the achievements in educational applications jointly designed by engineers and educators. Engineers design apps that improve their learning possibilities by integrating them into students' lives. This is a road for an educational quality and the development of intelligent learning (Sungkur, Panchoo, & Bhoyroo, 2016).

Problem Statement

University education requires attractive actions and connects AR to reality. The aim of this study was to identify the need of the use of AR and design new learning environments by adapting the contents, producing sensorial stimuli, experiencing self-assessment, and breaking the limits between formal and informal practices.

The current study aimed to determine possibility of transforming teaching practices to other intelligent learning practices, and making AR applicable. It focused on the following specific objectives:

1- To know university students' perceptions of the use of AR in teaching practices before and after the teaching intervention.

2- To determine whether there is any difference between university students' perceptions based on their departments . Find out if there are differences in perceptions depending on the specialty studied by university students.

3- To obtain how the factors (age, sex and academic course) influence their perceptions.

The following research questions guided the present study:

Does instruction with AR change the university students' attitudes and learning motivation toward its use?

Do university students' personal characteristics influence their perspectives of the use of AR in teaching practices?

Research Focus

To incorporate this technology in teaching practices, this study, followed four stages: 1) applying pre-test; 2) asking students to think about the questions 'how did the objects work?', 'how did they attribute different tips to the use of AR?' and 'where should they download the application(s) from their mobile devices along with the relative information?'; 3) working individually with the objects in the practical lectures, questions about the contents, AR and object handling for two weeks; and 4) answering the questionnaires about the motivation, performance and quality of the produced object. The university students were informed that the marks in their experiences would be taken into account for the subject evaluation.

METHODS

a) General Research Background

This study employed a quasi-experimental design (Shadish, Cook & Campbell, 2002) aiming to discover the possible relationship(s) between the variables in any phenomenon. It also uses statistical correlation for two or more variables, and considers the interconnection(s) between them (Hair, Anderson, Tatham, & Black, 1998).

b) Research Sample

The participants of this study comprised of 1920 students drawn from the departments of Early Childhood Education (50.5%), Primary Education (13.5%) and Pedagogy (35.9%). Likewise, they were from the first year (20.3%), the second year (34.4%), the third year (3.1%) and the last year of the study (42.2%). Most of the participants were women (86.5% women, 13.5% men) and aged between 18 and 24 years (85.9% of the total sample).

The students from the department of Early Childhood Education were 70 men (3.5% of the students) and 900 women (46.9% of the participants). 43.2% of them was between 18 and 24 years old, while the rest of them (7.3%) was over 24 years old. The frequencies of the students in regard to the year of the study were 200 for the first year (180 women and 20 men; 10 men over 24 years old), 340 for the second year (320 women and 20 men; 30 women and 10 men over 24 years old), 20 for the third year (females and one of them over 24 years old) and 400 students for the fourth year (380 women and 20 men; 80 women over 24 years old).

The students from the department of Primary Education were 80 men (4.2%) and 180 women (9.3%). 80 men and 160 women were between 18 and 24 years old (12.5% of the participants), whilst 20 women were over 24 years old (1%). The frequencies of the students in regard to the year of the study were 50 for the first year (20 women and 30 men; one woman over 24 years old), 90 for the second year (all was females and one of them over 24 years old), one female student for the third year (between 18 and 24 years old) and 110 for the fourth year (60 women and 50 men between 18 and 24 years old).

The students from the department of Pedagogy were 110 men (5.7%) and 580 women (30.2%). 80 men and 500 women were between 18 and 24 years old (30.2%) whereas the rest of them was 30 men and 80 women, and over 24 years old (5.7%). The frequencies of the students in regard to the year of the study were 150 for the first year (130 women and 20 men; 30 women over 24 years old), 210 for the second year (180 women and 3 men; one woman and one man over 24 years old), 30 for in the third year (one man and 2 women between 18 and 24 years old) and 300 for the fourth year (27 women and 3 men; 4 women and 2 men over 24 years old).

