

# Augmented Reality as a Didactic Tool in Education

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## ABSTRACT

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Augmented Reality as a didactic tool in education is a project that aims to support teachers in their teaching practice using augmented reality technology. This technology allows combining the real and virtual world by adding layers of visual information about the world that surrounds us, this helps to generate experiences that provide relevant knowledge about our environment and in this way the educational content is in different basic education school topics. In the process these tools were used: Aumentaty Creator, which allows to create AR projects easily and quickly; Augmented Scope to visualize AR projects; and Tinkercad for 3D modeling and animation.

**Key words:** *Augmented reality, education, Aumentaty, Technology*

## 1 Introduction

At present, information and communication technologies (ICT) have allowed a new form of interaction in the teaching-learning processes. The rapid evolution of computers and the growing use of mobile devices is making both students and teachers use new media and resources to enhance and acquire knowledge and thus facilitate learning.

One of the many tools that can be used in education to enhance knowledge is Augmented Reality (AR). AR is a technology that uses virtual objects (created by computer) for the user to perceive the real environment "augmented".

For example, with AR applications, in geography the parts that make up a volcano can be shown to the student, how the DNA of human beings is made, some math problems can be exemplified. All of this by using 3D models that are more attractive, visual, and fun.

The purpose of this project is to create an AR application that uses 3D models to enrich certain contents in 3 subjects of the secondary education curriculum: Geography, Science and Mathematics.

### 1-1 Justification

This project has been designed with the aim of favoring the development of disciplinary competencies and active learning, facilitating secondary education students the appropriation of disciplinary knowledge and transfer it in subjects related to Mathematics, Science I and Geography.

This will undoubtedly update the old didactic means of teaching science in which there are only images through sheets or, at best, with an explanatory video.

On the other hand, both students and teachers will benefit, as long as they know the benefits of AR technology, such as the use of three-dimensional models and the experimentation, as well as the generation of Learning Objects (LO) through the available tools, favoring the use of ICT and the development of future research on its impact on the teaching-learning process, and the design of strategies that can incorporate AR as a teaching resource.

### 1-2 Problem Statement

Most of the academic material that serves as a complement to the teaching material in the classes is based on the use of text that incorporates images, video,

animations, and sound. When using this type of resources, students become more interested, however, more visual and attractive media are needed so they allow them the ability to analyze, making them participate in a more collaborative and motivating environment.

Therefore, it is necessary to gradually provide teachers with innovative AR resources that allow students to understand a concept, content, or procedure, based on the exploration of knowledge with the body, since AR helps the learning process of students among other reasons due to the high degree of interaction it provides.

This form of teaching is the "learning by doing" approach, also known as active learning and "learning by playing", in this way it contributes to the achievement of the constructivist approach that allows the user to be able to modify, build, test ideas, and get actively involved in problem solving.

In addition, the use of AR in the classroom, and specifically, the use of mobile devices, overcomes the limitation of time and space in learning environments.

### 1-3 Objectives

Choose topics from the Geography, Science I and Mathematics subjects where 3D models can be used to generate an AR application that works on mobile devices.

Find, download, and optimize 3D Aumentaty Creator models to use in the AR application.

Create simple 3D models using the Tinkercad tool to use them in the AR application.

Use the RA Aumentaty platform to develop the augmented reality application and view the content on a mobile device.

## 2 Theoretical Framework

### 2-1 What is Augmented Reality

Augmented reality is the technology that complements the real environment with computer-generated information, in this way reality is combined with virtual elements, providing a mixed or augmented reality in real time. (Fig. 1).

For an application to be defined as an AR application, it must meet the following requirements:

- a) Combine virtual objects with the real world.
- b) Be interactive in real time.
- c) Present virtual objects in three dimensions.

