

## **Juegos didácticos y la realidad aumentada, un análisis para el aprendizaje en estudiantes de nivel básico**

***Educational Games and Augmented Reality, Analysis for Learning in Basic Level Students***

***Jogos educativos e realidade aumentada, uma análise para a aprendizagem de alunos de nível básico***

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### **Resumen**

Los juegos didácticos son de gran importancia en la educación. En este rubro, hoy en día existe tecnología y *software* que coadyuva en el empleo de aplicaciones que apoyan el quehacer educativo. En este trabajo se lleva a cabo, en un primer momento, una revisión de diferentes investigaciones sobre sistemas de realidad aumentada; la mayoría de estos trabajos concluyen en que el uso de dicha tecnología permite una mejora en el aprovechamiento del conocimiento de manera subjetiva. También se presenta una serie de herramientas que puede usar el docente para crear sus propias aplicaciones de realidad aumentada y llegar a emplearlas en el aula. Finalmente se hace un análisis de dichas aplicaciones.

**Palabras clave:** educación básica, juegos educativos, realidad aumentada.

## **Abstract**

The didactic games are of great importance in education, but nowadays there is technology and also software that contributes in the use of applications that support the educational task. This work presents the different systems of augmented reality and that most of these have concluded that the use of said technology allows an improvement in the use of knowledge in a subjective manner. It also presents the tools that the teacher can use to create their own applications of augmented reality and get to use them in the classroom. Finally, an analysis of these applications.

**Keywords:** basic education, educational games, augmented reality.

## **Resumo**

Os jogos didáticos são de grande importância na educação. Nesta área, hoje há tecnologia e software que contribuem para o uso de aplicativos que suportam o trabalho educacional. Neste trabalho, inicialmente, é feita uma revisão de diferentes investigações em sistemas de realidade aumentada; A maioria desses trabalhos conclui que o uso da referida tecnologia permite uma melhora no uso do conhecimento de maneira subjetiva. Ele também apresenta uma série de ferramentas que o professor pode usar para criar seus próprios aplicativos de realidade aumentada e usá-los na sala de aula. Finalmente, uma análise das referidas aplicações é feita.

**Palavras-chave:** educação básica, jogos educativos, realidade aumentada.

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## Introduction

This paper presents some of the applications of augmented reality that have been carried out for basic education and others of which are focused on learning. It also reviews what is the dynamics of the game and how it helps learning, a fundamental part for the development of applications focused on teaching. Subsequently, a series of tools is provided that allow the development of applications, as well as examples of this type of developments that already have the necessary elements to be able to be employed in the classroom. To finalize the applications of augmented reality focused on teaching, and is observed whether they are games or applications as the population that put them to the test and the results they present.

## The dynamics of the game

The sociologist J. Huizinga (1995), in his work *Homo ludens*, presents the following peculiar characteristics of the game:

1. The game has a certain function in the development of man; the human puppy, like the animal, plays and prepares for life; also the adult man plays and, in doing so, he experiences a sense of liberation, of evasion, of relaxation.
2. The game is not a joke, the worst game bust is the one that does not take his game seriously.
3. The game, like the work of art, produces pleasure through its contemplation and its execution.
4. The game gives rise to special bonds between those who practice it.
5. Through its rules, the game creates a new order, a new life, full of rhythm and harmony.
6. It is a free activity, in the sense of the Greek *paideia*, that is, an activity that is exercised by itself, not by the profit that can be derived from it.
7. It has certain elements of tension whose release and catharsis cause great pleasure.
8. Exercises separate from ordinary life in time and space (p. 7).

Currently, thanks to information and communication technologies (ICT) and the advancement of technology itself, there are games on computers, cell phones, tablets and other devices that allow interaction and the development of skills. However, in turn, this presents other challenges that will be explained later.

Before continuing, it is necessary to specify what is a didactic game. Chacón (2008) defines it as a strategy that can be used at any educational level or modality. However, in general, the teacher uses it very little because he does not know its multiple advantages, the different applications in which to use it and the objectives that can be met with these dynamics. For authors like Montessori, cited in Newson (2004), "the game is defined as a playful activity organized to achieve specific ends" (p.26).

