SUPPORTING SITUATED LEARNING BASED ON QR CODES WITH ETIQUETAR APP: A PILOT STUDY

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ABSTRACT

EtiquetAR is an authoring tool for supporting the design and enactment of situated learning experiences based on QR tags. Practitioners use etiquetAR for creating, managing and personalizing collections of QR codes with special properties: (1) codes can have more than one link pointing at different multimedia resources, (2) codes can be updated whenever needed without being reprinted and (3) multimedia resources linked through these codes can be commented by any user. This paper presents etiquetAR Mobile App, a mobile application that supports learners' interaction within spaces augmented with etiquetAR codes, offering responsive visualizations of the resources and mobile device adapted functionalities to add contributions. A pilot study with 95 students and 3 teachers illustrates the use of etiquetAR in a real learning activity. The results of this pilot indicate that etiquetAR App facilitates students' interaction with the tags having a positive impact on situated learning.

KEYWORDS

QR codes, Android App, Situated Learning, Pilot Study, Mobile Learning.

1. INTRODUCTION

QR (Quick Response) codes are a type of location-based technology that is attracting a lot of growing research in the field of technology-enhanced learning (Saravani & Clayton, 2009). Among the educational uses of QR codes, and related to this paper, it is worthwhile to highlight their usage to augment physical spaces, such as museums (Ceipidor et al., 2009) or libraries (Walsh, 2011), and in situated learning approaches, where learning is a function of the activity, context and culture (Lave & Wenger, 1990). However, the adoption of QR codes in education is still low and very few tools have been developed for increasing this adoption. Two exceptions are the "QR treasure Hunt Generator"[1] (a web-based tool for automatically generating treasure hunting activities based on QR codes, which contain multiple choice questions defined by the teacher), and etiquetAR[2] (Pérez–Sanagustín, et al., 2013), on which this paper focuses.

EtiquetAR is an authoring tool for supporting the design of adaptive and dynamic situated learning experiences based on "intelligent" QR codes, which extend the interaction possibilities of traditional QR codes. First, etiquetAR QR codes can be linked to more than one resource, allowing the creation of adaptive learning activities, and providing students with information that is more tailored to their profiles (e.g. different grades and languages). Second, etiquetAR QR codes can be updated without printing them again, which enables easily changing the content of the tags, thereby supporting dynamic learning activities. Third, etiquetAR users can add comments to each resource linked through this intelligent QR codes. Unlike the "QR treasure Hunt Generator", which focuses on supporting a particular type of activity, etiquetAR concentrates on supporting the management of QR codes.

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[1] http://www.classtools.net/QR/
[2] http://www.etiquetar.com.es

Any QR reader can be used to scan etiquetAR QR codes. However, we detected some technical problems in a real activity carried out during the last academic year at Universidad Carlos III de Madrid (where students used a generic QR code reader for interacting with etiquetAR codes): (1) the web interface where users are redirected when scanning the codes is not appropriate when using a mobile device (the resources are not clearly displayed and users have difficulties writing their comments), and (2) accessing videos or visualizing high quality images is time consuming in places wherein the wireless signal is weak. These technical problems led to some educational limitations: students had difficulties in concentrating, carrying out tasks without interruptions, and in working in groups (from 5 to 7 people) using a single device provided by the teachers. This paper presents a first prototype of the etiquetAR Mobile App, which is aimed at improving the interactions with the tags generated with etiquetAR and at solving the technical problems and overcoming the educational limitations detected in the former edition of the activity. This papers summarizes a pilot study designed to evaluate the use of etiquetAR Mobile App in the second edition of the activity.

2. ETIQUETAR MOBILE APP

EtiquetAR was designed as a web client that allows educators to create, personalize and manage intelligent QR codes, and redirects users to the information stored in these codes when scanning them with a third-party QR reader. etiquetAR was implemented using the Ruby on Rails framework, with a PostgreSQL object-relational database on the backend that manages the collections of QR codes created by the different users. etiquetAR Mobile App is an Android application developed using the Android SDK that interacts with etiquetAR for improving users' interactions with the QR codes generated with this tool (Fig. 1). As shown in Fig. 1, the functionalities in etiquetAR Mobile App can be classified within two groups depending on the moment of the activity in which they are used: Pre Activity (dotted line) or During the activity (solid line).