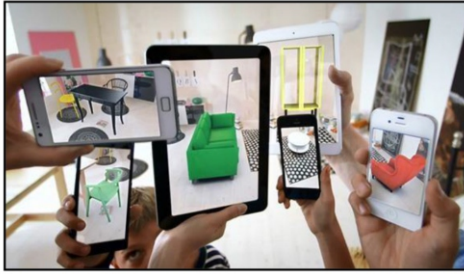


Fig. 1 :Textbook with augmented reality

### 2-2 Types of Augmented Reality

There are basically two types of AR, Augmented Reality based on markers or images and Augmented Reality based on position.

#### 2-2-1 Augmented Reality Based on Markers or Images

This type of Augmented Reality uses markers or images, in which some type of information (images, 3D objects, video) is superimposed when they are recognized by a certain software(Fig.2).



Fig. 2: Augmented Reality based on markers

#### 2-2-2 Augmented Reality Based on Position

In this type of applications, Augmented Reality browsers are used, these applications use the hardware of smartphones (GPS, compass and accelerometer) to locate and superimpose a layer of information on points of interest (POI) in our environment.

When the user moves the smartphone capturing the image of their surroundings, the navigator, based on a data map, shows the nearby POI. (Fig. 3).

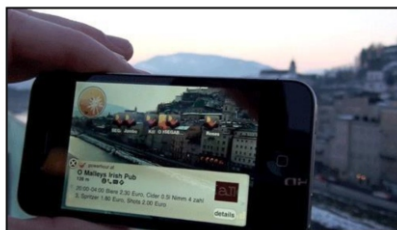


Fig. 3: Augmented Reality based on position

### 2-3 How Augmented Reality Works

In any augmented reality system, four fundamental tasks are necessary to carry out the augmentation process.

1. Scene capture

2. Scene identification
  3. Mixed reality and magnification
  4. Visualization.
- 2.4 Uses of the Augmented Reality.

Due to its benefits, AR can be used in an infinity of areas and topics of interest such as:

- Mobile marketing
- Online searching
- Tourism
- Medicine
- Architecture
- Interior design
- Science
- Education
- Videogames

Figure (4) shows an example of an AR application in video games.



Fig. 4: Augmented Reality in videogames

### 2-4 Augmented Reality in Education

The applicative possibilities of AR, with respect to the elaboration of didactic materials and learning activities, are multiple and heterogeneous in practically all subjects. It can provide learning experiences outside the classroom, more contextualized, displaying links between reality and the learning situation in which students participate. Any physical space can become a stimulating academic setting. For example, students of Archeology, History or Anthropology, could have applications that reconstruct exceptional historical sites (Fig. 5).

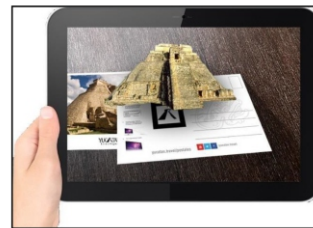


Fig. 5: Augmented Reality in a history class

### 2.5 Aumentaty

Aumentaty is a free software that allows users to create augmented reality scenes, it is the ideal Augmented Reality content generation tool for those who do not know how to program, but it does not have an editor or creator of 3D models(Fig.6).

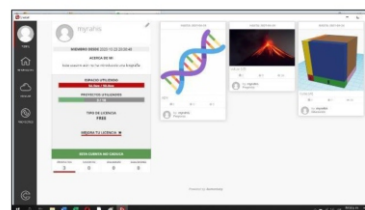


Fig. 6: Environment of Aumentaty development

**Aumentaty Creator** is the desktop version of Aumentaty to create our augmented reality applications. It is currently only available for Windows. Once the project is created, the Scope application is needed on our mobile device to view the AR. To start using creator, follow these steps:

1. Register at Incentaty.com
2. Verify your email
3. Click on new project and fill in your project information
4. Add files to your project
5. Choose what type of QR code to launch your file
6. Add what type of AR element you want to carry that marker
7. Publish the project

**Aumentaty Scope** is the Aumentaty application that allows you to view all the AR projects that have been created with the Creator tool. To use it, simply access the Android store. Once downloaded, you can enter the app as a guest without registration or you can register. Within the application, you can search for the project in the section searches, or scan with the camera in search of the project.