Galvañy and Martín (2011) comment that "you play to win, you win if you learn and, if you learn, you win". They give a reflection on the power that these creative activities have in the development of the communicative ability of the students, particularly in the technical language. In addition, they combine practice with theory and promote teamwork and collaboration, which allows the development of other skills.

Now, the definition of playful game is provided by Flores (2009). This author sets this concept as follows: "A participatory technique aimed at developing in the students methods of management and correct behavior, thus stimulating discipline with an appropriate level of decision and self-determination" (page 38). López and Pilar (2008) add that "the student stops being a passive part and becomes an active part in the learning process". In this regard, Flores points out that for this purpose, the type of game must be chosen, according to the objectives and the importance of the teacher in the participation, as well as the direction of this (page 7).

Next, the technology for the development of didactic games with augmented reality is presented, taking into account what it is and how it can be used.

### **Augmented reality**

As the author Boneu (2007) indicates, technologies advance and develop necessary tools to provide learning environments centered on the student. As part of this progress, a technology emerges that allows us to expand the information of the environment that is perceived, improving and expanding knowledge, showing 3D images and even videos and animations.

You can define augmented reality as those computer systems that mix virtual information of any kind, from 2D images, text or 3D figures, to a real physical scenario (Cawood and Fiala, 2008, Bimber and Rakar 2005).

With this technology students, in this case, expand the information of the environment that is perceived, since in any image, document with a pattern or digital element can be displayed information that can be used to improve their learning. Along the same lines, some of the benefits of augmented reality are presented below:

1. More interactive activities: Interact with elements that are seen by a device: at first sight they are not found, but with the use of technology they can be observed and, with this, obtain more information.
2. Increase in reality: Facilitate spatial vision by observing a 3D object that approaches something more real.
3. Learning by discovery: The environment contains more elements, which can encourage the student to carry out deductions or keep new concepts in mind.
4. Controlled environments: An environment is created where students can carry out non-risky activities, for certain subjects in which it is necessary to interact.
5. Greater control in the evolution of the participant: You can easily measure how each user is evolving in the use of the activities to be carried out.

These benefits have great potential for learning (Abdulmuslih, 2010). That is why Barfield and Caudell (2001) define augmented reality as a support tool in the educational field, because, without a doubt, it stimulates the desire to learn, awakens interest, increases the level of attention, creates in students a research spirit, among other factors that help understanding and assimilation are much easier.

Given this scenario, as indicated by Basogain, Olabe, Espinosa, Rouèche and Olabe (2012), "this technology is being introduced in new areas such as academics, however, the knowledge and applicability of augmented reality in teaching is minimal; among other reasons due to the very nature and state of development of the same, as well as its limited presence in the everyday areas of society "(p.1).

Currently, applications oriented to education have been developed, which allows obtaining new educational experiences -although these new developments need a well-defined route for their implementation, as suggested by Álvarez et al. (2017) -, more sophisticated, which are valuable to establish an affective learning.

While it is true that sometimes it is not possible to implement them in the classroom due to technical needs, or to an incomplete design for use in a school where there are usually no specific experts in technology, despite the fact that the usual teachers of the center if they know them, Blázquez (2017) mentions that showing augmented reality in the educational field in a simple way has provided great results. As it shows, Katmada, Mavridis and Tsiatos (2014) undertook an investigation where they concluded that the academic games improve the performance in the matter of mathematics. Likewise, in the study of Pareto, Arvermo, Dahl, Haake, and Gulz (2011) a good performance was also obtained, in this case, within the area of arithmetic (based on the testimony of students and teachers).

