

Pre-service Teachers' Perception of Quick Response (QR) Code integration in Classroom Activities

Nagla Ali

*Emirates College for Advanced Education, United Arab Emirates
nali@ecae.ac.ae, isantos@ecae.ac.ae, sareepattamannil@ecae.ac.ae*

Ieda M. Santos

*Emirates College for Advanced Education, United Arab Emirates
isantos@ecae.ac.ae*

Shaljan Areepattamannil

*Emirates College for Advanced Education, United Arab Emirates
sareepattamannil@ecae.ac.ae*

ABSTRACT

Quick Response (QR) codes have been discussed in the literature as adding value to teaching and learning. Despite their potential in education, more research is needed to inform practice and advance knowledge in this field. This paper investigated the integration of the QR code in classroom activities and the perceptions of the integration by pre-service teachers. Forty-four pre-service teachers enrolled on an undergraduate degree at a higher education institution in the United Arab Emirates took part in the study. Data were collected from a questionnaire, student journals and focus group interviews to enable triangulation. The main results suggested that the pre-service teachers perceived the use of QR codes to be easy and useful in learning activities. They also demonstrated positive attitudes towards the QR codes and stated the intention to use this application in their future career. The study provided practical examples of how QR codes can be integrated in teaching. It also revealed certain challenges that could hinder effective integration of QR code applications in the classroom. Recommendations for practice and future research are discussed.

Keywords: Quick Response (QR) code, classroom activities, integration

INTRODUCTION

The Quick Response (QR) code system has recently been introduced in Education (Rivers, 2009). It is a form of machine readable matrix barcode that has been around for almost two decades. It is an application that allows scan patterned 2D squares to obtain fast access to information (Jupiter, 2011; Shin, Jung, & Chang, 2012). QR codes can potentially add value to learning activities by encouraging students to create and share learning content (Sampson, 2012; Yusof, Goolamally, Latif, & Fadzil, 2012), engage students with different learning needs (Chen et al., 2010), and facilitate learning inside and outside the classroom (Crompton, LaFrance, & van't Hoof, 2012; Pérez-Sanagustín, Parra, Verdugo, García-Galleguillos & Nussbaum, 2016).

Despite their potential benefits, the adoption of QR codes in educational settings is still in its infancy (Albastroiu & Felea, 2015) and consequently, there is a clear need for more research examining the integration of QR codes in higher education (Gradel & Edson, 2012). This observation urges researchers to conduct further studies to investigate how QR codes can be integrated in learning activities and inform practice (Abdol Latif, Fadzil, Munira, & San, 2012). In this regard, based on an undergraduate course taught at a higher education institution in the United Arab Emirates (UAE), this paper has two aims; first to discuss the integration of QR codes in classroom activities, and second, investigate participants' perceptions of the integration. The following research questions were sought:

1. What are pre-service teachers' perceptions of QR codes in learning activities regarding the ease of use, usefulness and attitudes?
2. What are pre-service teachers' intentions of using QR codes in their future teaching?
3. What are the factors that affect pre-service teachers' attitudes towards the integration of QR codes in learning activities and their intention to use it in future teaching?

The authors expect to provide a practical example of the implementation of QR codes in the classroom and add to the body of knowledge on how this system can support learning activities.

BACKGROUND LITERATURE

The advantages of QR codes include fast readability and capacity, and a link to any type of information that can be accessed from any location using enabled-wireless mobile devices. The QR code reader application, which when installed on mobile devices, allows users to read the data in the code and present the information in the form of video, link, text or other formats. Researchers like Robertson and Green (2012) discussed examples of how QR codes could be used in the classroom, for example, they noted that students could generate their own codes and attach to pictures they had previously found online. In addition, the authors provided a list of aspects to consider before implementing QR codes in teaching such as Internet connectivity and their value for the users. Similarly, Gradel and Edson (2012) and Thorne (2016) described several QR code activities that instructors could implement in higher education.