The application allows you to save the projects so that it is not necessary to search for them every time you want to view them, it also tells you if there is a new update to it and gives you the option to download the new version.

### 3 Methodological Design

#### 3-1 Construction of the Target Image



To make use of Aumentaty Creator it is necessary to register on its portal and verify the registration by means of an email that the app sends you.

The next step is to download the software and install it, and then log in with your registration data (Fig.7).

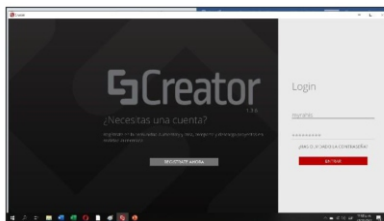


Fig. 7: Aumentaty Creator log in

Once logged in, we find on the left side a vertical menu with four options: profile, news, search, and projects. The latter is where the applications that can be made with this tool are built (Fig. 8).

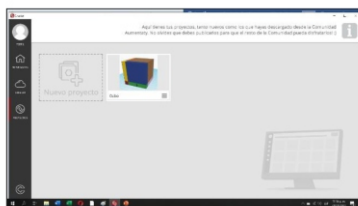


Fig.8: Aumentaty Creator log in

The process of creating projects in Aumentaty begins

when you click on new project and enter a name and description(Fig. 9).

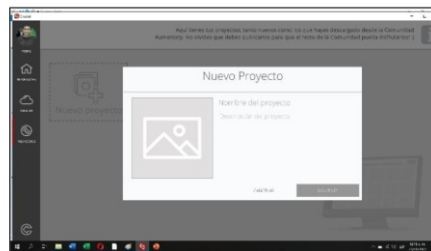


Fig. 9: Aumentaty Creator new project

Then the necessary files that the project will carry are added, they work by using different types of markers which can be: QR code type, image type or geolocation type (figure 10). For the three projects we carried out, files with image type makers were used.

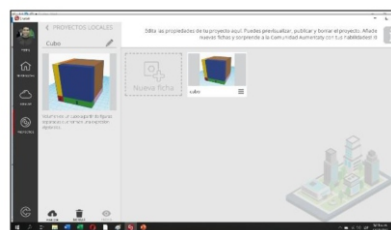


Fig. 10: Adding files to a project

The next step is to add elements to our scene which can be:

- Image
- Text
- Video
- 3D Models
- Link

In the case of the math project, the scene consists of 4 elements: one 3D model, two images, and one video (Fig. 11).

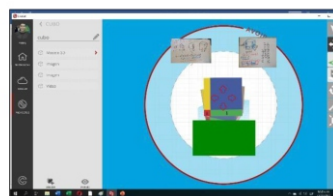


Fig. 11: "Cube" project elements of the mathematics subject

The options on the right-side menu are used to place each element in the desired position, as well as to modify its dimensions.

Once we have finished adding files and elements, we proceed to the publication of the project, for this we return to the main screen of the project and click on the publish button (Fig.12).



Fig.12: Publication of the finished project

Figures (13) and (14) show the other two projects related to the subjects of Science and Geography, in each of them we incorporate elements such as the 3d model, videos and images.

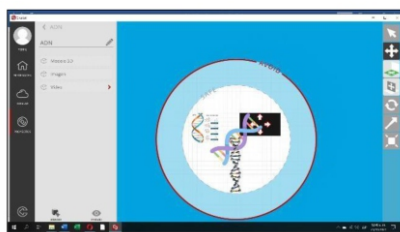


Fig. 13: DNA Project for the science subject

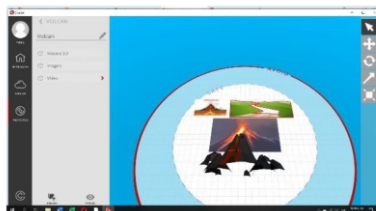


Fig. 14: Volcano project for the geography subject

**3-2 How to Use Tinkercad.**

This application is very good to make 3d models and animations. To start using it, you must first enter its website and then sign in with your Google or Apple account(Fig. 15). Once logged in, on the left side there is a vertical menu with several options from which we will occupy three, 3d designs, circuits, and code blocks (Fig. 16). In the latter you can make 3d animations.