For the creation of applications of augmented reality the following list is presented, taking into account what some authors used in the development of their proposals (López, 2010; Buenaventura, 2014; Orozco, 2014; Sedano, 2014; Prendes, 2015; Cozar y Sáez, 2017; Blázquez, 2017):

- Arcrowd: A platform that works through a free account and that, as a curiosity, shows on its website the most popular works of recent weeks, which can be explored and used in class.
- Aumentaty GEO: It is a technology of Spanish origin that is based on augmented reality; It allows you to download your app (IOS and Android) and is commonly used in location and routes.
- Amazing Space Journey - 3D Solar System: It allows to know the solar system in 3D; only the app and the corresponding bookmarks are downloaded.
- Anatomy 4D: The human body can be observed after printing the markers and activating the application.
- Aurasma: User-friendly tool for the creation of augmented reality applications. It is available for IOS, Android and computer.
- Augmented 3D: Allows viewing 3D objects in real environments. It contains 3D models by default, can read QR codes and import other models. In the world of landscaping, decoration, sales, among others, it is useful. It is available for IOS and Android.
- Aumentaty Author: It stands out for its simple use: it imports 3D models created by other applications, it also uses markers for the recognition of the models.

- **Blip:** Allows you to convert any object, place or image into an interactive experience. It has a specific section for education that allows transforming the classroom or the educational environment into an interactive learning space. It allows you to add games, videos, music to reality and call it the blippear concept.

- **Elements 4D:** After the printing of the markers and their manual assembly will be accessed by activating the application to the different chemical elements, if they are combined chemical reactions can be observed, in addition to providing exercise plans that can be done at any time and place and classify them by levels, primary, intermediate and secondary.

- **Field Trip:** Recognizes the information of the places that are focused with the mobile device, museums, historical sites, restaurants, stores, among others; It provides an information sheet of the site that can be archived.

- **Google Goggles:** It is a device that uses a mobile device camera, where you can access the information contained in the database of the application. It allows QR and bar codes, also translates texts.

- **Landscapar:** It facilitates the creation of 3D landscapes in a simple way. Islands or territories are made in a very easy way. Ideal for understanding topographic maps.

- **LayAR:** Tool to create augmented reality applications. It works in a simple way, like dragging the interactive digital elements, among which can be included video cuts, music, photographic presentations, complete web pages and links to social networks, among others.

- **Mybrana:** It provides the possibility of inserting different stickers and animations on the images and videos that are captured with the mobile device.

- **Smartify:** It is an application that allows access to additional information about museum works. At present it has integrated information from certain museums in the United States, Amsterdam, Brussels and London.

- **The Brain App:** It is accessed through layers of information to the human head, muscles, skin, skull and interior areas.

- **Wallame:** It focuses on establishing messages in geo-referenced places, its handling is simple and messages can be discovered. It has templates and allows to draw on captured images, as well as the insertion of comments. It is available for IOS and Android.

- Wikitude: Allows access to all the information registered by the application. The GPS and the compass are also involved in the process to determine position and coordinates.

- ZooBurst: It allows to create 3D books in a simple and dynamic way. The website has a database of more than 10,000 free-use images, and one can also use own illustrations that will go on until the story is composed.

- Zappar: One of the most successful content creation platforms with augmented, virtual and mixed reality; It allows you to create your own content in a very simple and intuitive way. It includes a specific section for education, so that both teachers and students can take advantage of the possibilities of this technology in the classroom.

These are some tools to create augmented reality applications through its interface. There are others that allow creating applications from scratch that create, in turn, augmented reality applications. For this type of software it is necessary, however, to have programming knowledge and some design elements. Here are some of them:

- Artoolkit: It is focused on programmers and includes a large number of help documents, the download of the program and a community to discuss and plan all kinds of questions made with the use of the program.

- Vuforia: For advanced users who have prior knowledge of programming and computing. It is one of the most successful platforms in the creation of apps with augmented reality content.

As you can see, there is a great diversity of software so that the teacher can carry out different types of educational purposes.

Finally, it is observed that technology is growing by leaps and bounds; Augmented reality can be applied to different environments relating digital content, a characteristic that allows students to reinforce their learning.