Chaisatien and Akahori (2007) discussed a system that combined both mobile phones and QR codes as a supporting learning tool. The system was used in an undergraduate course during poster sessions. The authors conducted a pilot study to gauge students' feedback about the system. Survey results suggested that the majority of students did not like the QR codes in poster sessions because they had to get closer to them to read the codes. Students also found it hard to visualize the whole content in one page because of the relative small size of the phone screen. However, students felt positive towards the application stating that it was easy to use, and it would be useful to use in larger classes. Additionally, Lee, Lee and Kwon (2011) described a teaching approach named "scan and learn" that integrated QR codes and smartphones during a biology class field trip. The use of QR codes motivated students to learn about natural fauna in a better way than using the traditional printed materials, and allowed them to discuss the results using one of the social network sites. A further example of how QR codes can be used in teaching is provided by Power (2013). Students could access just-in-time information as they explored course content in small groups at their own pace.

Huang, Wu and Chin (2012) discussed a procedural scaffolding approach (thinking before talking) using paper-based materials and electronic materials via QR codes supported by smartphones. Huang et al. adopted a mixed methods experimental study to investigate whether procedural scaffolding enriched collaborative learning and learning outcomes. Results suggested that the procedural scaffolding strategies not only helped enhance group learning outcomes but also individual learning outcomes. In future implementations, the authors suggested that bigger screen sized devices such as an iPad could help students type and read more effectively. Susono and Shimomura (2006) further illustrated the use of QR codes in education as an assessment tool. Results from the survey indicated that 43% students found it useful to use QR codes as a formative assessment aid as it allowed them to easily evaluate their progress. However, more than half (57%) had concerns regarding costs of using their phones and Internet, and they did not feel comfortable using their devices in face-to-face classes.

In contrast to Susono and Shimomura (2006), Lai, Chang, Li, Fan, and Wu (2013) reported the implementation of an integrated QR code system to conduct outside learning activities. About 160 elementary teachers participated in a 2-hour workshop to learn how to use the system and later completed a questionnaire based on the Technology Acceptance Model (TAM). The results suggested that both the ease of use and the usefulness of the system had a significant positive correlation with teachers' intention to adopt the system in the future. Pérez-Sanagustín et al. (2016) presented another approach to use QR codes outside the classroom. The authors adopted an experimental design to explore the delivery of content for an exhibition in a university campus using two types of QR codes (on-way and two-way type of information). All students, lectures and professionals, who were on the campus, had a chance to participate in the experiment. Results showed that the two-way QR codes had a positive effect on participants' engagement with the exhibits compared to the one-way codes. This study illustrated how QR codes could be used to deliver engaging content.

Study by Rivers (2009) explored Japanese students' attitude towards QR codes and language learning. The authors found some challenges related to the implementation of this application. Some students could not scan the codes, and while others did not understand the function of the codes. On the positive side, the survey suggested strong students' attitude toward the use of mobile phones and QR codes in the classroom. Other studies reported similar positive results (Abdol Latif et al., 2012; Albastroiu, & Felea, 2015; Gogova & Koceska, 2014). Abdol Latif et al., (2012), in addition to studying students' attitudes towards QR in teaching, also performed a multiple regression analysis to assess students' intention to use this application in the future. They found that usefulness and satisfaction had a significant impact on students' intention to continue using QR codes. A drawback reported in the study related to some students not owning a smartphone and costs of Internet connection.

Further study by Durak, Ozkeskin and Ataizi (2016) investigated college students' perceptions of the impact of QR codes in supporting learning. In this study, QR codes, which connected students to web links, applications

and social networks, were added to a lesson unit. Fifteen pre-service teachers participated in individual interviews. Results suggested students' positive attitude toward QR codes in supporting their learning, and they would use this application in the future. Similar to Abdol Latif et al., (2012), Durak et al. (2016) found some challenges attached to the implementation of QR codes such as Internet speed and lack of technical skills to install and use the application. In the same vein, Yip, Melling and Shaw (2016) studied the use of QR codes to provide undergraduate students with instantaneous access to a database. Survey results suggested the codes were seen by students an effective and easy strategy to access online instructional materials. The majority would recommend its use to access the database.

