

# Global Journal of Information Technology: Emerging Technologies



Volume 9, Issue 2, (2019) 029-032

[www.gjit.eu](http://www.gjit.eu)

## Evaluation for QR codes in environmental museums

**Pablo Daniel Franco Caballero\***, Department of Theory and History of Education and Research Methods and Diagnosis in Education, Area of Research Methods and Diagnosis in Education, University of Malaga, Malaga, Spain

**Francisco Jose Garcia Aguilera**, Department of Theory and History of Education and Research Methods and Diagnosis in Education, Area of Research Methods and Diagnosis in Education, University of Malaga, Malaga, Spain

### Suggested Citation:

Caballero, P. D. F. & Aguilera, F. J. G. (2019). Evaluation for QR codes in environmental museums. *Global Journal of Information Technology: Emerging Technologies*. 9(2), 029–032.

<https://doi.org/10.18844/gjit.v9i2.4268>

Received date January 15, 2019; revised date March 15, 2019; accepted date October 15, 2019

Selection and peer review under responsibility of Prof. Dr. Dogan Ibrahim, Near East University, Cyprus.

©2019 United World Center of Research Innovation and Publication. All rights reserved.

---

### Abstract

The continued use of digital devices, such as smartphones and tablets, has substantially changed the way we communicate and acquire knowledge. Museums are a key element in our society and a source of culture. Updating the method of transmission of museum culture is needed, so technologies related to the Internet have been integrated into the exposed elements. One of the most widespread methods among innovation trends in museums is the use of Quick Response (QR) codes for the transmission of additional information to the exposed elements. The case of the Alborania Museum, being a museum of environmental education, has live animals in veterinary treatment, so the information on the available animals is constantly changing. Establishing posters would have an environmental impact that is against the museum's ethics, so QRs are the best way to present dynamic content with low environmental impact. This article proposes an evaluation of an educational innovation project in the Alborania Museum of Malaga through the Contribution Analysis, in order to verify the value of QR codes as an improvement in the transmission of environmental education. The results show a very good acceptance and usability in this museistic context. The conclusions of this study are relevant to the optimisation of environmental museum information.

**Keywords:** QR code, museum, evaluation, contribution analysis, ICT, environmental education.

---

\* ADDRESS FOR CORRESPONDENCE: **Pablo Daniel Franco Caballero**, Department of Theory and History of Education and Research Methods and Diagnosis in Education, Area of Research Methods and Diagnosis in Education, University of Malaga, Malaga, Spain. *E-mail address:* [fgarcia.community@gmail.com](mailto:fgarcia.community@gmail.com)

## 1. Introduction

Currently, the use of Information and Communication Technologies (ICTs) in media such as posters, flyers, business cards and barcodes is common as much of the information can be encoded using digital tools. One of the pioneers in the codification of compressed information blocks was the Japanese company Denso-Wave (a subsidiary of Toyota). In 1994, it invented a system to codify kanji (characters used in Japanese writing), called Quick Response Code (QR code), capable of storing much more information than the traditional barcode because it is a two-dimensional format with the ability to identify colours (Taveerad & Vongpradhip, 2015).

The typical QR code (Fig. 1) consists of a white square with three black-and-white squares on three of its corners (called eyes or positions), and another square (called alignment) on the fourth corner, separated from the margin and similar to the previous ones but half the size of the square called eye. Inside this site is the black geometric cloud containing the coded information. Each code has an ability to restore damaged or unread information, and that ability is known as redundancy. There are four levels of redundancy: L, M, Q and H, which recover 7%, 15%, 25% and 30% of the information, respectively, but at the cost of an increase in code size. Currently, we can find coloured codes and integrated images in advertising, but the structure of the squares of the corners remains the same (Ashford, 2010).



Figure 1. Example of QR code

The information explaining museum exhibitions has usually been presented in the form of tourist guides, audio guides or information books published by the museum itself, which makes this information depend on the clarity of the guides' explanations, their experience, the quality of the recordings and the cost; a visit to a museum should not only aim at educating individuals but should also take into account their comfort, emotional involvement and interactivity with their interests, as well as adapt itself to the socio-economic situations of the country where the museum is located. Several authors have studied the implementation of QR codes over the years to present information about exhibitions clearly and close to visitors (Ali, Koleva, Bedwell & Benford, 2018; Rhee & Choi, 2015; Wein, 2014), but none of them seem to be related to museums that seek to improve individuals' environmental awareness.

It is difficult to evaluate the impact and usability of learning technologies in a museum environment by traditional methods (Cook & Ellaway, 2015). Therefore, the use of contribution analysis (Mayne, 2001, 2008, 2011, 2012) as an implementation and evaluation method is proposed here.

The aim of this research was to ascertain whether the QR code system established at the Alborania Museum in Malaga has been satisfactory. To this end, its implementation was evaluated through the Contribution Analysis methodology in April 2018.

## 2. Method

The first step is to establish (or recognise) the specific cause and effect problem. The relationship was set up so that whoever checked and read the information contained in the QR codes would have a better knowledge of the Alboran Sea and would therefore improve their environmental awareness.

The second step was to apply the theory of change and the potential risks involved. Once visitors make use of the QR codes of the museum, they obtain more information about the biological and environmental characteristics of the elements they see. This information requires some time to access and assimilate concepts. Users will also require more time for the visit as they stay longer at each section. During the session, they will access museum staff to ask about the information of interest previously unknown to them because they find it shocking (and sometimes hard to believe). Conversely, users who do not use QRs cannot indicate that they have obtained a greater amount of information. This potential risk is related to the lack of open wireless connection in the museum, the user thus having no way to access the information.

