https://doi.org/10.32541/recie.2020.v4i1.pp116-123

AUGMENTED REALITY OF SOCIAL ENVIRONMENT KNOWLEDGE IN THE CLASSROOM IN PRIMARY SCHOOL

Realidad Aumentada del Conocimiento del Medio Ambiente Social en el salón de clases de Primaria

Verónica Marín-Díaz*[1]
vmarin@uco.es

Begoña Esther Sampedro-Requena[1]
bsampedro@uco.es

Juan Manuel Muñoz-González[1]
juan.manuel@uco.es

* Autora por correspondencia
[1] Universidad de Córdoba, España

Fecha recepción: 18/11/2019
Fecha aprobación: 5/01/2019

ISSN (impreso): 2636-2139
ISSN (en línea): 2636-2147
Sitio web: https://revistas.isfodosu.edu.do/recie

Abstract

The increased use of information and communication technologies is now a reality that cannot be ignored. The portals, blogs, videos, etc., that we can find on the internet about positive experiences of their use show that the teacher-mediated use of them can turn the curriculum into something that is more attractive to students. Therefore, subjects such as Mathematics, which have a significant degree of complexity for some students, can become appealing and "simple". One of the so-called emergent technologies, which day by day has become more evident, is Augmented Reality. Saddled between virtual reality and scenic realism, its addition to classroom methodologies implies the possibility of experiencing the content first-hand. In this article, we present the results of a teaching innovation experiment conducted with Primary School students in Spain. Through the "Augment" program, the specific content named "The machines" was developed. This content corresponded to the school subject of Sciences. The starting hypothesis consisted on the use of Augmented Reality for the consolidation of content explained in the traditional manner. Afterwards, the students evaluated the experience developed. The main result obtained is the positive scoring of the tool by the students. Thus, we can conclude, plausibly, that its use in the classroom facilitates the learning of complex content.

Keywords: augment reality, learning, primary education, social environment knowledge, students, teaching.

Resumen

El incremento del uso de las Tecnologías de la Información y la Comunicación es ahora una realidad que no se puede ignorar. Los portales, blogs, videos, etc., que podemos encontrar en Internet sobre las experiencias positivas de su uso, muestran que el uso de ellos por parte de los docentes puede convertir el plan de estudios en algo que sea más atractivo para los estudiantes. Por lo tanto, materias como las Matemáticas, las cuales tienen un grado significativo de complejidad para algunos alumnos, pueden volverse atractivas y "simples". Una de las llamadas tecnologías emergentes, que día a día se ha vuelto más relevante, es la Realidad Aumentada. Engarzada entre la realidad virtual y el realismo escénico, su incorporación a las metodologías del aula implica la posibilidad de experimentar el contenido de primera mano. En este artículo, presentamos los resultados de una experimentación de innovación docente realizada con estudiantes de primaria en España. A través del programa "Aumentar" se desarrolló el contenido específico llamado "Las máquinas". Este contenido corresponde a la asignatura escolar de Ciencias. La hipótesis fue que el uso de Realidad Aumentada para la consolidación del contenido explicado de la manera tradicional. Posteriormente, el alumnado evaluó la experiencia desarrollada. El principal resultado obtenido es la calificación positiva de la herramienta por parte de los alumnos. Por lo tanto, podemos concluir, plausiblemente, que su uso en el aula facilita el aprendizaje de contenido complejo.

Palabras clave: alumnos, aprendizaje, conocimiento del medio social, Educación Primaria, enseñanza, realidad aumentada.

1. Introduction

Information and Communication Technologies (ICT from here on) evolve in a vertiginous rhythm, provoking changes in the style and rhythm of the life of the citizens from practically any society, except for, clearly, those who are currently immersed in the effects of the so-named digital divide (Cabero, 2014; Mur, 2016;). Thus, we see how practically most of the areas of our lives have been influenced by the advances of the technologies, with the mobile devices such as the Smartphone or the digital tablets being of special importance.