The above studies are useful not only to inform practice on the uses of QR codes in teaching but also to make a contribution towards knowledge as more research is needed in this field of inquiry. Many of the studies, however, relied on surveys while some provided only descriptions of how QR could be used in education. Similar to Durak et al. (2016) and Huang et al. (2012), our study will focus on the implementation of QR codes to support classroom activities and study participants' perceptions of such implementation.

CONTEXT AND PARTICIPANTS

We conducted the study at a higher education institution in the United Arab Emirates, in the academic year 2013-2014. A 15-week course offered in Year 4, consisting of three sections, was selected for the study. This course was chosen as we had convenient access to the students. Another reason for choosing this course related to allowing students experiment with a new teaching strategy (Quick Response codes) before their graduation. All 44 female pre-service teachers enrolled in the three sections agreed to participate. In case a student did not give their consent to participate, they still would be able to access the QR codes activities. About 97.7% of the students were in the 20 -25 age group, and one student was within the 26 –30 years old.

IMPLEMENTATION

We introduced the QR codes to the students in week 1. Wireless access was provided to students who needed it. Two weekly QR code activities were planned for two months. The activities included extra support to help students to complete tasks in the classroom. Support included hints, links to websites, videos, pictures, and illustrations. For example, Figure 1 shows a scenario that required answers to a series of questions (left hand side). For each question, a code was added to the worksheet to support students. On a different task, Figure 1 provided different kinds of support using a variety of formats (right hand side).

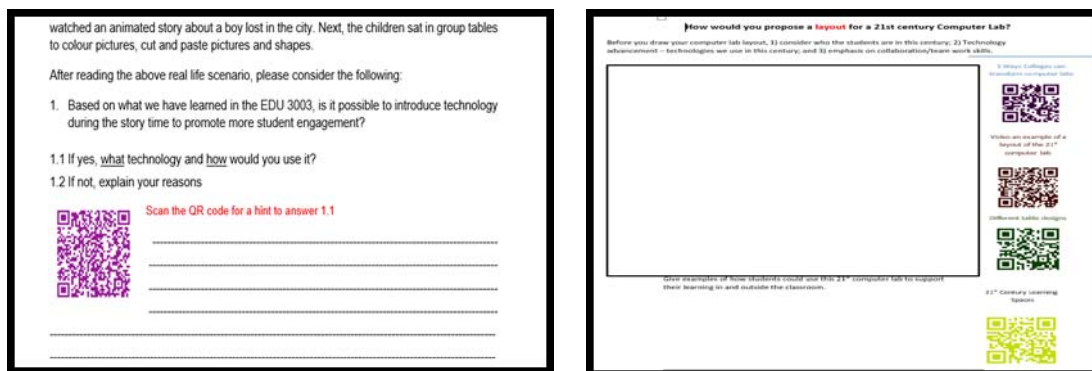


Figure 1. The QR codes using a variety of formats

DATA COLLECTION

We adopted an anonymous questionnaire, student journals and focus group interviews as data collection.

1. **Questionnaire:** it included closed questions, multiple choices, ticking boxes, yes and no type of questions, and a Likert scale (from strongly agree/5 to strongly disagree/1). We developed the questionnaire based on the Quick Response (QR) codes literature (Gogova & Koceska, 2014; Lee et al., 2011; Shin et al., 2012). The Likert scale statements were adapted from and Rikala and Kankaanranta's (2012) study; however, a few statements were based on the work by Gogova and Koceska (2014), Shin et al. (2012), Rivers (2009) and Lee et al. (2002). The questionnaire was piloted with 60 freshmen students. The test showed high reliability ($r= 0.79$). A total of 44 students completed the questionnaire.
2. **Journal:** the journal had four guiding questions: 1) what do you like most about the integration of QR in classroom activities? 2) what do you like least about the integration? 3) what recommendations do you have? and 4) what are your general experiences of scanning and using QR codes? Students were asked to record their notes every time they were exposed to a QR classroom activity. A total of 41 students completed the journals.

