MEMORIA FINAL

Actuaciones Avaladas para la Mejora Docente, Formación del Profesorado y Difusión de Resultados
Modalidad C

Identificación de la actuación	
Código:	AAC_13_18
Título:	QR CODES IN TEACHING ECONOMETRICS: A CASE STUDY. Difusión de resultados en el congreso EDULEARN 13

Responsable	
Apellidos y nombre:	Moreno Rodríguez, Pedro Jesús
Correo electrónico:	pedroj.moreno@uca.es
Departamento:	Economía General

1. **Describa la contribución a la actuación de cada uno de los participantes. Copie y pegue las líneas que necesite para contemplarlos a todos y disponga del espacio que necesite.**

Apellidos y nombre:	Moreno Rodríguez, Pedro Jesús
Coordinación y supervisión de todas las actividades que se han llevado a cabo dentro del proyecto. Búsqueda y elaboración de las actividades auto-evaluables de los temas 7 y 8 de la asignatura. Desarrollar en Moodle las actividades complementarias de la asignatura Creación de los códigos QR que enlazan con el contenido previamente creado. Redacción en inglés de la comunicación a Edulearn13, congreso internacional sobre educación y nuevas tecnologías en el aprendizaje. 1, 2 y 3 de julio de 2013 en Barcelona (España). Elaboración de la memoria y conclusiones.	

Apellidos y nombre:	Ferrándiz León, Esther
Búsqueda y elaboración de las actividades auto-evaluables de los temas 3 y 4 de la asignatura. Búsqueda de material audio visual para el temario de la asignatura. Análisis en español e inglés de las encuestas de opinión de los alumnos. Elaboración de gráficos y tablas resumen. Revisión de la comunicación a Edulearn13, la memoria y las conclusiones.	

Apellidos y nombre:	Flores Varo, Esther María
Búsqueda y elaboración de las actividades auto-evaluables de los temas 5 y 6 de la asignatura. Análisis en español e inglés de las encuestas de opinión de los alumnos. Búsqueda de material audio visual para el temario de la asignatura. Elaboración de gráficos y tablas resumen. Revisión de la comunicación a Edulearn13, la memoria y las conclusiones.	

Apellidos y nombre:	Puentes Graña, Carmen
Búsqueda y elaboración de las actividades auto-evaluables de los temas 9 y 10 de la asignatura. Elaboración de gráficos y tablas resumen.	

Revisión de todas las actividades.
Revisión de la comunicación a Edulearn13, la memoria y las conclusiones.

2. Aporte el producto final generado para la difusión.

A continuación se adjuntan los códigos ISBN de las dos publicaciones que se han generado en el 5º Congreso Internacional sobre educación y nuevas tecnologías en el aprendizaje, donde se encuentra recogida nuestra aportación.

Edulearn 13. 5th International Conference on education and new learning technologies Barcelona (Spain) July 1st, 2nd and 3rd, 2013.

- Edulearn 13 Abstracts – ISBN: 978-84-616-3823-9
- Edulearn 13 Proceedings – ISBN: 978-84-616-38223-2

En las siguientes páginas del presente documento se puede encontrar el texto de dichas publicaciones.

QR CODES IN TEACHING ECONOMETRICS: A CASE STUDY

P.J. Moreno, E. Ferrándiz, E. Flores, C. Puentes

University of Cadiz (SPAIN)
pedroj.moreno@uca.es, esther.ferrandiz@uca.es, esther.flores@uca.es,
carmen.puentes@uca.es

Abstract

The main objective of the teaching project described in this paper is unlocking and widening the learning process of Econometrics by using quick response (QR) codes. Econometrics is a subject taught within the third year of the degree of Business and Administration of the University of Cadiz. The tool described here is being implemented progressively during the academic year 2012/2013 and it mainly consists in the use of QR codes to provide students with access to additional materials using their mobile devices. *QR codes consist in a square grid on a white background with coded information that can be read by a decoding software and a mobile device camera, such as the camera of a Smartphone.*

This project is motivated by two reasons. First, Econometrics relies on theoretical reasoning and computer practices that students often find difficult to understand. This, jointly with the limited time available in lectures and the complexity of the subject, hinder the learning, comprehension and motivation of students. Second, changes in the learning process may arise from the popularisation of mobile devices. In this regard, it is notable that Spain is the second country in the World after UK regarding the penetration rate of mobile devices in the population [1]. Nowadays, almost 50% of the total phone sales in Spain are Smartphones, with a greater presence among the younger population. E-learning has also evolved in this direction moving towards mobile learning (m-learning) and it looks like that it is just a question of time that these portable devices jump into the education niche in a massive way. Companies such as Apple have already foreseen this possibility developing *itunes U,* a new app store specially focused on this market. More specifically, QR codes provide a fast way to link with digital and online resources [2]. The convenience in transferring information to cell phones has contributed to its popularity in many areas including business and marketing. Nevertheless, these new tools are still mainly used for entertainment and social networks [3]. The teaching experience described in this paper contributes to shortening this gap by using QR codes for mobile devices.

