

Using QR Codes to Enhance Learning of Elementary Statistics

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Abstract

Open University Malaysia (OUM) offers its courses via a blended mode. Learners experience self-managed learning, which is supplemented by face-to-face tutorials as well as online learning through online forum discussions. OUM continuously provides support for e-learning through the use of web-based modules, CDs, i-lectures, i-radio segments, lesson plans, e-schedules, online self-assessment, digital library, etc. OUM has also embarked in mobile learning and has implemented the use of mobile messages in several selected courses. OUM intends to further expand its mobile learning efforts and explore the use of (Quick Response) QR codes for immediate access of learning materials. QR codes provide a fast way to link with digital and online resources. The convenience in transferring information to cell phones has contributed to its popularity in many areas including business and marketing, and to a limited extent in education. The use of QR codes seems applicable and attractive for the learning environment at OUM where learners are expected to be responsible for their own learning. The vast majority of learners are working adults, who are always on the move, thus institutional efforts towards making learning resources immediately accessible will make learning possible at the point of need. The use of learners' own mobile devices means they are already familiar with the technology, eliminating technological barriers to accessing learning materials. An initial investigation on the awareness and readiness of OUM learners in using QR codes showed that generally learners are receptive to using QR codes in their learning. This paper describes an exploratory project that attempts to incorporate the use of QR codes as a supplemental instructional resource by introducing three specific examples of basic QR code-driven activities in an Elementary Statistics course. Three different types of content will be used to enhance learners understanding: text-based instruction, Uniform Resource Locator of video lectures (iLectures) and URL of self-test activities. The results are expected to reveal learners' perceptions towards QR code usage and whether QR codes have any impact on learners' performance. The constructs for the perceptions will include attitude, interest and engagement, while a quasi experimental research using a pre test-post test control group design will be used when examining learners' performance. This study will form the basis for OUM's future decision on the use of QR Codes in enhancing m-learning.

Introduction

Open University Malaysia (OUM) is an Open and Distance Learning institution and has an enrolment of over 120,000 learners distributed throughout the country. The majority of OUM's learners are working adults. The university promotes flexible learning and strives to provide a quality learning environment for all the learners. At OUM, courses are offered in a blended mode, which require learners to do self-managed learning supported by face-to-face tutorials and online learning through online discussion forums. A great deal of effort has been channelled into providing quality online support through quality content and resources and having qualified online facilitators. In 2009, OUM explored the use of the mobile learning (m-learning) with the purpose of further enriching the learning environment for OUM's distance learners. Prior to 2009, text-based short messaging system was used in OUM but merely for administrative announcements and not for academic purposes. Through the use of m-learning, OUM aims to introduce different levels of blends to suit to the nature of the courses and the different learning styles of students, increase flexibility of learning, and achieve greater degree of ubiquity in teaching and learning. A recent investigative study of learners at OUM showed that mobile telephone ownership is slightly above 95%, and since then the number of learners owning smart phones and tablet computers has grown. This along with the growth and development in mobile technology presents OUM with the opportunity to move forward in m-learning by utilising new mobile applications. Currently, OUM uses a basic system whereby different categories of content are pushed to learners via short messaging service (SMS). There is clearly a need to go beyond mere feeding of information.

QR codes are two-dimensional barcodes that can contain simple amounts of data such as multilingual text, a linked Uniform Resource Locator (URL), an automated SMS text, a business card or contact information (Law & So, 2010). The use of Quick Response (QR) codes is an example of a mobile application that has gained its popularity in the business world especially in the areas of business and marketing. In the education sector, the use of QR codes is still in its infancy. This paper will describe an exploratory project that attempts to leverage on the increasing ubiquity of mobile technology by introducing the use of QR codes as a supplemental instructional resource.

Literature Review

In 1994, Denso Wave, a Japanese industrial technology solutions provider invented QR codes. Initially QR codes were mainly used in industrial environments for tracking commercial products, managing industrial process and ect. Later there was increased use and acceptance of QR codes in product identification and advertising as virtually everyone in Japan carried mobile telephones with cameras and two-dimensional barcode scanning technology (Rivers, 2009).

The use of QR codes has also begun to gain popularity for marketing purposes. QR codes are embedded with related information or links in advertisements, billboards and signboards This is partly due to the advancement in mobile technology, specifically in smartphones that have computing and connective capacity of a small computer. These devices usually have high-resolution touch screens and cameras, web browsers, Global Positioning System (GPS) navigation, WiFi and broadband access – all of which are regular features that make it easy and quick to seek and retrieve the information that can be contained in QR codes. In more advanced societies, smartphones have a virtually blanket usage (e.g. South Korea, Europe and North America), thus making it even more practical to exploit them for promotional activities.