3. *Focus group:* three focus group interviews were conducted with a sample of students from the three sections. Each focus group consisted of five students (n=15). The focus group interview covered prior experience with QR codes, its use in and outside the classroom, ease of use, usefulness and recommendations. The interview questions were piloted by the same faculty who piloted the questionnaire for content validity. The interviews were audio taped and lasted approximately 35 minutes.

DATA ANALYSIS

Descriptive statistics were calculated to answer the research questions 1 and 2. Simple linear regression analysis was calculated to answer question 3 by predicting the factors (the independent variable-ease of use, usefulness and attitude) that affect the dependent variable (students’ intention of using QR codes) relationships between the research variables (ease of use, usefulness, attitude and intention of use). The simple linear regression analysis was also calculated to predict the factors (the independent variables – ease of use and usefulness) that would affect the independent variable (students’ attitude).

Qualitative data consisting of journals and focus group interviews were analyzed using Nvivo software. We analyzed the data without a prior list of codes. One of the authors read across the interviews and created a preliminary list of codes. This list went through changes where some codes were merged or deleted. Data were later assigned to each code. Next, we looked for themes inside and across categories. We discussed the codes and coding to validate the interpretations. Similar procedures were followed to analyze the answers from the journals.

RESULTS

In this section, quantitative data are presented first followed by the qualitative results.

Quantitative Data

Smartphone ownership amongst students was almost 100% (only one student did not own a Smartphone). About 65.9 % used the Internet connection provided by the institution to scan the codes. The majority (98%) scanned the QR codes in class. In addition, 54.5% accessed the QR code activities outside the classroom. One student, in particular, did not scan the codes because her phone did not support a code reader application.

Results in Table 1 clearly show positive perceptions of the ease of using QR codes in classroom activities. Although there is overall agreement, a few students may have faced issues with the speed for scanning the codes.

Table 1. Ease of use

Statement (scale 5- 1)	Mean (n= 44)	SD
The QR codes made access to website links easy	4.00	0.86
I found it easy to scan the QR codes	4.48	0.63
It was easy to learn how to scan QR codes using my mobile device	4.25	0.92
The speed of scanning a QR code was sufficient*	3.80	0.86
QR codes were simple and convenient to use	4.16	0.78

*Source: Shin et al. (2012)

Table 2 suggests agreement regarding the usefulness of the QR codes. Although there is a tendency to agreement on the first statement, the above results showed that some students did not use the QR outside the class; this may explain the value shown in Table 2 (M: 3.81).

Table 2. Usefulness

Statement (scale 5- 1)	Mean (n= 44)	SD
I found it useful to access the QR codes outside the classroom to complete the activities	3.81	0.93
The information provided in the QR codes helped me complete the activities	3.96	0.74
QR codes provided access to a variety of useful information*	4.14	0.73
The QR codes were useful in solving the problems in the worksheets	4.18	0.72

*Source: Lee et al. (2011)

Table 3 indicates a clear tendency to positive attitudes towards the use of QR codes to support classroom activities. Table 4 presents an overall tendency to agreement regarding students’ intention to use QR in the future.

Table 3. Student attitude towards QR codes

Statement (scale 5- 1)	Mean (n= 44)	SD
It is a good idea to use QR code to support learning activities	4.23	0.86
QR activities are a very interesting way to learn*	4.07	0.87
I enjoyed interacting with the QR activities	3.97	0.82
I have positive feelings toward using QR codes in the classroom	4.16	0.83

*Source: Gogova & Koceska (2014)

Table 4. Intention of use

Statement (scale 5- 1)	Mean (n= 44)	SD
I would like to do QR activities again	3.98	0.85
I intent to use QR codes in the future	3.84	0.86
I will encourage other teachers to use QR codes to support in-class activities	3.89	1.05
I would like the QR codes activities to be part of the curriculum I teach*	3.86	1.08

*Source: Rivers (2009)

As seen in Tables 5, students’ attitude was the only factor that affected students’ intention of using QR codes (independent variable). A significant regression equation was found $F(3, 40) = 21.041, p < .000$ with an R^2 of .612.