Along the same lines, we can see how, within the automobile industry, some cars have driving systems now that are more sophisticated. Connection to the Internet as well as global positioning systems (GPS), allow driving the vehicle without the need for a driver or the contacting of the pertinent emergency services in case of an accident; in the case of homes, we see how appliances start to include connectivity to the web. This is called the "Internet of Things" (IoT), and with any connected mobile device, we can monitor the state of the devices in our homes, connect the washer so that when we arrive clothes are washed, or start the heating and cooling systems so that when we arrive, we find a more comfortable environment (Aznar-Díaz et al., 2018; Dube & İnce, 2019; Specht et al., 2013; Velasco, 2015). Last but not least important, we also see how within the educational system, new resources are being incorporated, which plan the design of new learning methodologies to respond to the needs, interests and motivations of 21st century students; thus, facilitating the achieving of objectives found in the main curriculum, as well as the development of basic competencies. We are specifically speaking about resources that are based on Augmented Reality, an aspect which will be later discussed.

2. Augmented Reality in the education sphere

As previously mentioned, mobile devices have been the drivers of a great number of technological advances that have appeared in the past few years. Consequently, the Smartphone or the digital Tablet have become every-day use items in most families in our society.

These devices possess several common features, such as cameras, screens, speakers and gyroscopes, fundamental elements for conducted-learning dynamics based on Augmented Reality.

The addition of Augmented Reality in the scientific domain is not something new. However, its addition into the education sphere is fairly recent. and its process of incorporation has been slow, several researchers, such as Enyedy et al., (2012); Fonseca et al., (2014); Kysela and Stenkova (2015); Marín-Díaz (2017a, 2017b); Dube and İnce (2019), have shown its use in content-diverse learning processes. This tool was catalogued as an emergent technology by the Horizon 2012 report, and again in the 2016 report (Durrall et al., 2012; Johnson et al., 2016) thus indicating its importance in the education sphere. However, before delving into listing the reasons that support its use in teaching-learning processes, we believe it necessary to define what is currently understood as Augmented Reality. Taking into account the conceptualization by Cabero and Barroso (2016, p.44) "the real-time combination of digital and physical information through different technological devices", means that using a real environment as the reference, and through the use of the previously-mentioned devices, we can amplify or enrich the information that our environments provide (Cabero & García, 2016).

The literature published on the link between Augmented Reality and education shows how its positive elements allow for the confirmation (or not) of significant aspects of the content studied, motivates the students to learn through discovery, encourage curiosity and imagination, thereby driving learning, bringing the content closer by providing a real scenario, improving kinesthetic and abstract learning, etc. (Álvarez et al., 2017; Barroso & Gallego, 2017; Cozar et al., 2015; Dube & İnce, 2019; Fernández, 2017; Ivannova & Ivanov, 2011; Peréiro & Páramo,

2016). The main handicaps for the creation of this link should not be ignored, however. On the one hand, there is the lack of teacher training in its use, and on the other hand, we find the scarce economic resources that are found in many educational centers, which define the availability of the digital resources for conducting new innovative teaching experiences backed by technological tools.

These are the aspects that make feasible its use in the education sphere and its "fast" expansion in the different centers of Preschool, Primary, Secondary schools and at University (Fernández, 2017; Marín-Díaz, 2017a, 2017b; Peréiro & Páramo, 2016), such as the fact that it does not require a great economic investment, but only the availability of a Smartphone or Tablet, as well as an Internet connection.

As for its use in the Primary Education stage, there is a great number of studies that have been conducted that indicate the potential of these resources in the teaching-learning processes of the student body (De Pedro & Martínez, 2012; Kerawalla et al., 2006; Solano et al., 2012). Not only does this allow for the development of collaborative learning dynamics through the design of resources based on this tool, in which the students of the school as well as the teachers can intervene (Alhumaidan et al., 2015; Matcha & Rambli, 2013), but it also facilitates its use in the learning of contents from different areas of knowledge, such as Mathematics, Language Sciences, Social Sciences, Natural Sciences and Foreign Languages, bringing in the possibility of providing more meaningful learning (Cai et al., 2019; Persefoni & Tsniakos, 2015; Salvador et al., 2013; Stoyanova et al., 2015). In addition, Augmented Reality can be combined with didactic videogames, so that the learning dynamic is enriched with interactive environments, on the one hand, and with elements of play from videogames, on the other (Koutromanos & Stylianas, 2015; Lu & Lui, 2015). Lastly, its potential for the development of capabilities, abilities and skills through methodologies based on role-playing or simulations, should be highlighted (Narin & Jeerungsuwan, 2014).