The implementation process followed three steps:

1. In a first phase, we compiled a set of additional resources to facilitate and improve the understanding of the subject. In this step, we compiled links to a wide variety of contents, such as office hours, email addresses, video tutorials, animated charts, web and book references, etc. In addition, we created for every unit a self-evaluation multiple choice tests available online.

2. Then, we created the codes by using an online open access QR codes generators (e.g. www. http://www.codigos-qr.com)

3. Finally, we added complementary information through QR codes in the class handouts.

By the end of the course, we asked students to fill a survey in which they expressed their opinion about the usefulness of QR codes in learning the subject. In this paper we show the results of this survey and draw some conclusions.

Keywords: QR codes, m-learning, e-learning, econometrics.

1 INTRODUCTION

More and more, experts claim that the PC era is coming to an end giving way to a new period of mobile devices that will satisfy most of society technology demands. Currently, this change can already be observed in the sales figures in our country. Almost 50% of mobile phones sold in Spain are Smartphones with a greater presence among young people [1]. Moreover, Spain is ranked the second country in the world with the highest penetration rate of Smartphone after the United Kingdom [2].

If we focus on the use that minors and young people give to their Smartphone's advanced features, we can point out that the main uses are playing videogames (65%), accessing to social networks (54.3%), and instant messaging (48.3%) [1]. As we can see, education is not among the main uses yet, but it is expected to grow faster in the next years as new applications are developed. Companies such as Apple have already foreseen this possibility developing *itunes U,* a new application store specially focused on education.

Given this reality where these new tools are still mainly used for entertainment and social networks [3], lectures of Econometrics at the University of Cadiz have proposed an innovation project where students can use Smartphones in the subject. The main objectives of the project were two: 1)To promote the use of mobile devices in the education process, moving towards mobile learning (m-learning) 2) To identify the factors fostering the use of mobile phones in education.

In order to promote the use of Smartphones in Econometrics, a series of activities and a wide variety of contents, such as office hours, email addresses, video tutorials, animated charts, web and book references, etc. were linked to QR codes. These codes can be read by QR readers installed in mobile devices.

At the beginning of the semester students were informed of the possibility to access to activities and complementary information through the mobile phones and internet connection. Nevertheless, as part of the project they could not use them in teaching hours but after classes.

By the end of the semester, students filled a survey in which they expressed their opinion about the usefulness of QR codes in learning the subject. This information gave us some clues to assess the elements that are important to boost the use of mobile phones in education as a voluntary action and not just as a mandatory activity into class.

The article is structured as follows. The next section describes the methodology and the survey of our project. The subsequent section sets forth the results and finally we draw some conclusions and comment on future work.

2   METHODOLOGY

As a part of the innovation project, we decided to extend the theoretical and practical units of our subject by adding some online activities and book references, as well as useful information about the course. The implementation process followed three steps:

In a first phase, we compiled a set of additional resources to facilitate and improve the understanding of the subject, such as office hours, email addresses, video tutorials, animated charts, web and book references, etc. In addition, we created a self-evaluation multiple choice tests for each unit available online. These tests were used to reinforce the concepts while identifying econometric graphics, relating concepts and completing definitions.

On the second step, we created the codes by using an online open access QR code generator (e.g. http://www.codigos-qr.com). QR codes or quick response codes are a storage system. You can access to the stored information using a code reader that can be easily installed for free in mobile phones and tablets.

In our case, we use these codes to store URLs that were linked to the subject material mentioned in the first step, such as self-assessment tests. This method lets us to link the physical material (handouts) to online material. It also allows the encoding of text without access to Internet.

Finally, we added complementary information through QR codes in the class handouts. The QR codes are a practical way to give a new dimension to the paper-based material.