Tables 6 shows that usefulness was the only factor that affected students’ attitude towards QR codes. A significant regression equation was found $F(3, 40) = 46.083, p < .002$ with an R^2 of .776.

Table 5. Linear regression analysis results - Intention is the dependent Variable

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	SD	B		
(Constant)	.425	.547		.777	.442
Attitude	1.105	.173	.934	6.378	*.000
Usefulness	-.020	.176	-.017	-.115	.909
Ease of Use	-.267	.183	-.225	-1.460	.152

*Significant at .01 level

Table 6. Linear regression analysis results - Attitude is the dependent variable

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	SD	B		
(Constant)	.194	.353		.550	.585
Ease of Use	.173	.110	.168	1.571	.124
Usefulness	.361	.106	.359	3.393	*.002
Intention	.456	.072	.540	6.378	*.000

*Significant at .01 level

Qualitative Data

Results from the journal show that 29 students liked the opportunity to save information on their mobile devices and the easy and fast access to information. In addition, QR codes were fun (n=9), interesting (n=8), engaging (n=6), attractive (n=4), enjoyable (n=5) and a new way for learning. Despite the positives, 27 students did not like the fact that the QR codes activities needed Internet. More specifically, they said the Internet connection was a problem or could not access it. Three found the institution Internet connection slow. Other aspects students did not like included the small size of the phone screen, the complexity of the vocabulary in the activities, and flat battery. In terms of future improvements, four main themes emerged from journal:

1. integrate similar QR code activities in other subjects (n=34)
2. improve Internet connection (n=39)
3. offer training to students on how create and integrate QR codes (n=20)
4. make mobile devices available in the classroom to be used when needed (n=5)

The section below presents the analysis of the focus group interviews, organized in four main themes.

1. *Prior experience*: three students had prior experience with scanning QR codes such as scanning a magazine and a newspaper. Five had seen the QR codes before but did not know what they were for. All 15 students did not know that QR codes could be used “for learning.” In addition, all said having used the QR codes activities inside and outside the classroom.
2. *Ease of use and intention*: All students indicated it was easy to scan and use the reading application. However, one felt that, although it was easy to scan, sometimes one needs to scan the code more than one time to get the information. In addition, 12 students said they would use the QR codes in the future for educational purposes. They also planned to use the codes in their internship during the following semester.
3. *Usefulness*: thirteen students indicated they learned from the integration of QR codes in the classroom activities. It provided them with a way of scaffolding, for example, by giving them hints for solving a problem or answering a question. Most of the students found the hints useful and a fun strategy. The 13 students also found useful linking the worksheets to videos, websites, and podcasts because it helped them understand what is required to finish the activities. One student, however, did not find the QR codes useful because she could not read from her mobile device.
4. *Recommendations*: twelve students recommended the integration of QR codes in other subjects. Five students also recommended using QR codes to make the daily lesson learning outcomes and tasks available to the students. One student suggested that students could scan the QR codes and complete assignments on their mobile devices instead of using a paper-based format.

DISCUSSION

Results show, overall, positive perceptions regarding the integration of QR codes in the classroom. Concurrent with other findings (e.g. Abdol Latif et al., 2012; Lai et al., 2013; Yip et al., 2016), students perceived QR codes as an easy to use and useful application to support learning activities. Although we planned the QR codes for in-class activities, more than half of the students also scanned the codes outside the class, and found it useful (m=3.81). This was confirmed in the focus group interviews. This finding suggests that, in order to maximize its educational benefits, QR codes activities should be planned for both inside and outside the classroom as exemplified by Lee et al. (2011) and Pérez-Sanagustín et al. (2016).

