

# The Integration of Augmented Reality and the Concept of Sticker Album Collection for Informal Learning in Museums

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**Abstract.** Informal learning can have an important role in today's Education but, to be effective, it should be contextualized individually for each learner, and situated to enhance experience. Museums have invaluable collections of assets that are in display and curators use their knowledge to engage the audience. Museums are places where informal learning can be fostered to engage the students and provide opportunities for situated learning. Pervasive systems, that take into account context, from both the learner and the location, have a good potential to promote this effectiveness in a gamified process that transforms the regular museum exploration into an engaging experience that provides learning opportunities at the appropriate time and place.

In this paper, we propose a gamified approach based on the concept of sticker album collection and its integration in an Augmented Reality (AR) mobile application. The concept of sticker album collection is quite familiar to most people, mainly from their youth, and is the main dynamic of the gamification design, engaging the learner to collect more stickers and progress in the exploration of the museum. As a pervasive solution, we do not use physical support, but instead, a mobile application to provide the learning experiences by uncovering the stickers using AR over the museum collection, in order to enhance the knowledge transfer and rewarding. We present a prototype developed for a boat museum where, digital stickers are obtained by overcoming challenges in the context of the exploration of the boats in the museum.

Furthermore, we provide two evaluations from experts: a preliminary evaluation of user experience and a gamification evaluation using the Octalysis framework.

**Keywords:** Sticker album collection · Gamification · Museums · Augmented reality

## 1 Introduction

Museums consolidate the heritage of a country and a given region, interlinking history, art, science and the territory, among others. Confirming its importance, there is a gradual increase in the number of visitors, and the literature review points out to an increase in

projects that try to incorporate recent technological developments to effectively improve the attraction of (mainly) the younger population.

As an inalienable landmark in the history of Portugal, we focused this paper on a case study about Maritime Museums, and most particularly, the exploration of traditional boats. The main research question is: how to integrate museums in a gamified informal learning experience?

So, the basis of our approach is to capitalize the value of museum collections to provide engaging experiences and then to add an AR layer that gamifies the assets of the exhibition to provide the dynamics to foster progressions on informal learning activities. We focus on the concept of the digital sticker album collection as the basic dynamics together with a set of mechanics that require solving challenges using AR.

## 2 Related Work

Museums are places that materialize and display knowledge, fostering the collection, preservation and sharing of that knowledge with the public [1]. Museums are changing the way they engage the audience, by turning the visitors from passive to active participants [2, 3]. Technological solutions have been fostered to improve the experience of visitors, incorporating multimedia elements and AR [4, 5]. However, the technology should be integrated in the design of the experience and gamification [6] can have a major role to enhance it. Arnab and Clarke propose a holistic model for gamified and pervasive learning design, highlighting the necessity to shift the focus away from current strong overemphasis on technology in the field, and move it toward prioritizing the value of context, pedagogy and basic game design [9]. Pervasive learning can be defined as “learning at the speed of need through formal, informal and social learning modalities” [10] and should be explored to provide learning opportunities, formally or informally in contexts such as museums, that provide an epic context to deploy the learning activities.

Collecting can be defined as the process of acquiring and possessing things in an active, selective and passionate way [7]. The sticker album collection is rooted into many cultures and is intergenerational. Different target audiences have come to eternalize collecting, with football sticker cards and characters from the world of fantasy and comics, to the universe of adults with collectible objects and marketing strategies aimed at them. From these perspectives, previous work has focused on the integration of AR with the concept of the sticker album collection to enhance the visitor experience in a traditional boat museum [8].

In this paper we advance further in the validation of the gamification design to enhance the experience and relevance of AR in the context of museums to provide opportunities for pervasive learning.

### 3 Gamification Design Based on the Sticker Album Collection

The gamification design was inspired on the concept of the digital sticker album collection. Important in this design is the concept of the “Players’ journey” which divides the players’ experience in four steps: discovery, onboarding, scaffolding and endgame.

The discovery phase is not addressed in this study, but in the case of a museum the entrance lobby is a good place to motivate the user to download the app. Or in the case of a school visit, the teacher or the museum guide can have an essential role.