EtiquetAR Mobile App includes the following functionalities. **(1) "Synchronize"**: to download the contents related to a particular collection of etiquetAR QR codes, storing them in the mobile device. This functionality connects to the web client database to get the information from the collection indicated by the user. **(2) "Read tags and select the content"**: adapts the scanning functionality and the visualization of the resources to be responsive to the screen characteristics of mobile devices. The different contents associated to a QR code are read from the SD card of the mobile device and displayed as clickable buttons. Also, videos can be watched in a full screen mode. **(3) "Comment"**: Adapts the "comment" functionality to the mobile device characteristics so that users can visualize/add comments related to a particular resource in a pop-up window organized by the time comments were created. This functionality also extends the web-based functionality by allowing users to reply to previous comments in a differentiated conversation thread.

The first functionality is the only one that must be always used before the activity and, if possible, in places with a good Internet connection. In this way, if QR codes are updated at the "last minute", the content in the mobile device will be synchronized with the one in the web. Once contents are synchronized, it will not be necessary to have Internet access for reading the content hidden in the tags. The second and third functionalities are always used during the activity. From them, only the "Comment" functionality needs Internet connection. Otherwise, users could not see the comments posted in the tags on *runtime*.
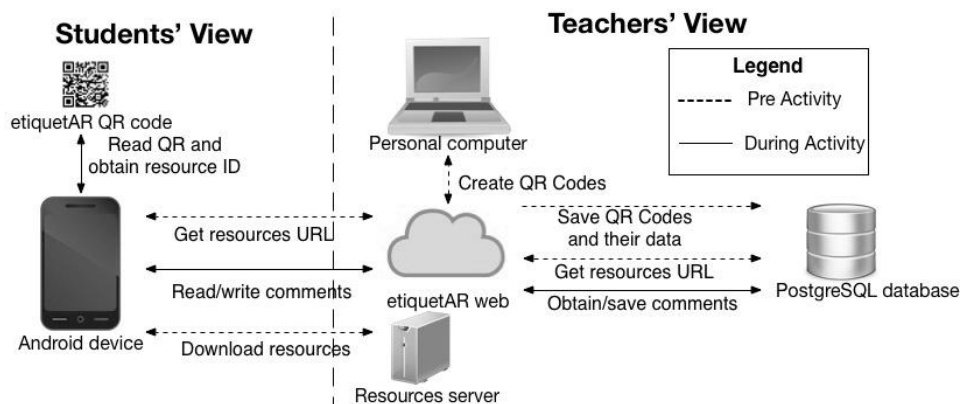

Figure 1. etiquetAR Mobile App architecture

3. PILOT STUDY: DESCRIPTION AND RESULTS

A pilot study was carried out in a laboratory activity of a first year course on System and Fabrication Procedures (SPF) in the studies of Mechanical Engineering at Universidad Carlos III de Madrid during 2013. The objective of this laboratory activity is to show a group of students (95) industrial machines that they would find in their professional career, how they work and which their main parts are. Three lecturers participated in this pilot too.

The three lecturers created 5 etiquetAR QR codes, which were attached to the 5 machines in the lab, for designing a situated collaborative activity. Each QR code contained the following information:

- A video explaining how the machine works in a real production environment;
- A picture highlighting the main elements of the machine;
- A question asking students to reflect on the different ways the machines are used in real contexts.

For the activity, students were grouped in teams of 5 to 6 people. An Assus Tablet with the Android OS and a dossier with problems to solve were handed out to each group (of 4 to 7 people). Each group was assigned to one of the 5 machines before the activity started. The activity was structured as follows:

(1) A **reflection activity.** Students had to scan the QR codes watch the video, see the picture, and answer both the reflection question and the problems in the dossier. This was done for all the machines with 12 minutes per machine. Before answering the reflection question, students could see the answers that their classmates had previously posted, in a way that they could contradict or complement the information;

(2) A **peer-evaluation activity**. After the first phase, students had to return to the first machine. Each team member had to access the tag corresponding to that machine, read the answers to the reflection question posted by their classmates, and evaluate their *correctness* and *completeness* using a Likert scale from 1 (lower mark) to 5 (higher mark).