3. Description of the experiment

The experiment carried out was conducted during the third trimester of the academic year 2015-2016 in a Primary Education center located in the community of Andalusia in Spain, with students enrolled in the third year of Primary Education, and within the subject of Natural Sciences, more specifically Unit nine, entitled "simple and complex machines". For this experiment, a total of 16 students participated (37.5% girls and 62.5% boys), who were on average 9 years old (56.3%), followed by 8 and 10 (37.5%, 16.3%, respectively).

The main objective of this research is to corroborate the usefulness of Augmented Reality as an element that can be used to develop curricular content for the primary education stage. This objective is materialized through the design of a didactic unit that is specific for the previously mentioned content, as well as the design of the material needed for the implementation of the tool in the classroom with the student body.

The methodology used in this study, as well as the learning dynamics was comprised of various phases as follows.

In the first place, the theme to be developed through Augmented Reality was specified with the course instructor, considering and abiding to the didactic programming of the instructor. Thus, the teacher of the group of students, through a theoretical session, explicitly defined the curricular content of the unit. For this, the manual of the course created by the publisher Santillana for the Community of Andalusia, was used. Learning was re-enforced by performing the activities indicated in the textbook from the publisher mentioned above.

For the launching of the Augmented Reality experiment, which was to be conducted with the use of the Tablet, the design of the diverse 3D environments was done with the SketchUp® software program. The environments were the places where the student body would learn the different contents of the course (areas in a house: kitchen, living room, bathroom and garage), as well as the objects found within the

subject matter (simple machines: levers, incline plane, wheel, gear…; complex machines: car, dryer, bicycle, vitroceramic hob…).

In order to "see" the machines designed with the SketchUp® program, three 2D markers related to the subject's theme, and which would serve to begin with the different 3D environments and models, were created (see example in Figure 1). These were also related to the student's social and family environments, so that they would be able to identify the different types of machines that they could find in their homes, as well as those they were not aware of.

Figure 1. Marker "living room"

Note: Living room designed by students with the SketchUp® program.

In this second phase, the classroom dynamic was conducted using Augmented Reality, with the markers designed and the tablets as well. The students were asked to search and find, through the different virtual environments (living room, garage and kitchen), all the simple and complex machines. For this, the class was divided into groups of five students; after, the different markers with the different rooms in a house were distributed. Also, each group had a tablet available, he device through which the learning with Augmented Reality was conducted.

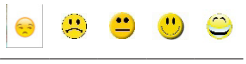
Once the groups and the materials were organized, the activity began within a specific environment, where the students, through the Augment® app, viewed that room in 3D through the corresponding marker. Afterwards, the students were asked to search for simple and complex machines within this environment, giving the students a space of time of ten minutes, so that each member of the group were able to use the digital tablet to explore the different spaces of the room (see Figure 2). After the tablet time was concluded, the groups were asked about the different machines they found, as well as the place they were found (location), to later project a video on the electronic blackboard where the students could view all the objects and places where these were found.

Figure 2. Implementation of the training session

Note: Each student was able to use the digital tablet to explore the different spaces of the room through the Augment® app.

Once the intervention in the classroom was ended, it was necessary to determine if the objective used for the actions in the classroom were reached. In this case, an instrument was designed to collect the opinions from the students who participated in the activity. This instrument was used to show if the acquisition of the content using Augmented Reality had been successful. For this, a questionnaire was constructed based on the target unit. It was composed of two items related to gender and age of the students, as well as ten items related to the subject matter itself. The response scale was Likert-type, with five answer options, where 1 was completely disagree, and 5 completely agree. Given the age of the participants, the numerical values were substituted by an emoticon that had a very sad face (value of 1) and one that was smiling brightly (value of 5) (See Table 1).