The onboarding phase is fundamental to provide ownership and identity in the experience and also is a tutorial phase in which the player learns the basic mechanics. As soon as the application is downloaded, and after selecting the language, a video introduces the story/goals. Afterwards, the registration/login menu appears, which can be performed through Google or Facebook, thus making it possible use the social networks in a transmedia perspective and also to access some basic profile information to customize the application to the user. The user can also customize the theme layout (historic or children theme) and the avatar.

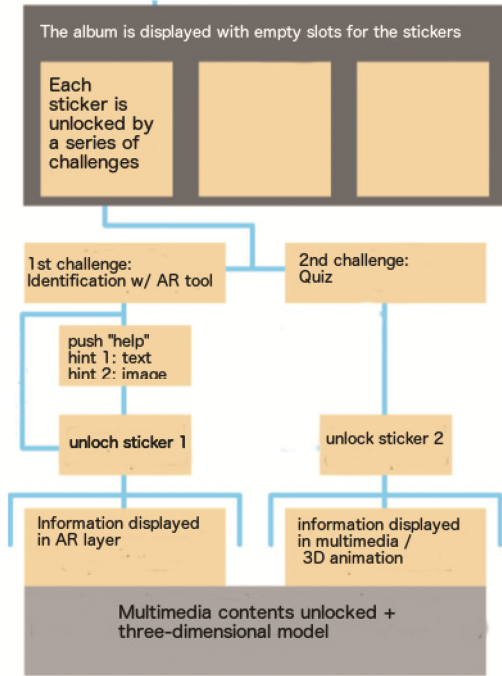
After the initial setup, the application shows an empty album. But to complete the onboarding, the user gets automatically the first sticker and the first challenge (Fig. 1) motivating the user to progress.



Fig. 1. The first sticker

Scaffolding is the third phase of the Players’ Journey and, basically, it is a progressive activity that engages the player into small iteration cycles in order to provide mastery. Informal learning can be included in these cycles. In this case, the user will discover the distinct boats of the museum and will unlock the digital stickers to complete the collection.

Each boat has a predefined number of stickers that, being initially drawn as empty slots, show the number of challenges to solve (this number can vary) in order to collect the boat. Figure 2 shows the typical iteration cycles for a specific boat.



**Fig. 2.** Iteration cycles designed for each boat’s collection of stickers

The first sticker provides a brief description of the boat and challenges the user to identify a specific component of the boat. Using the AR tool the user will need to find it. In the case of difficulty, a “help button” can be pressed and a text hint will be provided (about its location) and if the user is still not able to find it, another more detailed hint (like a drawing of the boat component) will be additionally provided. This provides mastery to proceed.

As the user identifies the boat component, additional information is provided in the AR layer, showing specificities and details on top of the original museum boat. This launches the second challenge, a simple quiz that assesses basic information provided previously in AR or on the site. After collecting this second sticker, the boat image in complete in the album, and a new multimedia content is available as a reward: a three-dimensional model of the boat and a small animation of how the boat is constructed. Thus, the user progresses through each level by surpassing each challenge, gaining access to digital stickers (and associated multimedia content) as a reward, making the exploration of the museum and the real apprehension of knowledge more attractive. The AR layer has the major role to make the connection with the heritage of the museum.

By exploring the museum rooms and completing the sticker album collection, the player reaches the Endgame phase, where (s)he is awarded a captain certificate and a complete collection of three-dimensional models of the boats that (s)he will be able to bring home. This experience could be shared on the social network where the user has

registered or continued in other museums, for which a “passport” could be created, and a “travel stamp” would be rewarded also for each museum.

### 4 Preliminary Evaluation of User Experience

Based on the application developed, still as a prototype, a preliminary evaluation of the user experience was carried out with specialists on the museum area, through a questionnaire applied after an experimentation session. The questionnaire was applied to six key stakeholders, from the Director of the museum to staff members and visitors, as well the author of books on these particular traditional boats.

Figure 3 summarizes the mean and standard deviation of the responses obtained (Likert scale 1 to 5) according to the following key metrics: graphic layout, relevance of content, relevance of the application, interactivity, user feedback, usability, effectiveness, appropriateness of instructions, objectives, learning and the degree of satisfaction with the application.