The online material was available as for laptops as for mobile phones, trying to not cause any detriment to students with no mobile internet connection. In doing so, we could also check the number of students that chose the mobile option over the traditional one.

For this study we prepared a questionnaire of 25 questions answered by 156 students of Econometrics at the University of Cadiz during the academic year 2012/13. The survey had the purpose to shed some light on the following questions: 1) Are students using the QR codes provided into the handouts of the subject by self motivation? 2) What factors are influencing the decision to use this additional material on the mobile phone?

The questions of the survey included a set of different closed answers including: Yes/No answer, multiple choice answers, where more than one option could be selected, and liker scale. For the later the number 1 meant totally disagree/useless and 5 totally agree/useful. The full questionnaire can be found at the appendix of this paper.

3   RESULTS

This paper analyses the experience of implementing a learning/teaching methodology based on QR codes in Econometrics. The success of this experience is evaluated through a questionnaire to know the student's opinion. The results obtained from the survey were analysed attending to several factors that, in our opinion, would influence in enhancing the use of QR as tool for reinforcing and promoting student learning. More specifically, the results were analysed attending three groups of factors: previous knowledge in using QR codes (Table 1), individual student characteristics such as age and gender (Table 2) and technological factors proxied by the availability of mobile devices (Fig. 1 and 2).

With respect to the first kind of factors (previous knowledge in using QR codes), it is expected that those students that had a previous experience in the use of QR codes will use them in Econometrics as a way to access to the contents of the subject. In this sense, we introduced a control question to distinguish among students who had a code reader installed on their phone and who had not. Table 1 shows that only the 36.5% of students had installed a code reader in their mobiles while 59.6% of them did not. However, it is interesting to remark that 73.7% of students who had installed a code reader had used it at least once and more than half of them (54.8%) used the QR code to access to the contents of the subject. With respect to those who have installed the code reader but have not used during the course (only fifteen students), the explanation seems to be that they didn't have previous experience in the use of such codes. Finally, the results point out that the main reason to do not use QR codes in the subject was because most of students didn't have any code reader installed on their mobiles.

Table 1. Previous knowledge in using QR codes.

Do you have a code reader (barcode or QR) installed on your phone?	Yes 57 36.54%				No 93 59.62%				NA 6 3.85%
Have you ever used your phone to scan QR codes, for example: museums, advertising, etc.?	Yes 42 73.68%		No 15 26.32%		Yes 8 8.60%		No 85 91.40%		
Have you ever read any QR code in Econometrics?	Yes 23 54.76%	No 19 45.24%	Yes 4 26.67%	No 11 73.33%	Yes 1 12.50%	No 7 87.50%	Yes 1 1.18%	No 84 98.82%	

Source: Own elaboration.

Table 2 presents the results by gender and age. This analysis is proposed with the aim of study whether there are differences in the use of Information and Communications Technologies (ICTs) as learning methodologies by students with respect to their age and gender. It is important to mention that Econometrics is a subject taught in the third year of the degree in Business Administration & Management offered by University of Cadiz; the average age of students in the course is about twenty one year old, for this reason twenty one is the cut off age shown in the table. Although, females participated more actively in using QR codes in Econometrics than males (17 women versus 12 men); in general, the results suggest that there are not significant differences among males and females by age.

Table 2. Differences in using QR codes in Econometrics by age and gender.

	MALES 64 41.03%				FEMALES 92 58.97%			
Student age	21 and older 55 85.94%		Under 21 9 14.06%		21 and older 73 79.35%		Under 21 19 20.65%	
Have you ever read any QR code in Econometrics?	Yes 11 20.00%	No 44 80.00%	Yes 1 11.11%	No 8 88.89%	Yes 14 19.18%	No 59 80.82%	Yes 3 15.79%	No 16 84.21%

Source: Own elaboration.