c) Instrument and Procedures

Augmented Reality Applications Attitude Scale (ARAAS), This instrument allows to evaluate the level of satisfaction, motivation, attitude or orientation towards professional work and the need for training in Augmented Reality app before and after the training of university students in this area with values from 1 to 5.which is a 5-point Likert type, measures satisfaction level, motivation, attitude or orientation toward professional work and the educational need training need for Augmented Reality applications. The instrument was administered before and after the intervention. The pre-test and post-test consisted of 49 and 57 items respectively. The last item in both cases included an open question to gather the participants' observations (e.g., comments, suggestions, opinions, critics, etc.). The numbers of items in pre-test and post-test were 13 and 16 for the satisfaction level respectively. The motivation dimension comprised of 10 items in the pre-test and 12 items in the post-test, while the attitude or orientation toward professional work contained 16 items in the pre-test and 15 items in the post-test. Lastly, the educational need training need dimension incorporated 9 items in the pre-test and 14 items in the post-test. The open question asked the participants to write down their comments, opinions, critics, etc.

Cronbach's alpha values were found to be 0.72 for the pre-test and 0.73 for the post-test (see Table 1). Likewise, the communality analysis, KMO test for sampling adequacy and Barlett's sphericity test in each dimension confirmed the internal validity of the instrument. Further, the sample was adequate for the instrument. Also, there was a relationship between the items of the dimensions.

Table 1. *The instrument's reliability measures*

	Cronbach's α	
	Pre-test	Post-test
Satisfaction	.67	.71
Motivation	.76	.74
Attitude	.65	.62
Training Need	.69	.75

e) Procedure

The teachers from the different subjects evaluated students in two different sessions. In the first session, the university students participated in a survey prior to the treatment with AR, which was part of the initial evaluation of an interdisciplinary educational module integrated in the inclusive ecosystem. The study plan involved participants from different disciplines/departments (e.g., Education Technology in Early Childhood Education and Educational Organization and Management in Pedagogy). In the second session, the participants completed the post-test to evaluate the same aspects in the pre-test, e.g., the treatment with AR. The participants responded the instrument about 15 minutes in each session.

The study included three phases:

The first phase (Diagnosis and Planning of the experience) contained the administration of the pre-test. The second phase (Design of the training module) targeted to solve a designed problem engaging the students at primary education in the training module. This inclusive ecosystem comprised of two different spaces: virtual and face-to-face. In the virtual space, the students worked in groups to search solutions for the given problems. They were given guidelines and encouraged to use a set of tools that were common in the inclusive educational ecosystem, i.e., a Googgle Professional and training community in google applications community known as "ICT and Road Traffic Safety".

The third phase (Evaluation and improvement) analyzed and compared the results from the post-test with the previous evaluation. The treatment with AR allowed the teachers' perceptions to improve their teaching practices with future students through the involved subjects.

f) Data analysis

The data were gathered by the involved teachers in the different subjects from the Faculty of Education at the University of Seville. They were analyzed using SPSS 23.0TM. The results of the pre-test and post-test firstly focused on the dimensions, and, secondly the students' comments, suggestions, opinions and critics to the open-ended question. Thus, the descriptive and inferential analyses were conducted through the results for each dimension (satisfaction, motivation, attitude and orientation toward professional work and educational need training need for AR apps) by considering the results of pre- and post-test and the specialty of the students. Then, a multilevel analysis was carried out to measure the effects of the treatment with AR on the dependent variables (i.e., their performance levels in pre- and post-test) via fixed factors (e.g., specialty, sex, age and academic course). The multilevel analysis motivated the cluster analysis considering the student profiles based on the four factors (specialty, sex, age and academic course). Lastly, the most representative student profiles were selected to analyze their average results of the pre- and post-tests in each dimension.

The researchers analyzed their comments, suggestions, opinions and critics before and after the treatment with AR. Thereby, they aimed at adjusting the random effect in the analysis. Then, the inter-rater reliability amongst the three researchers was calculated using 0,70 the Cohen's kappa coefficient.