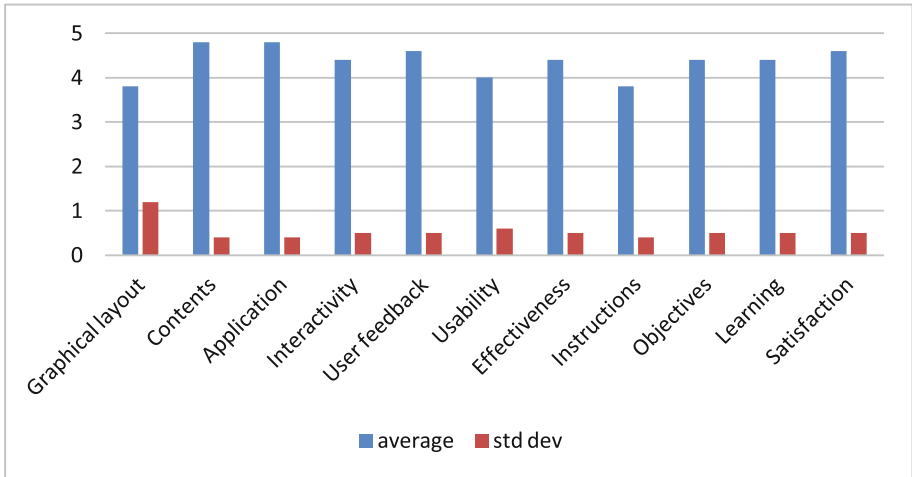


Fig. 3. Results of the preliminary evaluation

The results show that all metrics were scored above four, with the exception of two: graphical layout and appropriateness of instructions. Being a prototype, this is natural as the design and instructions have not been completed. But, overall, this good score shows a large potential to promote the prototype to a final product and to explore it in other applications.

There are also other variables to test, namely the most appropriated number of stickers for each boat and the number of iterations in the museum. In this first prototype we have developed five iterations (each one on a distinct boat) with just two stickers for each boat.

## 5 Evaluation Using the Octalsys Framework

The Octalsys framework, allows the evaluation of the effectiveness of the gamification design in 8 core drives, assessed on a scale from 0 to 10.

On the basis of the prototype developed we assessed the potential of this approach by involving four experts in the area (three of them with a PhD). In the following paragraphs, we show the resulting score (average/standard deviation) of the distinct contributions, and exposing the main reasoning behind it:

**Epic Meaning & Calling (6,5/1,29)** is related to the motivation (call to action) of the user. Discovering the history through museums can provide an epic meaning, particularly if the user integrates the learning activities within the museum experience. This could also be enhanced through an interesting narrative but, it is the AR tool that creates the connection of the experience to the real historical artifact, bridging the virtual and physical worlds.

**Development & Accomplishment (8,75/0,5)** is the internal drive of making progress, and in this case is the core nature of the stickers card collection. The motivation to complete the album provides small iteration cycles that provide progression and learning. Furthermore, the visual feedback on the collected/missing stickers works like a progress bar.

**Empowerment of Creativity & Feedback (3,5/1,29)** is when users are engaged in a creative process. Although the user can explore the rooms and the stickers collection over an arbitrary order, following a personal narrative, this is not a main drive of the approach. However the three-dimensional models awarded could be used on creative activities after the museum visit and promote feedback from the visitor on additional activities.

**Ownership & Possession (9/0)** is one of the main drives of the stickers collection as it is the user that constructs the album by collecting each individual sticker. Also the user can configure his own avatar and customize the theme layout, which will engage them even more. At the endgame phase the user takes possession not only of the album but also of the multimedia/animation contents and the three-dimensional models of the boats.

**Social Influence & Relatedness (3,75/2,5)** is one of the topics that we did not explore deeply in this work. Nevertheless if the user uses social networks, the “stickers” working similar to achievements, can serve as means to compare experiences between visitors, as well as an incentive to promote cooperation and competition. And, clearly, this is one of the future work directions, as the core concept of the physical stickers collections is the exchange of stickers between people. This could be digitally provided to distinct students in a school visit to the museums or through the social networks.

**Scarcity & Impatience (7,75/0,96)** is driven by the desire to complete the collection. Having to unlock each sticker in each challenge requires exploration and learning at the museum rooms. However, this can lead the visitor to subvert the visit to the museum, focusing on hastily collecting stickers instead of enjoying the museum. This is where AR takes another relevant role to focus the visitor attention on the museum collections.

