

# Augmented reality uses in educational research projects: The “Falcones Project”, a case study applying technology in the Humanities framework at high school level

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## ABSTRACT

In the present paper, we describe the methodology for the implementation of Augmented Reality (AR) on a project with high-school students, in order to display content related to the book *La reina descalza* (Ildefonso Falcones), which was presented at the official launch of the bestseller. The project was developed by a group of students in the Humanities and Technology specialties of the school La Salle Virgen del Mar, Almería, Spain. The method proposed is based on the recognition of the cover picture of the book, which acts as a mark of AR, allowing for the viewing of a series of digital images that are linked to multimedia content developed by the students. The proposed method is intended as a technologically advanced and entertaining system for use in educational environments that enables the display of information to students in addition to the printed documentation with which they are provided. The main objective of this work is a qualitative assessment of the use and adaptation of RA content in research projects at high school levels for displaying multimedia content.

## Categories and Subject Descriptors

H.5.1 [Information interfaces and presentation (e.g., HCI)]: Multimedia Information Systems-*Artificial, augmented, and virtual realities*.

K.3.1 [Computers and education]: Computer Uses in Education-*Collaborative learning*

## General Terms

Performance, Design, Experimentation, Human Factors

## Keywords

Augmented reality, educational research, human-computer interaction, mobile learning.

## 1. INTRODUCTION

One visualization technology that is gaining attention and being incorporated into every field of society is Augmented Reality (AR). Its creators [1] define AR as a version of virtual reality in which the user can see the real world with virtual objects mixed or

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superimposed on it. Unlike virtual reality, AR does not replace the real environment; rather, AR uses the real environment as a background. The final result is a file with data, static images, or a dynamic 3D virtual model superimposed onto a real-time video of the environment [2]. This scene is shown to the user via a computer screen or other device, such as a projector, digital board, special glasses, smartphone, or tablet. This concrete superposition capability between virtual models and reality makes this technology an interesting resource in any type of teaching that aims to improve students' spatial comprehension [3]. The primary questions currently relating to this field of research are how to incorporate AR in the classroom and how to evaluate the experience, in order to increase the motivation, satisfaction, and the curriculum.

The case study presented in this paper was carried out with first-year students of the high school La Salle Virgen del Mar, in Almería, Spain. The students of this educational center collaborated with the La Salle Campus Barcelona (Ramon Llull University) to create the 'Falcones project,' which involved generating AR content AR with the photo on the cover of *La reina descalza*, the latest bestseller by writer Ildefonso Falcones. A study of this was carried out to assess the experience (user experience evaluation of the project using a qualitative method) and the feasibility of incorporating AR in an active way in new educational processes at high school levels.

## 2. THEORETICAL, PEDAGOGICAL AND DIDACTIC FOUNDATIONS

There are extensive amounts of studies of the relationship between student motivation, degree of satisfaction, and the user experience or student perception in the interaction with and teaching of applied collaborative works, with recent contributions having helped to design new e-learning experiences or dislocated teaching using IT (Information Technologies) [4,5]. This is not however the case when the focus is the use of mobile technology and AR applications, which are more extensively studied from a technological perspective or from the perspective of sociological and communication impacts instead of its educational capacity or ability to transform teaching, which is the focus of the present and previous studies implemented by our team [3, 6-7].

Recent uses of AR in the areas of entertainment and education demonstrate the potential of this technology [8-11]. In education, however, AR might be considered a new tool, and further studies are necessary, particularly in order to devote attention to the user experience, learning process, and its entertainment capability, which can increase interest in less interesting classes, including

classes in which the content is presented with no interaction with the student.

The implementation and the use of IT in classrooms, schools, colleges and universities is a *fait accompli*, having become especially extensive during the last decade. We can find examples ranging from early childhood education (with the use of digital whiteboards), through secondary education (the widespread use of computers in almost every subject), to higher education, with specific and advanced uses of all types of media, highlighting the internet and all kinds of intranets and digital solutions [12].

Parallel to this process, new technologies such as the e-book have revolutionized the publishing industry. Publication in digital format has eliminated the barrier of the requirement for the physical support of the book or magazine to make content accessible through all kinds of devices. The resulting extension of the ability to acquire, read and store publications has enabled an innovation in content management, and users now have the ability to customize their experience of reading and to adapt the format to their desires.

The first initiatives similar to the use of RA for the adding of multimedia content in printed documents were the intermediate use of QR codes (Quick Response codes). One of the first examples of this use was Ubimark's adaptation of Jules Verne's classic *Around the World in 80 Days*, which was enhanced with QR codes that incorporate additional information such as videos or images the user is able to see from the mobile device (Fig. 1).