RESULTS

Descriptive analysis shows the average results of the students in the pre-test and post-test. Mean scores of the students from pedagogy, early childhood education and primary education were 123.78 (SD=15.16), 125.11 (SD= 17.09), and 127.08 (SD=17.91) for the pre-test respectively, while those for the same departments were 130.02 (SD=25.02), 133.42 (SD= 19.53) and 138.35 (SD=22.73) for the post-test in the same order.

To compare the results of the pre-test and post-test, the total performances in the tests and each dimension were calculated based on the sum of the items divided by the number of items: (Σx1+…xn) / n. Mean scores of the students from pedagogy, early childhood education and primary education were 2.56 (SD=.34), 2.62 (SD= .38) and 2.54 (SD=.39) for the pre-test respectively, while those for the post-test were 2.28 (SD=.05), 2.35 (SD= .07) and 2.43 (SD=.05) for the post-test. Thus, the results of the pre-test were better than those of the post-test for all three departments.

Figure 1 shows the student performances in all different dimensions of the tests (n = 192) in regard to departments. As observed in Figure 1, the level of motivation and the educational need training need for the use of AR were higher in the pre-test than the post-test. Whereas the level of satisfaction remained the same from the pre-test to the post-test, the attitude increased for the post-test.

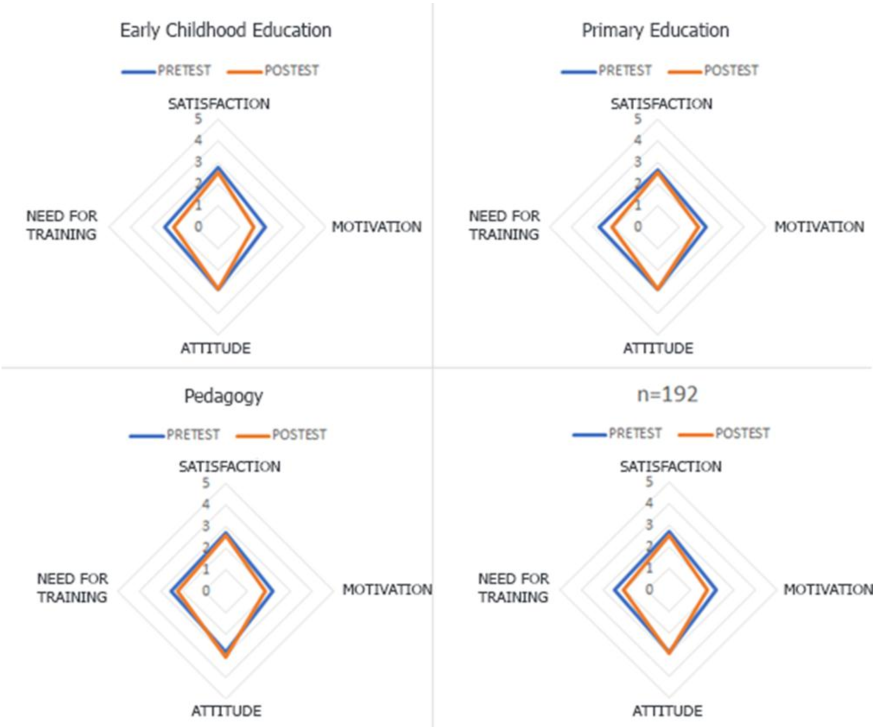

Figure 1. Student performances in the different dimensions of the tests in regard to departments

As seen from Table 2, Kruskal-Wallis test allows analyzing the existence of statistically significant differences between the students from three departments at the significance of 0.05. There were no statistically significant differences between groups in the results of the pre-test. However, statistically significant differences appeared between the post-test's dimensions (motivation, attitude and educational need training need) for the students from three departments , except for the level of satisfaction.