Results also suggest, overall, that the pre-service teachers not only demonstrated positive attitudes towards the integration of QR codes in learning activities but also had clear intentions to use the system in the future. Data from the journal about what students liked most about this application further supported their positive attitudes. Their recommendations in the journal and focus group interviews to include this application in other subjects also indicate their positive attitudes towards the QR codes. Similar findings were reported by others (e.g. Abdol Latif et al., 2012; Chaisatien, & Akahori, 2007; Durak et al., 2016). In addition, the regressions analysis revealed attitude towards the use of QR codes as the single factor that significantly impacted on students’ intention to use this application in the future. This may suggest that the planned activities facilitated a positive learning experience that impacted on students’ attitudes. However, more research is needed to verify this statement.

A closer look at the qualitative data indicates a few difficulties that may hinder the effective integration of QR codes in teaching, and, in turn, impact on student attitudes. For example, a significant number of students mentioned problems with Internet speed, and made recommendations for improvement. Rivers (2009), for instance, noted that there are several issues that need to be resolved for effective implementation of QR codes. Rivers found that those students who were against QR codes in class, pointed out that not all mobile phones could scan the codes. In our study, despite the few identified limitations, they did not impact on how students perceived the QR codes; perhaps due to its novelty. The implication is that instructors need to carefully consider

student mobile devices' capacity to scan the codes, and whether there is a reliable wireless connection for effective integration. These issues may disadvantage a student as she or he will not be able to benefit from the information available in the codes. Others (Durak et al., 2016; Susono & Shimomura, 2006; Lee et al., 2011) also found some challenges related to QR codes implementation in teaching.

The study indicates that usefulness was the single factor that significantly impacted on students' attitudes towards QR codes integration in class. This may suggest that the pre-service teachers understood its value in classroom activities. In week 1, we explained the reasons for using this application and although it requires more research, this factor may have helped students understand why we were introducing QR codes in the activities. As noted by Albastroiou, & Felea (2015), "the key to successful adoption of QR code in education is to understand why students might use this technology...design and adopt codes that are more precisely targeted and tailored to student' preferences, and more useful in the learning process" (p. 201). In contrast to our study, Rivers (2009) found that some students did not understand the QR codes activities.

Recommendations for Practice

This study provides the following recommendations to effectively implement QR codes in teaching:

- 1) Develop QR code activities for both inside and outside the classroom to make learning more meaningful.
- 2) Have students creating their own QR codes.
- 3) Conduct a needs assessment of student mobile devices' capacity and ownership to avoid inequity.
- 4) Concurrent with Robertson and Green's (2012) list of considerations, provide reliable Internet connection as QR code activities depend on Internet access.
- 5) Explain to students the educational value of QR codes in activities.
- 6) Have instructors attending workshops or seminar to learn how to effectively integrate this application in teaching.
- 7) Encourage instructors to experiment with QR codes in teaching, and share their experience with colleagues.

Limitations and Future Research

Despite the positive outcomes, this study must acknowledge some limitations. The sample consisted of female students and the study was based on educational technology courses. Researchers could consider a more heterogeneous group and a different context to validate the findings. They could also investigate the implementation of other QR activities, both inside and outside the classroom, and consider different subjects to strengthen the results of this study. A further topic to investigate is whether the design of the instructional activities impacts on student attitudes and intentions to use QR codes in the future. It could be interesting to research both student and instructor perspectives of the integration of this application in teaching.

CONCLUSIONS

This paper described the integration of QR codes in class activities, and pre-service teachers' perceptions of the integration by students enrolled upon an undergraduate course within the UAE. Results suggested that the pre-service teachers perceived QR codes as an easy and useful application to support learning activities. They also demonstrated an overall positive attitude and intention to use this application in the future. Their attitude toward the integration of QR codes was affected by only one factor which was usefulness. Additionally, the study discussed some challenges that could hinder the effective integration of QR code systems in teaching and learning. These issues need be resolved in order to maximize the educational benefits of QR codes. Recommendations for practice and future research were discussed.

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