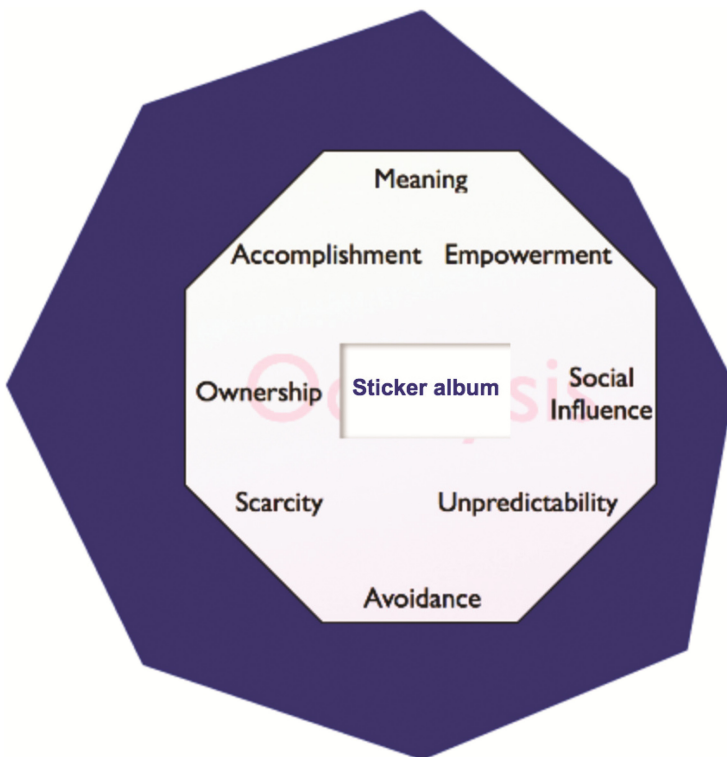
**Unpredictability & Curiosity (6,5/1,73)** is also something that, although we did not explore deeply, is also natural to the physical counterpart of the album as you open

the stickers bags... You do not know in advance which sticker will come out and if they are missing or already have been collected. This is also something that can be pushed forward in future work as the museum collection can provide this unpredictability, tied to the visitor's curiosity and thirst for knowledge.

**Loss & Avoidance (7,25/1,5)** is a “negative” drive that motivates people to continuing progressing in order to avoid the loss of the previous effort. A collection is only finished when all the stickers are collected. So by missing just one sticker the whole objective is compromised.

Looking at the eight core drivers individually we can see unanimity and high scores in “Ownership & Possession” and “Development & Accomplishment”, which are good leads for learning. On the contrary, it shows low scores in “Empowerment of Creativity & Feedback” and in “Social Influence & Relatedness”. Particularly in this last score there was some disagreement on the experts panel, showing that, although not explored in this approach, there is a good potencial.

Looking at Fig. 4 we can observe the resulting diagram of the Octalsys evaluation of the concept of the digital sticker album collection. The diagram has the eight core drives represented in the eight vertexes of a regular octagon. But the order is not random and from the symmetry of the diagram we can observe that the drives on the left side of the brain are related to the “left side of the brain”, associated to logic, calculations,



**Fig. 4.** Octalsys diagram [9] of the Sticker Album Collection with AR

and ownership, while the ones on the “right side of the brain” are associated to creativity, self-expression, and social aspects.

The resulting diagram of this evaluation shows an ample gamification (large blue area) and also that it is quite balanced, with just a slight shift to the “left side”. This means that this concept has a lot of potential to engage the user, and the shift towards the “left-side of the brain” means that this approach is more appealing to the logical reasoning than to motivate the creative skills of the user or social engagement. This result can be interpreted as suggesting the use of this approach for informal learning in STEM rather than in Arts.

## 6 Conclusions and Future Work

In this paper we propose the concept of the sticker album collection integrated with AR to improve the experience of informal learning. The museum heritage is the anchor point that provides the epic meaning of the experience, and informal learning is fostered on the challenges associated to the locked stickers, while progression is achieved by collecting the missing stickers. The AR layer is the key element that provides the connection between the museum’s heritage and the gamified learning experience. Preliminary evaluation of the user experience achieved a good score, showing the potential of this approach to engage the visitors. We also validated in more detail the potential of this approach to gamify experiences in museums using the Octalsys framework. The results obtained with four experts gives a clear view on the balance and amplitude of this approach.

Future work will extend the approach to improve social interaction and unpredictability, as well as to develop pilot studies in informal learning activities on specific STEM areas like programming, for example.

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