Table 2. *Kruskal-Wallis test*

	Chi-square	*Degrees of freedom*	*Asymptotic significance*
Pre-test			
Total	.808	2	.668
Satisfaction	1.213	2	.545
Motivation	.657	2	.720
Attitude	3.886	2	.143
Training Need	3.949	2	.139
Post-test			
Total	11.093	2	.004
Satisfaction	3.490	2	.175
Motivation	9.108	2	.011
Attitude	15.001	2	.001
Training Need	9.772	2	.008

The fact that significant differences between the students' post-test performances in regard to the departments were found resulted in considering other factors in the student performances of the tests. The predictive values of the specialty, sex, age and academic year for the performances in the tests were analyzed through a multilevel analysis. Four dimensions were considered as dependent variables for the pre-test, post-test and total results, whereas the specialty, sex, age and academic year were seen as fixed factors. Table 3 shows the corrected model in the multilevel analysis. The four factors slightly determined the performances in the tests, and explained no more than 16% of the variance in the best case. However, it was possible to detect statistically significant differences between the results of the pre-test according to four analyzed factors (p = 0.05), the total results and the dimensions of satisfaction and educational need training need.

Table 3. *Predictive values of specialty, sex, age and academic year for the performance in the AR tests in the multilevel analysis*

	Corrected R^2	Sum of the type III squares	Df	Square mean	F	Sig.
Pre-test						
Total	.155	7.578	32	.237	2.096	.001
Satisfaction	.085	5.514	32	.172	1.554	.041
Motivation	.066	13.521	32	.423	1.422	.082
Attitude	.075	4.362	32	.136	1.480	.061
Training Need	.161	19.270	32	.602	2.144	.001
Post-test						
Total	-.077	3.814	32	.119	.571	.968
Satisfaction	-.046	4.800	32	.150	.736	.845
Motivation	-.063	11.055	32	.345	.644	.928
Attitude	.029	3.737	32	.117	1.179	.251
Training Need	-.091	6.362	32	.199	.501	.988

The results of the multilevel analysis showed the need to consider the age, sex and academic year factors as compared with their specialties. Thus, the students were categorized based on these four criteria, and grouped the participants into 33 different groups. Table 4 shows the percentages of the student groups based on four criteria. 40.1% of the students were women between 18 and 24 years old in the department of Early Childhood Education and the different academic years of this program.

Table 4. *Frequencies of the student groups according to specialty, sex,age and academic year*

Group	Spec	Sex	Age	Year	%	Cummulative %
1	ECE	M	A	1	1.0	1.0
2	ECE	M	A	2	1.0	2.1
3	ECE	M	A	4	1.0	3.1
4	ECE	M	B	2	.5	3.6
5	ECE	W	A	1	8.9	12.5
6	ECE	W	A	2	15.1	27.6
7	ECE	W	A	3	.5	28.1
8	ECE	W	A	4	15.6	43.8
9	ECE	W	B	1	.5	44.3
10	ECE	W	B	2	1.6	45.8
11	ECE	W	B	3	.5	46.4
12	ECE	W	B	4	4.2	50.5
13	PE	M	A	1	1.6	52.1
14	PE	M	A	4	2.6	54.7
15	PE	W	A	1	.5	55.2
16	PE	W	A	2	4.2	59.4
17	PE	W	A	3	.5	59.9
18	PE	W	A	4	3.1	63.0
19	PE	W	B	1	.5	63.5
20	PE	W	B	2	.5	64.1
21	Ped.	M	A	1	1.0	65.1
22	Ped.	M	A	2	1.0	66.1
23	Ped	M	A	3	.5	66.7
24	Ped	M	A	4	1.6	68.2
25	Ped	M	A	2	.5	68.8
26	Ped	M	A	4	1.0	69.8
27	Ped	W	A	1	5.2	75.0
28	Ped	W	A	2	8.9	83.9
29	Ped	W	A	3	1.0	84.9
30	Ped	W	A	4	10.9	95.8
31	Ped	W	B	1	1.6	97.4
32	Ped	W	B	2	.5	97.9
33	Ped	W	B	4	2.1	100.0

Note: ECE=Early Childhood Education; PE= Primary Education; Ped. = Pedagogy; M= Man; W= Woman; A= between 18 and 24 years old; B= over 24 years old; 1= First-year of the study; 2= Second-year of the study; 3= Third-year of the study; 4= Fourth-year of the study.