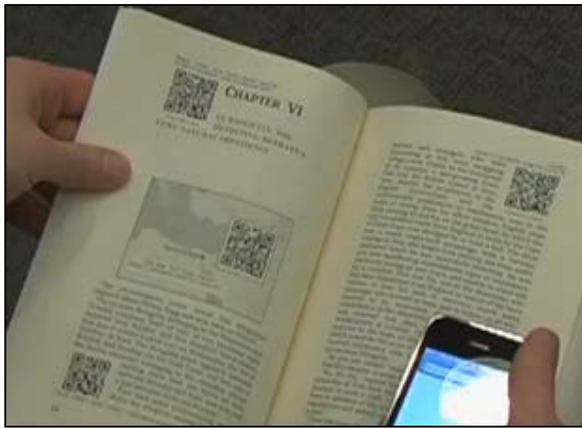


Fig. 1 <http://2d-code.co.uk/around-the-world-with-qr-codes/>

However, RA is currently most widely used in advertising and marketing before that in editorial content, being in this way an innovative project in the scope of application, as well as in the fields of development and education. At the basis of the educational project is a use of IT elements capable of providing better representation and formulation of the concepts dealt with in the subject, overcoming the difficulties of the learning process without forgetting the students' prior knowledge, and, perhaps most significantly, allowing for a flexible, collaborative environment, which marks a radical departure from the notion of a simple repository of information. Achieving these principles, we will improve not only the expected skills of self-learning and resource management of the student, but also, in an intrinsic way, will be providing capacities related to research and reflection [13], training the student in understanding and deepening of the knowledge presented [12].

### 3. METHOD

The project was developed during the second half of the 2012-2013 academic year as a research activity in the subject CMC ("Ciencias para el Mundo Contemporáneo" – Science for the Contemporary World) among first-year students of the high school La Salle Virgen del Mar, Almeria, Spain. The implementation of this was achieved by way of the following:

- Five students were commissioned to develop the technology platform for using AR. They were responsible for the preparation of the picture on the cover as a generic mark as well as the virtual images that linked with the multimedia content.
- Eight students developed both the multimedia content and the documentation associated with it. In addition to generating a presentation using AR, they also generated a Prezi explanation.
- Two members of staff coordinated both groups: the lecturer in charge of CMC and a consultant of the La Salle Campus Barcelona specializing in AR.

The students worked in two groups separated in the areas of technology and documentation to generate the audiovisual and digital content designed for the cover of the book (published by the publisher Random House Mondadori-Grijalbo and currently for sale).

#### 3.1 Phases of the project (Chronology)

This initiative arose from a contest for research projects called LSdreams (<http://lsdreams.lasalleuniversities.net/>), directed to all La Salle schools of the RELEM region (Région Lasallienne Européenne-Méditerranéenne). In the third edition of this contest the winning group in the category of Engineering was formed by five students of La Salle Virgen del Mar, which co-operated with La Salle Campus Barcelona for this initiative.

The project started at the beginning of April 2013, and proceeded via the following steps:

- Explanation of the protocols for working with RA from different applications and selection of that to be used in the experience, Aurasma. This process was done in a compacted schedule of about six hours of work over two days.
- Selection of physical work on which to deploy the experience. Given that the visit of Ildefonso Falcones to the college to present his latest book was scheduled in early May, it was decided to use the cover of the book to develop multimedia content related to the storyline of it. The contents selected for development were:
  - Biography of the writer Ildefonso Falcones.
  - History of the gypsies in Spain, affecting the Great Raid of 1751.
  - Slavery in Spain during the 18th century.
  - Tobacco in the 18th century.
  - The city of Seville in 1750.
  - The Coliseum of the Prince in the 18th century, explaining the situation and the typology of the spectator of the time.
- The presentation of the content described above was done by way of:
  - Enlargement of the book used as support to display the content using Prezi.
  - Video recording, for some of which professional dancers were hired.
  - Re-formatted videos for AR visualization.

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### 3.2 Technological implementation description

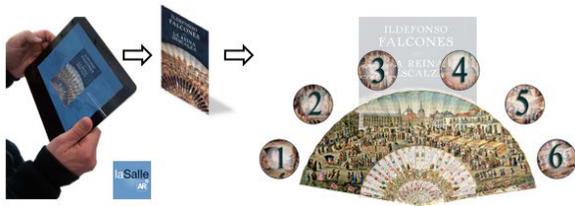
As we have stated previously, the process began by distributing the work (Fig. 2) into two parts:

- The training of students in the creation of content with RA. This process was carried out in three sessions for a total of six hours, during which the work with QR codes, the technique to relate content with recognition of image (image-tracking), and the deployment of AR content using Aurasma platform were explained.
- The other group developed the necessary documentation for the submission. These students were responsible for describing the subjects selected using the online PREZI software, which in a later iteration will be transformed into video format to fit into the Aurasma platform.

