Beyond the simple codes: QR codes in education

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As mobile technologies become increasingly prominent in our daily lives, mobile tagging with QR (Quick Response) codes in the business sector is prevalently in many parts of the world. However, we believe the movement of using QR codes in education is still in its infancy. Apart from our own research in this area, this paper explores the possibilities beyond the simple use of the codes and offers some suggestions on how the technology can be used to its full potential.

Keywords: QR Codes, m-Learning, Smart Mobile Devices

Introduction

QR codes can literally hold any kind of information up to several thousand bytes. Coupled with a moderate equipped mobile device, it opens up a new horizon for many applications in the commercial world as well as in education. From hospital applications to labels of wine bottles, we can find QR codes everywhere commercially. In education, we believe that the movement of using QR codes is slow and still in its infancy. Many researchers are very excited about the technology and found the use of QR codes in education fun. They felt that the technology is easy to use, easy to implement, and, to a certain extent, low cost. This observation is quite obvious when we search the web and we can find many web links related to the educational use of QR codes in education. Some researchers have gone beyond this initial stage and start questioning the legitimate use of the technology. This paper is in this direction and offers some suggestions on how the technology can be used to its full potential.

Before we go on to discuss the use of this technology, we must first provide what a common decoder such as *i-nigma* (3GVision, 2010) can do with the codes. Figure 1 illustrates the different natures of QR codes that can be very useful for education and personal use. One must be aware that not all readers can handle these different types of codes and not all generators from the web provide the facilities to generate such codes. Interested readers can refer to Law & So (2010) for the process of generating and decoding QR codes.

Text: any textual information can be embedded	URL: a link to Youtube (the audio exercise described below)	Event: ascilite 2011 (dates and location can be directly inserted to the device's calendar)	Geo Location: Wrest Point's coordinates; ascilite 2011 conference location (directly map to Google Map etc.)	Contact: can store the information directly into the address book or call the phone number directly	SMS: can send the message to the destined phone number directly	WIFI Setting: can set the device's wireless connection (e.g. SSID, password, and protocol) if the device can accept it

Figure 1: Different natures of QR codes can be processed by a typical decoder

Exemplars of applications

We will also provide some examples of QR code applications in education from our own research (Law & So, 2010) and other examples from the research community. Although these examples certainly cannot represent the whole picture from the literature, these are typical applications and can form the exemplars for our discussion.

Review the information directly

When information is embedded into a QR code, the user can retrieve the content directly through the mobile devices. Answers for self-evaluated exercises can typically be retrieved in this way. Figure 2(a) shows a worksheet for the experiment we tried in two primary schools in Hong Kong. The students can work on the math questions and check the answers for themselves. For straight forward and simple answers, the answers can be stored directly into the code. For more complex answers, the answers can be retrieved from the web. Figure 2(b) shows another example of information embedded into the QR codes. A group of primary students participated in a competition of Math Trail (Shoaf, Pollak & Schneider, 2004). The questions are embedded into the codes and students have to complete the trail as fast as possible by answering the questions from one location to another and write the results and observations onto a worksheet.
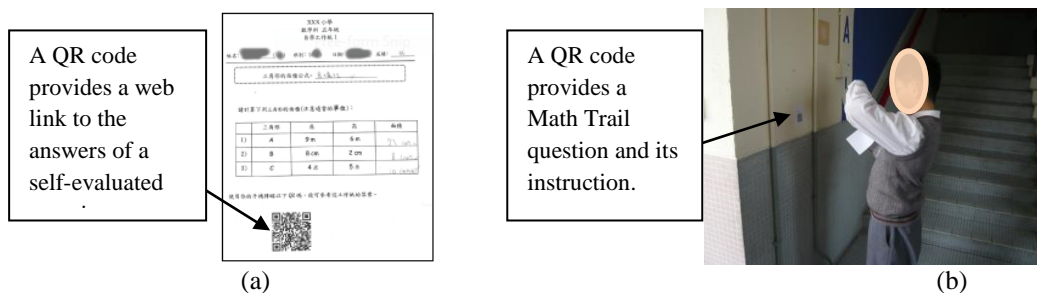

A QR code provides a web link to the answers of a self-evaluated .

(a)

A QR code provides a Math Trail question and its instruction.

(b)

Figure 2: (a) A worksheet for a self-evaluated exercise. (b) A student carried out a Math Trail competition

Access the multimedia resources from the web

This type of applications requires the learner to have a device that can play or display multimedia resources from the web. It can also be web pages to be retrieved by the learner. Figure 3 (a) shows a listening exercise performed by a group of primary students in a primary school. They listened to a Youtube clip referred by the URL on the worksheet. Podcast materials or video clips can be accessed via the QR codes printed on books or notes. Students can also pick up QR codes from slide projectors or computer monitors. Figure 3 (b) shows an outdoor activity of a life science subject. Students can learn different species of trees at a garden by accessing the web pages via the codes.