The average results of the pre-test (specially the dimensions of satisfaction and need for training) and post-test of the groups were the highest scores for Groups 5, 6, 8, 28 and 30. Groups 5, 6 and 8 comprised of female students (aged 18-24 years) in the first-year, second-year and fourth-year of early childhood education respectively. Groups 28 and 30 comprised of female students (aged 18-24 years) in the second-year and fourth year of Pedagogy respectively. . Figure 2 shows the differences between the results of the groups for the dimension ‘training need’ in the pre-test. The results of the rest of the dimensions (satisfaction, motivation and attitude), tests (pre-test and post-test) and groups (5, 6, 8, 28 and 30). In order to focus the analysis of our results, we analyze Figure 2 that illustrates the different data obtained when crossing the items and the origin of the students, according to their age and the groups of different academic degrees that have intervened.

We remind that our focus of analysis is in the post, specifically in the dimensions SATISFACTION and NEED FOR TRAINING, in groups 5,6, 8, 28 and 30. We will describe group 5 corresponds to a group of students that are between 18 and 24 years old, are attending the 1st Child Specialization Course, group 6, is made up of students between 18 and 24 years old who are studying 2nd of the Primary Education specialization, group 8, is made up of students between 18 and 24 years of age who are in 4th grade of Early Childhood Education specialization. Group 28 is made up of students between 18 and 24 years of age who are studying 2nd in the specialty of Pedagogy, and group 30, by students between 18 and 24 years of age who are studying the specialty of 4th in Pedagogy. We can infer how academic specialties are not a differentiating factor in the analysis.

In this sense, we can observe how the dimension NEEDS TRAINING in the pretest is accentuated. This means that students at their starting point share the same training needs regardless of their academic degree and age. We obtain identical results, when we analyze the following dimensions: satisfaction, motivation or attitude.

We can infer that the level of SATISFACTION is maintained and the ATTITUDE towards the use of RA increases in general terms and fell into the similar ranges. The selected groups showed higher levels of motivation and training need for the AR in the pre-test than the post-test, whereas the level of satisfaction was practically the same from the pre-test to the post-test. Also, the attitude for the post-test increased in general terms.

Figure 2. The results of the main student groups according to specialty, sex, age and academic year

DISCUSSION

The first question ‘Why were the post-test results lower?’ may come from the design of learning experiences, good advising on the learning objects and the information about the evaluation and feedback processes. Therefore, revising the design of the educational modules calls for the data providing evidence on the importance of simplicity and flexibility.

It is important to consider efficient indicators of these educational practices, such as the number of the group members. In this sense, the authors reviewed the implications of other related studies (Pelargos et al., 2017).

The results of the factors related to sex, age and academic year had a great influence on the AR-assisted learning, which is in line with relevant literature (Cabero, & Marín, 2018; Cabero, & Marín, 2018). Thereby, future studies should consider these aspects when designing further research activities and instruments.

The fact that the average results were better for the pre-test than the post-test in all three specialties may be explained by the following reasons: firstly, educational AR might not be satisfactory and, secondly, the lack of knowledge on the use of AR in the initial evaluation might lead the students to overvalue their answers, which might be more accurate after the educational AR. This may call for a improving the aspects related to the accessibility and the used technique. Statistically significant differences between the students from the three departments for the post-test, except for the dimension 'level of satisfaction' show that specialty is relevant to the students' level of motivation, attitude and the training need for the AR. Also, other factors (sex, age and academic year) had the significant differences in the pre-test. Particularly, the results of the pre-test indicated statistically significant differences in the total and dimensions 'level of satisfaction and the training need'. Further, other criteria increased the differences for the initial valuation. The results of the post-test showed an increase in attitude, whereas the dimensions 'level of motivation and educational need for the AR' were higher for the pre-test than the post-test. The dimension 'level of satisfaction' remained similar for the pre-test and post-test. This occurred at the specialty factor. Also, the multivariate analysis of influential factors in the performance of the tests revealed the sample, sex-based groups, age and academic year when the most representative groups were used. The question 'Why was motivation higher in the pre-test?' may be addressed with the lack of knowledge about the tool and its real applicability. That is, they may have led the students to have a higher initial motivation. The question 'Why was the training need higher in the pre-test?' may stem from the fact that the students had acquired more information about the tool after participating in the course/workshop. The authors have not had any clear answer to the question 'Why did the level of satisfaction remain similar at the pre-test and post-test?'. It is possible that their expectations about the applicability of the AR might have been fulfilled after the teaching intervention. The question 'Why did the attitude increase?' may result from the students' interest toward the use of the tool after the teaching intervention.