Today's tablet computers (such as the Apple iPad) also have the same (if not more sophisticated) features as the smartphone.

From an education perspective, exploring the use of mobile technology for learning (i.e. m-learning) requires fulfilling three significant attributes, i.e. are location independence, time independence and meaningful content (cited in Law & So, 2010). With the newfound popularity and increasing ubiquity of smartphones as well as tablet computers that have very similar capabilities and features, the use of a novel application like QR codes offers a new dimension for the advancement of m-learning. According to Law and So (ibid.), QR codes have great potential in educational endeavours as they are incredibly simple and quick to use – a feature that makes them ideal for teaching and learning. Another reason is that they offer a way to link the physical and virtual worlds by providing on-the-spot access to various information and resources; thereby taking teaching and learning out of the classroom (EDUCAUSE Learning Initiative, 2009). They also offer expanded pedagogical value in activities that encourage learners to create, contribute and share content. Additionally, QR codes operate through scanning actions using built-in cameras in smartphones and tablet computers, thus avoiding the hassle and potential errors of keyboard input. In the context of m-learning, the potential of QR codes to fulfil the four significant aspects stated above is indeed great.

Despite of all the advantages of using QR codes, its actual use in education is still in its infancy and examples are scarce. The University of Bath (<http://blogs.bath.ac.uk/qrcode/>) is one of the most advanced institutions in this regard; having started its project in 2008. Its team has explored various ways of using QR codes, e.g. to catalogue books in the library, for student assignment submission and even as marketing material from different departments. Other possible uses, as described by other researchers, include:

- Subscription to course-related Really Simple Syndication (RSS) news feed;
- As additional/complementary inclusion in printed learning materials; and
- As just-in-time information (e.g. related links to online resources and presentation materials) during a face-to-face session.

In Malaysia, several research studies have been carried out to explore the use of m-learning. For example, a study conducted in 2008 found that the majority (64%) of learners surveyed in OUM were ready for m-learning (Zoraini Wati Abas, et.al. 2009). This was followed by another pilot study in 2009 to examine OUM's efforts at enhancing the blended learning approach with the Mobile Learning via SMS initiative (Lim, et.al. 2011). Aspects such as the conceptual model, the process flow of group messaging, challenges faced and effectiveness of the initiative, were discussed in this paper. Another study on m-learning found that there were significant differences in the usage of mobile telephones for m-learning between heavy and light mobile telephone users (Norbayah Mohd Suki & Norazah Mohd Suki, 2007). The study also revealed that heavy mobile telephone users accessed/subscribed to more than one type of mobile content; have more frequent access, more likely to subscribe to and purchase mobile content; as well as more likely to spend more money on m-learning, its content and mobile games than light mobile phone users.

The use of QR codes in teaching and learning is something that has yet to be studied in Malaysian institutions. Of late, QR codes have been quite commonly used in marketing and promotions, particularly in print and billboard advertisements, but nothing yet has been accomplished in an educational context. Outside Malaysia, with institutions like the University of Bath leading the way, the use of QR codes is

likely to grow in the near future. Thus, from this literature review, it can be seen that QR codes has significant potential for m-learning. Nevertheless, more research needs to be done to examine how QR codes can be used to enhance m-learning in a blended learning environment such as in OUM. This is one of the first attempts to look into the possibility of using QR codes to enhance mobile learning; the findings of which should be of great benefit not only to ODL but other higher education institutions which aspire to enrich their teaching and learning.

Purpose and Objectives Of Project

The purpose of the project is to introduce QR codes and investigate students' response towards the use of QR codes as a supplementary learning resource in the Elementary Statistics course in January 2013 semester.

The main objectives of the project are as follows:

- (a) To investigate how learners access QR codes for learning purposes;
- (b) To determine learners' perceptions towards QR code usage for learning;
- (c) To investigate whether QR codes improve students' performance.

Methodology and Approaches

At OUM, Elementary Statistics is one of a few courses deemed as a *high risk course* (high failure rate). Learners taking this course require additional support and help in their learning. While face to face tutorial sessions and the online forum formed the main learning mode for students, they are expected to self manage their study by utilizing other materials including video lectures (*iLectures*) and other forms of learning materials.. In the ODL mode, learning should be enhanced through the learner-centred approach. Keeping learners engaged with a variety of learning tools and flexibility to access these tools is the basis of establishing a learner-centred approach to learning.