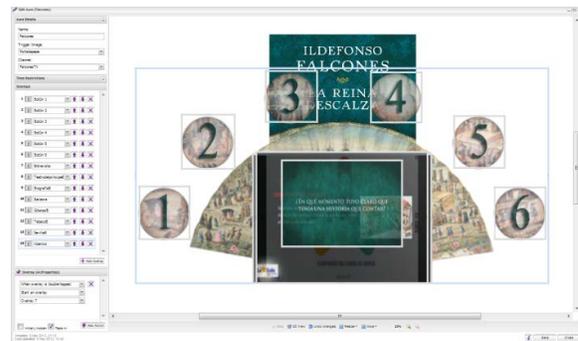
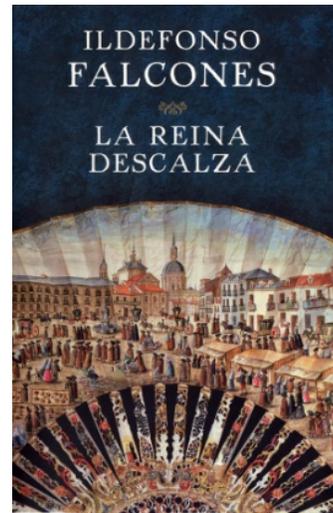


**Fig. 2 Presentation of the groups of the project with students and teachers**

The next phase of work focused on the creation of the sequence of digital images that will show on the cover of a book with AR when it is captured with a mobile device with a camera and with the selected application. (In order to be able to view the multimedia content generated, it is necessary to download the application ‘La Salle AR,’ available for the Android systems in Google Play (<http://goo.gl/agdYV>), and IOS in iTunes (<http://goo.gl/lcCWH>.) This can be seen in Figure 3:



**Fig. 3 Example of interactive menu visualized with AR on the cover of the book *La reina descalsa*, Ildefonso Falcones, 2013.** The process of content generation is distributed over four steps to define the final interaction with AR. The first step is the design of the images, called ‘Triggers,’ which will be tracked to start the RA experience. These images will be placed in the cover of the book in digital format (Fig. 4). The second step is the definition of the ‘Overlays’: these are the videos about the themes related to the book made by the students of the second group. These files are optimized to a maximum of 100 Mb in order to make the experience rapid and useful. The third step is the definition of the relationship between the Trigger image and the Overlays. In this step, the AURASMA platform allows for both to be combined in a desktop where students place each Overlay over the Trigger image (Fig. 4). They must configure the actions between the Overlays to play correctly with the application. This configuration is probably the most difficult step in the process. The support by the teachers was increased at this point. The fourth point consists in creating and sharing the Channel for publishing. This is the final process, and is very easy for the students to do.



**Fig 4. Cover (Trigger image) and configuration with AURASMA.**

## 4. RESULTS

Qualitative methods are commonly employed in usability studies and, inspired by experimental psychology and the hypothetical-deductive paradigm, employ samples of users who are relatively limited. Nevertheless, the Socratic paradigm from postmodern psychology is also applicable and useful in these studies of usability because it targets details related to the UX with high reliability and uncovers subtle information about the product or technology studied [14].

This migration from the hypothetical-deductive paradigm to the Socratic paradigm was inspired by the paradigm shift in clinical psychology away from constructivism and toward other post-modern schools of psychotherapy. This psychological model defends the subjective treatment of the user, unlike the objective hypothetical-deductive model [15].

Starting from Socratic paradigm basis, the BLA system (Bipolar Laddering) has been designed. BLA method could be defined as a psychological exploration technique, which points out the key factors of user experience.

The main goal of this system is to ascertain which concrete characteristic of the product entails users’ frustration, confidence or gratitude (between many others). BLA method works on positive and negative poles to define the strengths and weaknesses of the product. Once the element is obtained the laddering

technique is going to be applied to define the relevant details of the product.