Considering the perceptions of the participants, and the objectives proposed in this study, it can be concluded that the AR is an efficient application at improving the personal projects of the students. Moreover, it helped the users comprehend complex topics, and increase their motivation levels with the design and creation of multimedia materials proposed in the learning modules. Thus, it has a potential to become "own designer"of the AR objects. A change in attitude toward the AR, in particular, may come from the use of Information and Communication Technologies (ICT), in general, and influential role of active education. These results pointed no comparisons or differences according to sex, academic year or specialty. Moreover, there were no data on another hypothesis taking into account the evaluation of the students, orientation toward learning, effort to meet the proposed goals, and so forth. For further research on this subject we should study the differences found according to sex and academic qualifications. It would also be of interest to add the qualifications obtained by the students, if the methodology used and, from the didactic or formative point of view, has been adequate. Without a doubt, if we make an important aspect in the results, it is the positive attitude of the students towards this type of experiences and the integration of emerging technologies. We repeat the importance of this experience in the training processes of future professionals, they have acquired new professional competences and when it comes to sharing and disseminating abstract content, it has been possible to view and observe problems from multiple perspectives.

This study deduces that the AR has provided very positive attitudes for the students, who had experienced it. Therefore, this technology enhances educational processes and advocates the acquisition of professional competences by allowing the students to observe the objects from multiple perspectives. In this sense, future teachers should design their own didactic model incorporating the AR in that the use of this application has important effects on the selection of activities or cognitive and intrinsic motivational challenges (Pintrich, 1999; UNESCO, 2015). Overall, it could help the students develop or foster collaborative work (Waugh, & Su-Searle, 2012).

CONCLUSIONS

This study, which employed educational activities for the students from Early Childhood, and Primary Education and Pedagogy targeted to design an enriched educational module with the AR. The objective of this study was to activate professional action competences and recruited constructive methodology based on learning projects and learning ecosystems. These educational ecosystems facilitate the development of an active, playful and motivated education that removes superfluous information. Thus, ubiquitous and mobile learning enhance these educational ecosystems. Likewise, the AR helps the students create laboratories or simulators of conflictive situations by providing safe environments. This may be a fundamental idea for introducing innovative technologies such as AR in inclusive learning ecosystems. Given long-term analyses (meta-analyses of ten or fifteen years showed the positive results) (Tekedere, & Göker, 2016), the educational applications with the AR have had a positive effect on student learning. However, this effect seems to have appeared a medium level that could not be underestimated according to the Thalheimer and Cook's Classification (Thalheimer & Cook 2002).

The present study showed how the students' values of the use of emerging technologies (e.g., AR) decreased after the treatment. This may come from the design of the modules. That is; the modules should have focused on brief and direct contents (simplicity and flexibility principles) instead of overflowing and cognitive disorientation while the students were using the object(s). This aspect is consistent with other studies and their conclusions (Cabero & Marín, 2018). Another recurring aspect, on the other hand, future teachers ought to be willing to endure when carrying out these activities. An improvement at making an intuitive, comfortable and easy interaction with the object points to basic principles in the use of emerging technologies. Likewise, given the idea 'text book" in paper is no longer the predominant format in the field of education', every production capable of incorporating different elements from other symbolic systems should activate multiple aspects of intelligence and the targeted competences.

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List of abbreviations

AR: Augmented Reality
App: Aplications
KMO: The Kaiser-Meyer-Olkin. Mesuare of Sampling Adequacy
SPPS: Statistical Software
UNESCO: United Nations Educational, Scientific and Cultural Organization
VR: Virtual Reality.