In the majority of the studies researched, students reported having a strong, positive reaction to integrating m-learning into the classroom (Clarke et.al 2008, Al-Fahad,2009; Wang,2009; Garrett & Jackson,2006; Cavus & Uzunboylu,2009; Uzunboylu et.al, 2009; Manair, 2007; Maag, 2007). Students found that using mobile devices was convenient and enabled learning to be flexible and portable (Clarke et.al, 2008; Cavus & Ibrahim, 2009; Bottentuit Junior, 2008; Al-Fahad, 2009). The positive results obtained from past research on m- learning motivated the research team to use the mobile learning platform as another instructional tool for the Elementary Statistics course. While most research showed that m-learning tools are mainly used to send short messages in the form of reminders or notes, this research intends to incorporate QR codes of worked examples from the Elementary Statistics course into the mobile learning environment.

The sample for the study will be learners from the Elementary Statistics course in all the learning centres throughout the country. The research team will inform all the tutors involved in the face to face tutorials on the objectives of this project. The QR codes will be shared to all tutors with the help of the staffs in

the Institute of Teaching and Learning Advancement and the IT Department. Survey questionnaires to investigate learners' perceptions on the usage of QR codes in the m-learning environment will be developed. Generally for all the students, the constructs to be measured include attitude, interest and engagement.

In addition to the above, the project will go a step further; that is looking into students' performance. This will be conducted through a quasi experimental research using a pretest-posttest control group design. The QR code project will start in January 2013. This project will be structured into three phases; Phase 1- Design and Generating QR Codes, Phase 2- Implementation and Experimentation and Phase 3- Data Analysis and Closing. Initially, the QR code project will begin by introducing the use of QR codes in an Elementary Statistics course.

Figure 1 depicts the phases involved in this project. The subsequent sections will provide greater explanation on the relevant details.

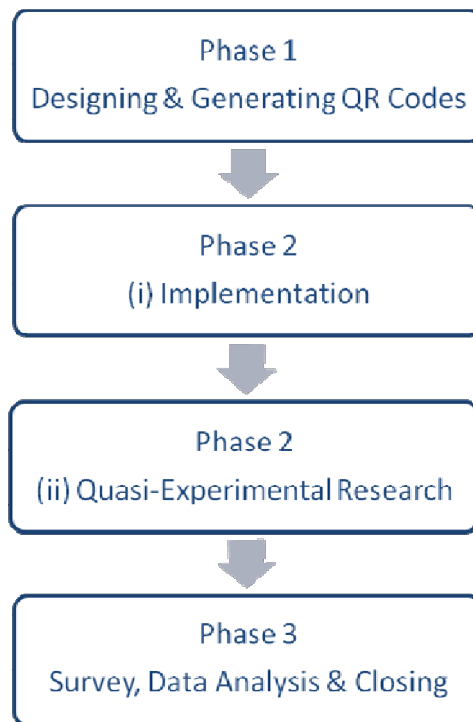


Figure 1: The Phases in the QR Project

The project involves three phases and is detailed as follows.

Phase 1- Design and Generating QR Codes

The basic requirements to using QR codes include:

- A smartphone or tablet computer (e.g. the Apple iPad);
- A built-in camera;
- A QR code reader; and
- Internet or WiFi connection.

QR codes are generated for the course using a web-based QR code generator, specifically the ZXing Project (accessible at <http://zxing.appspot.com/generator/>). There are several other web-based QR code generators that can be found on the net, including Kaywa (at <http://qrcode.kaywa.com/>), NFG Games (at <http://nfggames.com/system/qrcodegen.php>), and Delivr (at <http://delivr.com/qr-code-generator>). The ZXing Project will be used to encode the text-based instructions and URL links to iLectures and Q&A exercises. Four sets of QR codes will be generated containing three codes: (a) for general instructions; (b) URL link to iLecture; and (c) URL link to the Q&A exercise. Each learner participating in the study will then given the different sets of QR codes to gain access to the appropriate instructions, iLecture and Q&A exercise.

In order to be able to access and decode the QR codes generated for each course, all participating learners are required to have a QR code reader installed in their smartphones or tablet computers. Several free QR code readers are available for various devices and different types of operating systems (OS). The following is a list of recommended QR code readers according to OS.