Regarding technological factors, students were asked to choose their favorite device between two options: Mobile/Tablets and PC/Laptops. From our sample, 25.64% of students chose mobiles and tablets as their favorite devices. The vast majority (81.41%) prefer PCs or laptops. Fig. 1 shows the use of the QR codes in Econometrics according to the students' favorite device. The results show that 35% of mobile/tablet supporters have scanned QR codes in econometrics. It is noteworthy that this percentage dramatically decreases for users who prefer pc/laptops, since only 12.93% of them have read QR codes of the subject. This finding suggests that the preference for small devices, such as mobiles and tablets, affects the willingness of students to use QR codes.
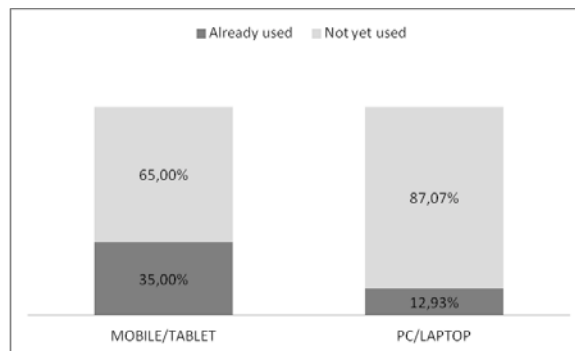

Fig. 1 Use of QR codes in Econometrics by student's favorite device
Source: Own elaboration.

Fig. 2 shows the willingness of students to read econometrics QR codes depending on whether they have already done it or not. The results show that 31.03% of students that have already scanned some QR codes are willing to repeat and a similar proportion of students (30.71%) would intend to scan them for the first time before the end of the course. However, it is noticeable that 68.97% of students that have already scanned at least once QR codes in Econometrics do not intend to repeat the experience.
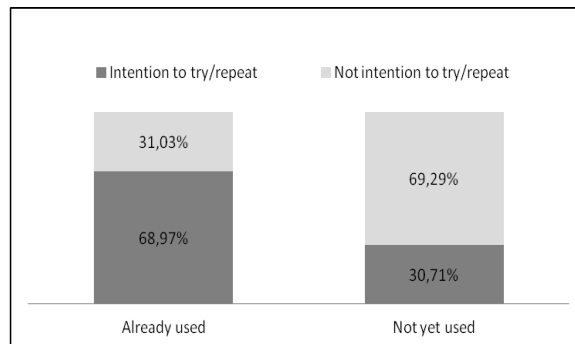

Fig. 2 Students' willingness to read econometric QR codes by previous use.
Source: Own elaboration.

In fig. 3, we can see the main reasons for not reading the QR codes with the mobile phone. As expected, the mere existence of the codes is not reason enough for students to decide to use them. The presence of the same material in the virtual campus hindered a greater use of QR codes and most of the students decided to use the conventional way through their PC or laptop. Moreover, a relative high percentage of students (17.31%) answered that they didn't know how to read the codes. Behind the answer *Others* (13.46%) we mainly find the lack of free time to install the QR code reader application and to learn how to use it. This may reflect how reluctant to changes students are.
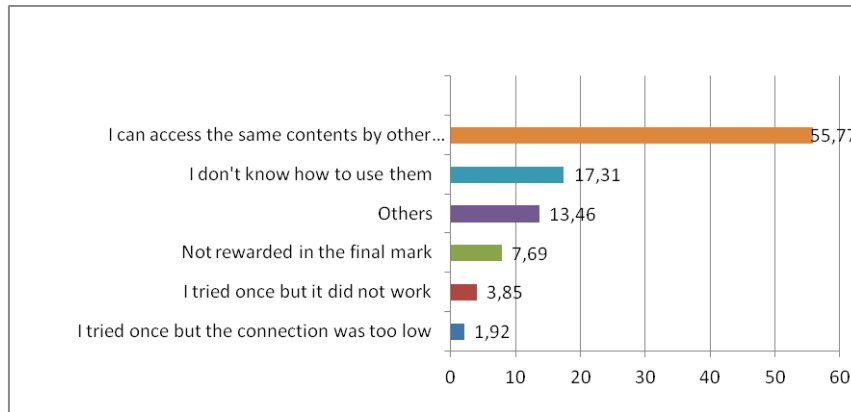

Fig. 3 Reasons hindering the use of QR codes (%)
Source: Own elaboration.

To the question *Where have you read the Econometrics QR codes?,* slightly under 50% of the students answered that they have read them at home, followed by 27,91% of the students that have read the codes at the university between teaching hours and 11,63% in the library while studying the subject. These results show that even though the codes are thought to be used in mobile devices, the learning process require a quiet environment.

4   CONCLUSIONS

As the results have shown, our experience had some light and dark in using mobile phones in education. On the one hand, we didn't manage to catch the full attention of the majority of our students with the use of the QR codes. As we wanted to test how attractive was the use of mobile phones in the learning process, we didn't reward their use with extra points for the final mark, though students missed that point of external motivation. On the other hand, we got some interesting feedback about the factors that influence their use.