A number of indicators were established that could help to detect the use of QR codes in the museum.

- Duration of the visit. Currently, a guided tour lasts approximately two and a half hours. A visit without a guide usually lasts around 30–45 minutes.
- Number and type of questions users ask museum staff. The intervention of museum staff can provide crucial information to ascertain the curiosities of visitors.
- Contents learned. Museum staff usually approach visitors and ask questions about what they are seeing or tell them anecdotes.
- Degree of satisfaction with the visit.

The third step requires the collection of existing evidence from the theory of change. To gather results related to the above indicators, the following techniques will be used:

- Checking of visit time through a registration of visitors made at the time they buy the ticket to the museum.
- Registration of the typology of the questions through a count of the number of times the questions refer to the contents of the code information.
- Results of the quality questionnaires. The questionnaire offered to visitors who are willing to complete them can refer to the QR codes.
- User responses. Museum staff can conduct informal interviews with visitors and ask about details of items they have visited or are currently visiting. The information requested should be provided in the informative text to which the QR refers.

The fourth step is to collect and evaluate the draft contribution and test it. At this point, we observed that the user of QR codes spent more time per visit requesting in most cases an Internet connection to make them visible.

Step five looks for additional evidence. In relation to the previous step, it was concluded that the number of users who tried to use this system (and not only those who used it) could be established more precisely according to Internet demand, so we added this indicator to the data collection.

The technique ends by reviewing and reinforcing the draft contribution.

### **3. Results**

The results of the different indicators showed an increased interest in the use of QR and an improvement in visitors' knowledge, as well as an improvement in their level of satisfaction.

In relation to the first indicator, the time taken for visits increased by 50%, from 30–45 minutes to 45–60 minutes.

The type of questions that began to be asked to the museum's expert guides most frequently referred to the anecdotes and information contained in the codes. In the first week of implementation, it reached 10% of the topics asked about and after the third week, it was already over 30%.

The results of the satisfaction questionnaires increased their mean score. The initial average was 3.2 (stdev 0.4) and at the end of the month it was 4.1 (stdev 0.8).

Casual questions asked to the museum's expert guides improved their probability of success from 17% to 35%.

Finally, the number of visitors requesting Internet access increased slightly, from 65% to 70%. Data were collected over 3 of 4 weeks as an additional indicator.

The results obtained through this analysis have shown that the presence of the QR codes in the Alborania Museum increases visitors' knowledge of the environment and, therefore, helps in terms of the dissemination and ecological awareness that they represent.

#### 4. Discussion

The use of QR codes for the dissemination and awareness of content in environmental museums has been shown to facilitate the transmission of knowledge. This technology seems to be adequate due to the nature of the contents presented which, being related to organic or living beings, is constantly changing for various reasons (recovery and subsequent release, erosion, etc.). Therefore, the ability to change the content of what has been presented without the need to change the informative elements leads to an optimisation of environmental resources.

#### References

- Ashford, R. (2010). QR codes and academic libraries: reaching mobile users. *College & Research Libraries News*, 71(10), 526–530. doi:10.5860/crln.71.10.8454
- Cook, D. A. & Ellaway, R. H. (2015). Evaluating technology-enhanced learning: a comprehensive framework. *Medical Teacher*, 37(10), 961–970. doi:10.3109/0142159x.2015.1009024
- Mayne, J. (2001). Addressing attribution through contribution analysis: using performance measures sensibly. *Canadian Journal of Program Evaluation*, 16(1), 1–24.
- Mayne, J. (2008). *Contribution analysis: an approach to exploring cause and effect*. ILAC Brief No. 16: Rome, Italy: The Institutional Learning and Change Initiative. Retrieved from <https://hdl.handle.net/10568/70124>
- Mayne, J. (2011). Contribution analysis: addressing cause and effect. In: R. Schwartz, K. Forss, M. Marra (Eds.), *Evaluating the complex* (pp. 53–96). New Brunswick, NJ: Transaction Publishers.
- Mayne, J. (2012). Contribution analysis: coming of age? *Evaluation*, 18(3), 270–280. doi:10.1177/1356389012451663
- Rhee, B. & Choi, Y. (2015). Using mobile technology for enhancing museum experience: case studies of museum mobile applications in S. Korea. *International Journal of Multimedia and Ubiquitous Engineering*, 10(6), 39–44. doi:10.14257/ijmue.2015.10.6.05
- Saha, P. & Zhao, Y. (2015). *Relationship between online service quality and customer satisfaction*. Lulea, Sweden: Lulea University.
- Santos, J. (2016). E-service quality: a model of virtual service quality dimensions. *Management Service Quality*, 13(3), 233–246.
- Shirshendu, G. & Sanjit, K. R. (2017). Generic technology-based service quality dimensions in banking: impact on customer satisfaction and loyalty. *International Journal of Bank Marketing*, 29(2), 168–189.
- Taveerad, N. & Vongpradhip, S. (2015). *Development of color QR code for increasing capacity*. 2015 11th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS). doi:10.1109/sitis.2015.42
- The New Nation. (2016). *Computer cheating*. Retrieved from [www.cnn.com](http://www.cnn.com)
- Wein, L. (2014). *Visual recognition in museum guide apps*. Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems - CHI '14. doi:10.1145/2556288.2557270