Table 1: Recommended QR Code Readers by OS

OS/Device	Source	Name of Reader(s)
Blackberry OS	App World	NeoReader, BeeTagg, QR Reader
Android	Google Play Shop (previously Android Market)	QR Droid, Barcode Scanner
iOS for iPhone	App Store	QR Reader for iPhone
iOS for iPad	App Store	Scan by QR Code City

With their devices ready, learners will be directed to scan (in correct sequence) the given QR codes assigned to them. Learners are required to: (a) read the given instruction, (b) read and understand the worked examples, and (c) attempt the exercises given in the final QR code.

The following are some examples of QR codes developed from a study conducted in OUM (Latifah Abdol Latif, *et al.* 2012).



Figure 2: Examples of QR codes

**Phase 2- i. Implementation of QR codes in tutorial classes nationwide;
ii. Implementation of the Quasi-Experimental research design**

In the second phase, the developed QR codes will be shared with tutors from all the learning centres in the country. The guidelines in using and implementation of the QR codes will be prepared and this will be explained to the face to face tutors via email/ online forum. Students will be able to access worked examples either in class or after class time provided there is availability of internet or WiFi connection. After the fourth tutorial, students will be required to answer the survey questionnaire. The questionnaire will be designed and uploaded in OUM's learning management system *myVLE* (my Virtual Learning Environment).

Concurrently, the quasi-experimental research will be conducted in one of the learning centres in the Klang Valley area. Two non-randomised classes will be selected and for the smooth running of the project, a lecturer from OUM who will be briefed on the project will be conducting the teaching and learning for the two classes. One of the classes will act as the control group where normal teaching and learning is given and the other class will be given the treatment. The treatment given is the QR codes prepared for the worked examples. The exercises from the module will be assigned QR code and students will be able to access them from their Smartphones using the recommended QR code reader. The research team will prepare the pretest and posttest questions on the topics taught for the second tutorial sessions before the class starts. The pretest questions will be given to students before teaching starts and the posttest questions will be given after the tutorial slot ends. The questions developed for the pretest and posttest are taken from the content of the second tutorial session. The time to answer the questions will be set at only 15 minutes.

Answers will be collected during the tutorial session and marked by the tutor (OUM lecturer). The marks for the pretest and the posttest will be recorded. Consequently, students in the control group will also be given the lesson on how to use the QR codes to ensure that they obtained the treatment given to the experimental group.

Phase 3- Data Analysis and Closing

The data collected from the survey questionnaire will be analysed using SPSS 17.0. Descriptive statistical analysis using mean scores and percentages will be obtained to show responses of students on the constructs measured. T-test analysis will be applied to show whether there is a significant difference in the mean performance scores for the pretest and posttest for the control and experimental groups.

Discussion

Recent technological advances and innovation and the latest development in communication devices in the market demands that educational institutions leverage on the various types of tools available so as to continuously improve its teaching and learning. One of the important requirements of today's students who are busy and always on the move is to provide ubiquitous mode of learning to everyone. A wide variety of e-learning tools have been introduced to tutors as well as students and have been applied in the classroom for students' individual learning. These same learning tools have been used for the Elementary Statistics course. However, the project is being carried out in an attempt to further improve students' performance in this course.

Therefore, the main contribution to the inception of this project is to help students learn, practice and enhance their knowledge on statistics wherever they maybe at all time and hopefully this initiative will support students learning and finally show positive impact on their overall performance in the course.

Review of literature on previous studies showed that QR codes is rapidly penetrating into the teaching and learning process. Considering the QR codes generated for the course as well as the availability of the QR codes reader in the smartphones, it is undeniable that this project will also enhance learning through the mobile learning environment. While on one hand this project is developed to help students further improve their statistics and get better results, the project would also encourage students and teachers alike to share and collaborate in using QR Code for teaching and learning. In most cases, students learn on their own and teachers work in isolation, and both parties would miss out on the richness of teaching and learning.

Results obtained from the Nielsen's Southeast Asia Digital Consumer Survey Report- Malaysia Edition (2011) indicated that more than 49% of Malaysians owned a Smartphone and they forecast that the number will increase to 89% in 2012. Of the total 1321 respondents interviewed in the survey, 71% claimed that they watch TV and browsed the internet at the same time. This implies that the capabilities of information technology have improved tremendously leading to increased accessibility to instant communication and learning materials. Learning has become ubiquitous with the use of smartphones. A preliminary study on the use of QR Codes on several selected courses has previously been conducted and it is expected that the results of this study will further enhance the initial study and provide greater insights for OUM to move forward in meeting the challenges of eliminating the barriers of time and place in facilitating both learning and teaching in an ODL environment.

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