The object of a laddering interview is to uncover how product attributes, usage consequences, and personal values are linked in a person's mind. The characteristics obtained through laddering application will define what specific factors make consider an element as strength or as a weakness. BLA performing consists in three steps:

1. Elicitation of the elements: The implementation of the test starts from a blank template for the positive elements (strengths) and another exactly the same for the negative elements (weaknesses). The interviewer (in this case an academic tutor) will ask the users (the student) to mention what aspects of the subject and experiment they like best or which help them in their tasks.  
The elements mentioned need to be summarized in one word or short sentence. This first step may be open or limited, i.e., positing a number of aspects without limits or reducing them to a specific number, as in our case where every student was asked to indicate three positive aspects and three negative ones.
2. Marking of elements: Once the list of positive and negative elements is done, the interviewer will ask the user to mark each one from 0 (lowest possible level of satisfaction) to 10 (maximum level of satisfaction).
3. Elements definition: Once the elements have been assessed, the qualitative phase starts. The interviewer reads out the elements of both lists to the user and asks for a justification of each one of the elements performing laddering technique. Why is it a positive element? Why this mark? The answer must be a specific explanation of the exact characteristics that make the mentioned element a strength or weakness of the product.

Once the element has been defined, the interviewer asks to the user for a solution of the problem he just describes in the case of negative elements or an improvement in the case of positive elements. (Fig. 5) shows an example of the BLA test used:

1. ELICITACIÓN DE ELEMENTOS  
2. Puntuación de 0 (mínimo nivel de satisfacción) a 10.

1. POSITIVOS (3) - en una palabra/frase	2.	3. NEGATIVOS (3) - en una palabra/frase	4.
1. Tecnología muy interesante, útil y novedosa además de divertida.	9	4. La rapidez y profesionalidad de los datos presentados.	4
2. Muy buena actitud del profesor, comportamiento sin clases después de venir con Google +	10	5. Mala organización de la difusión de la actividad a la hora de atender a la posición.	3
3. A pesar de ser de LSU el profesor incluyó licencias de uso de prop.	10		

1. Elemento a elemento, porqué es positivo/negativo y porqué esa puntuación. Concretar aspectos muy concretos...finalmente como mejorar la nota.

1. Podrían haberse visto mediciones más como que de verdad hubieran sido muy útiles, pero lo visto ya fue de por sí muy interesante.
2. La verdad es que la obtención de la información es imposible.
3. No pueden ser más generosos.
4. Un poco más de tiempo hubiera sido ideal para perfeccionar la técnica, resolver dudas y mejorar la coordinación.
5. Muy poca gente dispuso de la tecnología del día de la presentación, pero falta de recursos más pero.

Fig.5 BLA Sample Test.

From the results obtained, the next step was to polarize the elements based on two criteria:

1. Positive (Px) / Negative (Nx): The student must differentiate the elements perceived as strong points of the experience that helped them to improve the type of work proposed as are useful, satisfactory, or simply functional aesthetic, in front of the negative aspects that did not facilitate work or simply need to be modified to be satisfactory or useful.
2. Common Elements (xC) / Particular (xP): Finally, we separated the positive and negative elements that were repeated in the students' answers (common elements) and the responses that were only given by one of the students (particular elements).

The common positive elements (PC) were the use and explanation of the AR technology (Mention Index: 100%, Average score: 9.67), and the help/support of the faculty (MI: 100%, Av: 9.00). The common negative elements (NC) we can highlight were the lack of time to practice with this technology (MI: 100%, Av: 3.67), and insufficient publicity given to the project (MI: 66.5%, Av: 3.50).

If we analyze the solutions and improvements for both the strengths and the weaknesses identified, the majority focuses on two fundamental aspects: the need for more time in the explanation of the AR technology, including more details, other programs and applications, etc.; and improving the timing of the experiment, because on this occasion more extensive attention was paid to the assistance of the famous author and the presentation of his work, to the detriment of the work with the AR technology. Another factor in this respect was that the project did not have the expected media impact, which is an issue to improve in possible future initiatives.

## 5. CONCLUSIONS

The main conclusion that we can extract from the initiative is the high degree of involvement, motivation and satisfaction of students in the use and development of content for viewing through the RA. The additional fact of working on a high profile piece of literature and having the support of the author in the official presentation of the book on the one hand led to an increase in students' motivation to develop the experience, but also, on the other, may have led to too many resources and time being devoted to institutional contacts that have detracted from the technological development, the key aspect from the academic point of view. Similarly, interviews conducted with students demonstrated that there was a general perception of a lack of a greater impact of the exercise, associated directly with the impact of the work. In this line, and waiting for effective implementation, the editorial Grijalbo confirmed that both the news and the content that has been developed will be published on its webpage, due to the quality of the generated elements.

This experience makes possible replication in future courses, exploring new content for literary works or those related to the world of the arts. This will enable these students to study the contents of these subjects from a technological point of view, which has been found to be highly satisfactory and motivating.

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