Table 1. Evaluation questionnaire of the activity

1. With the use of Augmented Reality, I have learned what machines are.	
2. With the use of Augmented Reality, I have learned that many of the objects that surround us are machines.	
3. With the use of Augmented Reality, I have learned that machines have many uses.	
4. With the use of Augmented Reality, I have learned that machines use different types of energy (wind, electric, fuels…).	
5. With the use of Augmented Reality, I have learned that machines that are used to do work are called tools.	
6. With the use of Augmented Reality, I have learned to distinguish simple machines from complex machines.	
7. With the use of Augmented Reality, I have learned how some machines are used.	
8. With the use of Augmented Reality, I have learned that people have invented machines throughout history to improve their lives.	
9. With the use of Augmented Reality, I have learned that machines make our lives easier, but they can also cause problems.	
10. With the use of Augmented Reality, I have learned to build a machine (a windmill).	

To verify if the collection instrument contained the essence of the content from Unit 9 from the school subject used, a Cronbach's Alpha test was conducted, which gave a score of .888. This score indicated that the questionnaire had enough internal consistency to reach the objective for which it was designed. The descriptive study conducted (see Table 2) shows that in general, the students were in total agreement with the fact that the didactic action conducted through Augmented Reality had helped them in the acquisition of the knowledge related to simple and complex machines.

Table 2. Descriptive Study

Item	M.	SD.
1. With the use of Augmented Reality, I have learned what machines are.	4.63	1.025
2. With the use of Augmented Reality, I have learned that many of the objects that surround us are machines.	4.69	.793
3. With the use of Augmented Reality, I have learned that machines have many uses.	4.75	.447
4. With the use of Augmented Reality, I have learned that machines use different types of energy (wind, electric, fuels…)	4.56	1.031
5. With the use of Augmented Reality, I have learned that machines that are used to do work are called tools.	4.81	.403
6. With the use of Augmented Reality, I have learned to distinguish simple machines from complex machines.	4.50	1.095
7. With the use of Augmented Reality, I have learned how some machines are used.	4.69	.793
8. With the use of Augmented Reality, I have learned that people have invented machines throughout history to improve their lives.	4.56	1.031
9. With the use of Augmented Reality, I have learned that machines make our lives easier, but they can also cause problems.	4.56	.629
10. With the use of Augmented Reality, I have learned to build a machine (a windmill).	4.53	.640

The content itself is, *per se*, austere and not attractive for the student; however, the students have shown that throughout its real implementation and experimentation, their learning has been conducted sub-consciously.

4. Discussion and preliminary conclusions

The addition of Augmented Reality in the classrooms in the different educational levels is becoming, little by little, a confirmation of the current situation of the digital development in society. It is important to verify how educational experiences, in which the students take the reins of their learning through the addition of this resource, are increasing (Álvarez et al., 2017; Cozar, 2015; De Pedro & Martínez, 2012; Enyedy et al., 2012), as confirmed in this experiment, in which the content used by the students was re-enforced (Álvarez et al., 2017; Fonseca et al., 2014). However, and as already discussed above, the two inconveniences related to the lack of resources and training were verified, as the school in which the teaching was conducted did not have a good Internet connection, there were no digital tablets for the students, and the teaching staff came into contact with Augmented Reality in the initial presentation for the first time, when the experiment was explained. On the other hand, it should be noted that the proposal conducted was highly regarded by the teachers during that school year as well as other teachers at the school, and they expressed their wish to continue with this experience, widening it to other curricular contents and academic years. In conclusion, we must confirm that the objective planned was reached.

Acknowledgments: The outcomes are the result of the previous research carried out in the research of Marín-Díaz in 2017 within the R & D research project financed by the Ministry of Economy and Competitiveness of the Government of Spain entitled: "Augmented reality to increase training. Design, production and evaluation of augmented reality programs for university education" (EDU-5746-P-Rafodiun Project).

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CÓMO CITAR:

Marín-Díaz, V., Sampedro-Requena, B. E., & Muñoz-González, J. M. (2020). Augmented Reality of Social Environment Knowledge in the Classroom in Primary School. *Revista Caribeña de Investigación Educativa (RECIE), 4*(1), 116-123. https://doi.org/10.32541/recie.2020.v4i1.pp116-123