Almost sixty percent of the students (58.33%) considered the self-evaluation questionnaires useful or very useful to review the contents of the subject, nevertheless the possibility to answer them in a laptop or PC discouraged them to try alternatives that they still do not master such as scanning QR codes.

Empirical results confirm some of our hypothesis. Students that already had some previous experience with QR codes were more pro active in the use of the links. More than fifty percent of students who read the codes already knew the system and had installed the code reader application on their phones Moreover, most of students who tried the experience have repeated it or are thinking about doing it. Nevertheless, the weaknesses of mobile phones are quite present, such as the size of the screen and the connection speed, which hinders use and make laptops the preferred choice when the contents are the same. The great majority of students who didn't try to read the codes have never read a QR code, either in Econometrics or in their private life.

It is remarkable that less than 5% of the students (3.21%) have used QR codes in a different subject than Econometrics, which give us an idea of the novelty of the method and the long way to come for education into the m-learning.

In any case, we consider that it is a matter of time that Smartphones, whether using QR codes or not, will increasingly appear in teaching projects as 40.38% of our students consider useful/very useful the possibility of using them in learning and 63.46% of them would like to use mobile phones in future learning projects.

REFERENCES

[1]   INTECO, National Institute of Communication Technologies (2011). Estudio sobre hábitos seguros en el uso de *smartphones* por niños y adultos españoles. Available at: http://www.inteco.es/file/BbzXMkVkX8VG7-0ggHlozQ

[2]   Ipsos (2012). Our mobile planet: Global smatphone users. Available at: http://services.google.com/fh/files/blogs/final_global_smartphone_user_study_2012.pdf

[3]   Yusof, S., Goolamally, N., Latif, L.A. & Fadzil, M. (2012). 12th International conference on information, Kuala Lumpur (MALAYSIA).

APPENDIX

The survey consisted of the following questions:

1.   Age:

2.   Gender: *Male, Female*

3.   Do you have smartphone? *Yes, No*

4.   What OS has your mobile phone? *Android, IOS, Windows, Others, N/A*

5.   Do you have an Internet flat rate in your mobile phone? *Yes, No*

6.   What kind of connection do you normally use? *Flat rate, WiFi at home, WiFi at Uni, None*

7.   How often is your mobile phone online? *Always, Very often, Sometimes, Seldom, Never*

8.   Have you installed any QR code reader? *Yes, No, N/A*

9.   Have you ever read any QR code, eg. Museums, advertisements? *Yes, No, N/A*

10. Do you think that reading QR codes is more useful than typing the URL? *1 – 5*

11. Have you ever read a QR code in Econometrics? *Yes, No*

12. Do you intend to read again / for the first time a QR code of the subject before the end of the course? *Yes, No, N/A*

13. In case you answer is negative. Why? *I tried once but it didn't work, I tried once but the connection was too slow, I don't consider it useful, I can access to the same information using other ways that I'm more used to, It doesn't count in my final mark, I don't know how to read them, Other*

14. How much profit can have QR codes in education? E.g. Answering to self-evaluation questionnaires in the mobile phone, watching video tutorials, accessing to office hours or email teachers. *1 - 5*

15. How much profit can have QR codes in Econometrics? *1 - 5*

16. In case you have read any Econometrics QR code, where did you read it? *Public transport, Between classes, At home, In the library, Other.*

17. Have you read QR codes in any other subject? *Yes, No, N/A*

18. Do you think that it is easy to access content related to the subject using QR codes? *Yes, No*

19. Would you like to use your mobile phone in future teaching projects? *Yes, No*

20. What uses do you highlight from your mobile phone with Internet connection? *Reading email, Sending emails, News/blogs, Virtual campus, Dictionaries, Games, Videos, Twitter, Facebook, Maps, Other*

21. What is the worst fault of mobile phones in your everyday use? *Screen size, Connection speed, None, N/A*

22. Which device do you prefer for the above uses? *Phone, Tablet, Notebook, Laptops, PC*

23. Have you tried to respond to any of the self-evaluation questionnaires of the subject? *Yes, using mobile phone and laptop; Yes, only with my mobile phone; Yes, only with my laptop; No.*

24. How much profit do self-evaluation questionnaires have to review the contents of the course? *1 - 5*

25. Have you tried to access to any video tutorial with your mobile phone? *Yes, using mobile phone and laptop; Yes, only with my mobile phone; Yes, only with my laptop; No.*