(a)   (b)

Figure 3: (a) A listening exercise. (b) Students can explore a life science subject via QR codes

Other examples are reported by the educational community

Beside learning and teaching applications, there are many reported examples of personal or administrative use of QR codes. Interested readers could refer to the literature listed in the reference section. We can loosely highlight some of them as follows:
- History learning with QR codes (Chen & Choi, 2010)
- A QR code associated with each record on a library catalogue (Bath, 2010)
- Assignment submission sheets bearing the relevant QR code (Bath, n.d.)
- Automatic generation of a QR code to the bottom of Moodle print-outs (Bath, n.d.)
- Posters, flyers and catalog with QR codes indicating the websites (HKIEd, 2011)
- Language learning supported by QR codes (Liu, Tan & Chu, 2007)
- A periodic table with each chemical element represented by a QR code (Stefano & Rizzo, 2009)

Where QR codes can make the difference

Quick access and fun to use are two obvious reasons for people like to use this technology. But why the technology has a slow pick-up in education? Are people aware of the full potential of this technology? One may argue that although smart mobile devices are getting popular, many people like teachers and students do not have the devices. They cannot fully understand the potential of this technology can bring to their daily teaching and learning. In any cases, the following discussion highlights the capability of the technology beyond its typical use. The ideas presented in this section could be of interest to some of the researchers in the area.

Extend learning to outdoor activities

The ubiquitous nature of accessing information through mobile handheld devices creates a so-called *u-space* for learners. Rather than carrying a laptop or other bulky devices to a location outside the classroom for learning, a learner can immerse into the learning process through a pocket-sized device. For example, our Math Trail activity or any treasure and scavenger hunt allows the learner to access questions and information at a spot outside the classroom. The code can also review the next location as we did in our activity. In fact, QR codes can also provide delayed information to the learners or players (see explanation below). This allows the process of carrying out the outdoor activities more sophisticated and interesting.

For outdoor exploration of subjects like Life Science described in the previous section, QR codes can really shine. The codes provide the required anchors to retrieve the additional resources. Extended learning can therefore be quickly established. Furthermore, this approach can give the learner a bookmark she or he can retrieve later. A trace of visited websites or information can be valuable to the learner for revision. We can facilitate social interaction through blogs, wikis and any social networking software via QR codes as well.

Location-based activities or activities related to geographic location can also be provided through QR codes. As shown in the introduction section, geographic positioning coordinates can be embedded into a QR code. By reading the code, the device can directly invoke a map to pinpoint the location. Many activities can be

established by making use of this possibility.

Provide interaction among learners and tutors

Beside the social interaction we described above, there are many opportunities for making use of QR codes in classroom. For example, a voting system can be created with QR codes and handheld devices to accept responses from the learners during lecture. In other words, we can establish a personal response system (PRS) to allow interaction among learners and tutors. The tutor can display various QR codes onto the projector and the learners can choose different codes according to their choices. Different codes with printed responses can also be made available on a piece of paper. Once the selections are made, the responses can be stored at the server. The tutor can activate another piece of software to review the statistics and individual responses. We believe this is an effective instructional strategy (So, 2009).

Assessment is an integral part of any learning and teaching activities. Imagine that learners can participate in a test that QR codes not only can provide the questions and self-evaluated answers like the worksheet described above. The teacher can monitor the progress by observing the flow of answers, interaction and timing. This kind of dynamic information is valuable and reflective to the teacher.

Require an extra step to get the information

Paradoxically, the extra step to get the information through the scanning of the code is sometimes advantageous. There are several reasons to this. Firstly, the content can be changed dynamically. Using the listening test as an example, we can replace the content at the last minute for different learners if the content is just a file at the server. Furthermore, question banks can be adopted for various tests. After all, the QR code can just be a label to a piece of information at the server. We can override the information easily. Secondly, the delayed information prevents the learner to look at the information directly. The periodic table of elements in Chemistry is a good example on this. Normally, whether we like it or not, we have to remember the positions and properties of some elements in the periodic table when we study Chemistry in high school. If the periodic table is made out of tiles of QR codes, we can turn it into a fun memory game for students. This kind of challenge should be less boring than dry memorization!

Trace the time stamps of scanning QR codes

Most readers provide the history of reading the codes. Some readers provide the time stamp when the code was scanned as well. If this is the case, this level of information can be used for analysis and for record keeping. The timing on when the learners respond to the questions is important for some activities. Therefore, if we can collect this piece of information, we have a dynamic picture of the learning process. Furthermore, we can verify the activity has been performed at the appropriate time.

Exchange encrypted information

As mentioned before, any kind of information can be embedded into the codes. It is entirely possible that the information may be encrypted for those who have the keys to read the content while the code can be read by anyone. We can explore the XML technologies to encrypt information or just to use the public key infrastructure to carry out the encryption. After all, QR codes can handle plain text or binary characters.

Summary

QR codes can be very versatile to use. The growing use of QR codes in business sector does not equate to more use in education. In fact, they have been slow to catch on. From our previous research, we provided examples on how the technology can be used. In this paper, we explore beyond the simple use of the codes and offer some suggestions on how the technology can be used to its full potential. Some ideas are directly extended from our previous research. They can inspire other researchers in the area to explore.

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