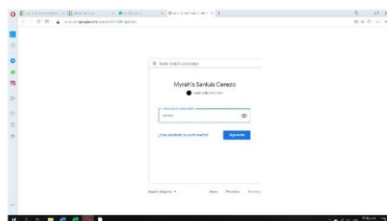


Fig.15: Tinkercad log in

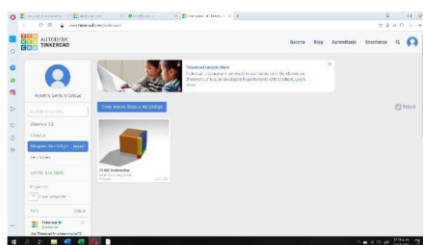


Fig. 16: Tinkercad main page

**3-3 Creation of 3D Animations**

The procedure to make animations is when you click on Create new Code Block (Fig. 17). Immediately, you will find a box that gives you the option to choose a design or make a new design. For the animations of the "Cube" and "Rotation and Translation" projects, the option of "a new design" was used.

Consequently, the animation is made with code blocks which are found on the left side (Fig. 18), these give us tools to:

- Form

- Modify
- Control
- Mathematics
- Data
- Mark

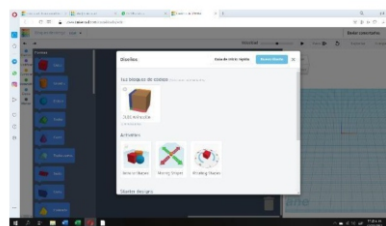


Fig. 17: Choosing 3D design

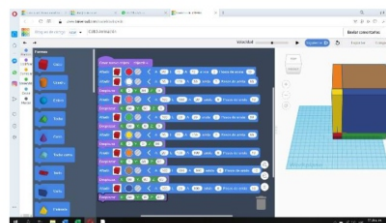


Fig. 18:Code blocks for the Cube animation

When our animation has already accomplished what we wanted to achieve, we will proceed to save it as a video and then use it in Aumentaty Creator. For this, you click on the share button which is in the upper right part. Next, a box will appear where you will click on Animated Gif, button at the bottom right (Fig. 19).

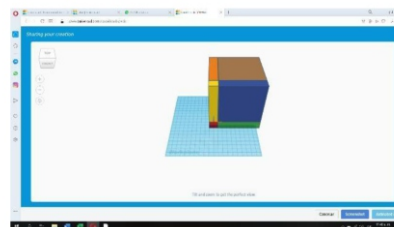


Fig. 19: Saving the Cube animation

Later the gif will be downloaded automatically.

**3-4 How to Use Scope Aumentaty**

This is a mobile application which helps us to visualize the figures in 3D, figure 20. To use it you must first download it, then open it, you can enter with your user or enter as a guest, then you will find the initial page where you will find the following:

- Marker
- Browser
- Searcher
- Downloads

Next, to visualize the Cube Project, we will open the search magnifying glass and then enter the name of the project, once found, you click on the image, then the project will appear and then at the bottom you click on download. (Fig. 21).

Afterwards, you click on the open button, then on the lower left button that shows a camera in order to focus on the marker and observe the 3D figure, along with the images and videos (Fig. 22).