After the activity, we delivered a questionnaire to the students and interviewed (individually) the teachers. The questionnaire asked students to assess their experience with the etiquetAR Mobile App in a Likert scale [Students Quest]. The results of this questionnaire are summarized in Table 1. Teachers were asked to compare this activity with the former edition, performed with the support of traditional QR readers [Teachers Interview]. Further, two observers took notes during the whole activity, paying special attention to those limitations detected in the former activity (outlined in the Introduction) [Observations].

To have a general view of the results, we analysed the data by following a mixed evaluation approach, in which we combined and triangulated (Creswell, 2003) the results of students' questionnaires (quantitative data) with the observations and interviews (qualitative data). To focus the analysis, we organized it around two questions of interest. We summarize the main results according to these two questions next.

Table 1. Students' ratings in a Likert Scale about the etiquetAR Mobile App. For each of the answers we indicate the number of answers provided and the % over the 95 total answers. We indicate the maximum rates in grey.

Question	Students' Ratings (Over 95 total answers)				
	1	2	3	4	5
Q1. It was easy to read the tags	0 (0%)	1 (1%)	3 (3%)	18 (19%)	73 (77%)
Q2. It was easy to visualize the videos.	0 (0%)	0 (0%)	2 (2%)	32 (34%)	61(64%)
Q3. Videos took lot of time to load	50 (53%)	25 (26%)	7 (7%)	6 (6%)	7 (7%)
Q4. I liked viewing "full screen" videos	0 (0%)	1 (1%)	7 (7%)	28 (29%)	59 (62%)
Q5. It was easy to know who wrote each comment	1 (1%)	8 (8%)	19 (20%)	32 (34%)	35 (37%)
Q6. I wrote lots of replies to my classmates answers	9 (9%)	20 (21%)	37 (39%)	28 (29%)	1 (1%)

(1) Does etiquetAR Mobile App improve the interaction with QR codes generated with etiquetAR compared with traditional QR readers? The results in Table 1 indicate that the etiquetAR Mobile App was useful to interact with intelligent QR codes, facilitating the access to the contents and overcoming the visualization limitations imposed by the mobile device. First, most of the students easily scanned the tags and read their content (77% assess this functionality with 5, Q1), and had no problems visualizing the videos (64%, Q2), even under poor Internet connection conditions (Q3). Second, most of the students rate positively the possibility of viewing full screen videos (62% in Q4). Third, results indicate that 71% of students rated the "comment" functionality positively (71% of rates 4 and 5 in Q5). Observations during the activity indicate that students had no difficulties when answering the reflection question [Observations]. Finally, it is noteworthy that most of the students contributed with comments to the resources and that some of them

contributed with more than one comment. This is also supported by the positive rates of students poi when evaluating how they replied to their classmates answers (30% of rating between 4 and 5 and 39% with a rate of 3)

(2) Does these improvements have a positive impact on the students' learning experience? The teachers' interviews as well as the observations indicate that using etiquetAR Mobile App had a positive impact on the students' learning experience. First, teachers stress that etiquetAR Mobile App works better than the generic the QR code reader employed in the former activity, increasing the time students spent on watching the videos and working on the activity. As one of the teachers said "*since this year the application worked better, students had the possibility of watching the videos more than once*" and stressed that with the etiquetAR Mobile App "*students had more time –*to spend on the activity- *and less waiting for the content*" [Teachers Interview, Teacher 1]. In addition, another teacher highlighted that the new App "*gave more time for the students* (for doing the activity)*, which was translated into more reflected and better answers* (to the questions)" [Teachers Interview, Teacher 2]. Finally, the observations made during the activity indicate that students spent most of the time discussing about the activities, filling in the questionnaire and reflecting on the different possibilities offered by the machine [Observations].

4. CONCLUSIONS AND FUTURE WORK

This paper has presented a first prototype of the etiquetAR Mobile App, an Android application that targets students, so as to improve their interactions with QR codes generated with the web authoring tool etiquetAR. The results of a pilot study with 95 students and 3 lecturers in a real scenario of situated learning indicate that: (1) the etiquetAR Mobile App provides a more fluid and friendly interaction with QR codes than traditional QR code readers, and (2) this improvement on the interaction with QR codes is translated in an enhanced situated learning activity, in which collaboration among students is better supported, while they focus on the tasks and on the activity performance. Our plan for the future is to add social functionalities to the App, such as a voting mechanism for evaluating the comments, or a system based on badges to reward the best contributions.

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