## **Works with augmented reality oriented to basic education**

Some works that are oriented to education and that also use augmented reality tools are the following:



- Cozar y Sáez (2017) they integrate the technology of augmented reality in a didactic unit in 4th, 5th and 6th grade, starting from pedagogical assumptions of constructivist psychological theories, specifically from the theory of meaningful and collaborative learning.
- Henríquez (2015) provides an overview of augmented reality and its applications in the creation of educational scenarios. Also some tools and elements that must be contemplated and that to be implemented use the Microsoft Kinect sensor and software such as Unity 3D, 3D Max and Maya.
- Barreira et al. (2012) present an augmented reality game, Matching Objects and Words (MOW), created in collaboration with primary school teachers, which allows children to learn vocabulary in English and Portuguese.
- Sarracino (2014) proposes a series of workshops that improve learning experiences by enriching the perception of the real world to students of basic schools through the creation of augmented reality applications at the Naples Toy Museum.
- Tovar (2013) carries out an investigation to use this technology in a didactic and dynamic model for the teaching of chess, in order that the apprentice can see and understand the concepts and movements of the pieces.
- Buenaventura (2014) creates an augmented reality application as a teaching strategy in the classroom for the area of natural sciences of the 5th grade, based on the contents proposed by the Ministry of National Education for the teaching of this subject.
- Carballal (2015) carries out the activity "Hoy cocinas tú", aimed at students of basic level Spanish, in which the student is offered a practical approach to the theoretical contents previously presented. With the aim of producing a simple recipe for Spanish cuisine and throughout a 60-minute session, students will practice grammatical, lexical, functional and cultural knowledge.

As a complement to the information presented above, a comparative table of the applications was carried out (table 1), from which it is observed that certain applications, some without a name, are directed to a small study group. In addition, it is observed that there are other developments that do not contemplate study groups as such, but apply it with different people to obtain their results. Also, it is perceived that in other of these the type of the application is not

defined, that is, it is not known if it is a type of game, thematic game or developed application; some authors describe it, however, as dynamic. Finally, table 1 includes the place where the tests were carried out.

**Tabla 1.** Descripción de las aplicaciones de RA orientadas a la educación

<b>Autores</b>	<b>Nombre de la aplicación</b>	<b>Grupo de estudio</b>	<b>Tipo</b>	<b>Lugar de pruebas</b>
Cozar y Sáez (2017)	Ninguno	Alumnos de 4.º, 5.º y 6.º de primaria	No especifica	Madrid, España
Barreira <i>et al.</i> , (2012)	MOW	Escuela básica	Didáctico	Portugal
Sarracino (2014)	Ninguno	Niños	Juego	Italia
Tovar (2013)	Ninguno	15 estudiantes entre 10 a 15 años	Juego	Cartagena de Indias, Colombia
Buenaventura (2014)	AR Ciencias Básicas	36 estudiantes del grupo 5.º	Aplicación	Medellín, Colombia
Carballal (2015)	Hoy cocino yo	Estudiantes de secundaria	No especifica	España

Fuente: obtenidas de los autores Cozar y Sáez (2017), Barreira *et al.*, (2012), Sarracino (2014), Tovar (2013), Buenaventura (2014) y Carballal (2015).

As you can see, there are several jobs that use augmented reality for teaching, what stands out of each is that they make a proposal of the dynamics, some carry out the standards used by educational institutions.

It is observed that some of the evaluations in the learning established with the populations are subjective and that not all apply in the development of their applications a game that can reinforce the competitiveness and evolution of the student. In the same way, there is no evaluation or the way in which they evaluated their application is not specified.

## Conclusions

Education is very important, and in recent years the inclusion of new technology and applications has been increasing. But what indicators should these have so that the objective of the students having an adequate learning is fulfilled? Not only is creating an augmented reality application and comment that students learn with it, but there is a basis (metrics, elements) that can measure the application and that meet the minimum requirements to claim that they carry out a learning. According to the different proposals, learning is subjective.

Some researchers are based on the rules established by schools, however, other measures must be used, since the groups are diverse and constantly change. It is also observed that the abuse of such technology can result in the student losing interest. Faced with this, the teacher must be constantly changing to be able to present new material and new dynamics before the group.

Finally, the technology lends itself to the development of a great diversity of educational dynamics that the teacher can take advantage of and that contribute in the creation of applications of augmented reality without requiring too much computer or advanced computer knowledge.

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