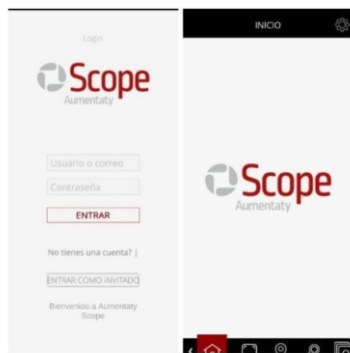


Fig. 20: Aumentaty Scope log in

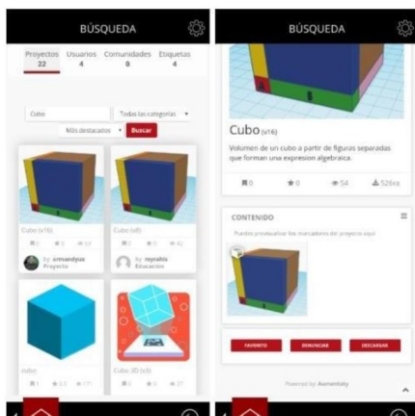


Fig. 21: Searching and downloading the Cube project

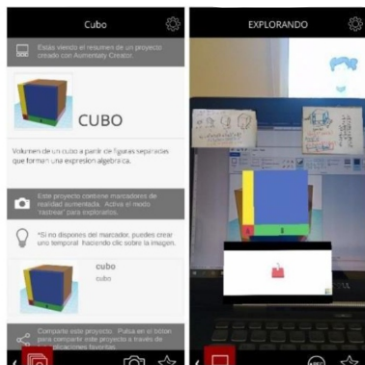


Fig.22: Verify Cube Project on AR

4 Results

To verify the acceptance of the application, a survey of 9 questions was applied using a Google form and the following results were obtained (Figs.23 -30).

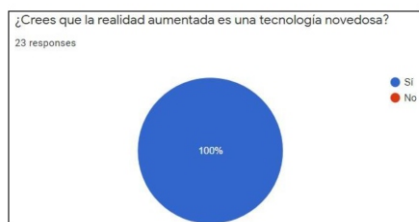


Fig. 23: Do you think that Augmented Reality is an innovating technology?



Fig. 24: Do you consider that Augmented Reality can be applied in education?

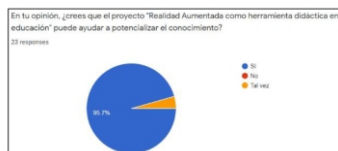


Fig. 25: In your opinion, Do you think that the project "Augmented Reality as a didactic tool in education" can help to enhance knowledge?

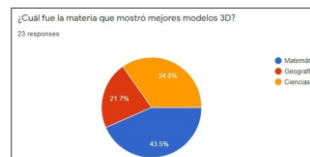


Fig. 26: Which subject showed the best 3D models?

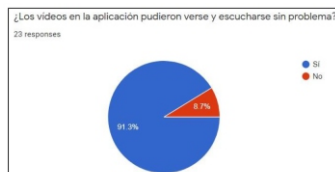


Fig. 27: Did the videos in the application reproduce without problems?



Fig. 28: Were the images in the Project legible?

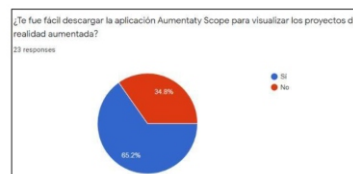


Fig. 29: Was it easy to download the Aumentaty Scope app to visualize the projects in Augmented Reality?

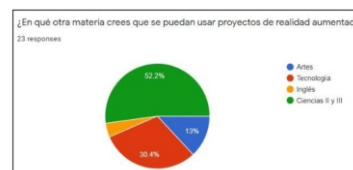


Fig. 30: Which other subjects can use the Augmented Reality projects?

5 Conclusions

After the completion of this project, we were able to conclude that:

- Augmented Reality is very useful and can be used as a pedagogical tool in basic education.
- Teaching materials are needed to promote active student

learning, and AR projects can help to achieve this.

- The Aumentaty platform provides the possibility to create AR applications in a quick and easy way.

- The people who tested the application we developed like it and there were comments and observations that will undoubtedly help to improve it in some respects and create future versions.

### 5-1 Future Lines of Research

Based on the observations and recommendations that teachers and students shared with us, in future versions of the project it is proposed to use better designed and more detailed 3D models, for this we must use specialized tools for the creation of those models

This also raises the possibility of using a development tool such as Unity 3D to develop mobile applications so as not to depend on an online platform.

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