ORIGINAL RESEARCH

Assessing the feasibility of Quick Response (QR) Codes as a Novel Approach towards New Era Learning Method in Undergraduate Medical Students

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ABSTRACT
Background: Healthcare education with the use of QR (quick response) Codes has a great impact on knowledge and learning skills. A QR code (or quick response code) is a type of matrix barcode or two-dimensional barcode that contains data to identify, track, or locate a website or application. This study was conducted to assess the feasibility of the Quick Response (QR) codes as a New Era Learning method in Undergraduate Medical Students in the Department of Pharmacology.
Materials and Methods: An observational, questionnaire based study carried out under the Department of Pharmacology of R.U.H.S. College of Medical Sciences at Jaipur, Rajasthan. The study tool consists of a digital questionnaire which was prepared in English language to evaluate the feasibility and the approach of the students towards new learning.
Results: The present study was carried out among 141 second year MBBS students. Out of 141, 90.07% (127) of students in the course responded to the questionnaire.Maximum of the students agreed towards QR Code as a New Era learning method for undergraduate teaching.55.9% (71) of study participants agreed that QR code is useful in their learning with highly significant P value < 0.0001 followed by no disagreements. The responses towards QR codes as being more interesting than traditional learning methods were also found to be highly significant (P value = 0.0033).
Conclusion: The attitudes of the students towards usage of QR Codes as a new road towards learning was undoubtedly positive .With eagerness and aptitude to learn through this was also motivating and interesting than traditional methodology.

Keywords: Augmented Reality Integrated Simulation Education (ARISE), Healthcare education, QR Code, Smart devices, Undergraduate Medical Students.

INTRODUCTION

Quick response code (or QR code) is a type or matrix barcode that was invented by Denso Wave, a Japanese automobile company in 1994[1]. A barcode is a machine-readable optical label that can contain information about the item to which it is attached and data to identify, track, or locate a website or application [2]. QR code basically uses four standardized encoding methods (numeric/alphanumeric/byte/binary and kanji) in order to store data efficiently. Extensions can also be used [3]. QR code consists of black squares arranged in a square grid on a white background, which can be read by an image scanning device, appropriately interpreted and processed using Reed–Solomon error correction. The required data is then extracted from patterns that are present in both horizontal and vertical components of the image and then it is used further to retrieve information which is provided [4].

There are two different types of QR codes: Ones that link to one set location on the web (known as a static QR code) and one's that send customers to an updatable web location (known as a dynamic QR code). Static QR codes once created cannot be changed as they have a long and complicated URL and takes ample amount of time to scan. On the other hand dynamic codes are easier, faster, have a short & clean URL, take less time to scan. Apple's camera app for iPhone includes QR code scanner support. Google Assistant (with the words "scan QR Code") and the Google Camera App, with Google Lens mode let you point your Smartphone at a QR code and tap to scan. This is a great learning tool to incorporate in undergraduate medical education. [5][6]. Nowadays, various methods are used to generate QR Codes. For this project, it was generated using Google docs which mainly follows two methods with "Chrome Omni Bar" and "Google Doc Toolbar" [7].

Healthcare education with the use of QR Codes has a great impact on knowledge and learning skills. The QR codes were predominantly categorized to four common themes that are to increase participant engagement, for simulation training, for just-in-time (JIT) learning and to facilitate with administrative tasks in training. Perceptions towards the use of QR codes were definitely positive with some limitations that were also encountered which included: problems with technical infrastructure, internet facilities, unavailability of smart devices and resistance to use in certain environments [8]. "Increasing participant engagement" is to increase interest and to maintain the spectrum of the subject Pharmacology which at time becomes a bit difficult for students to understand, participant engagement is one such approach to simplify the topics and to keep them unified for easy learning. Benefits of QR codes included its low-cost and adaptability in any learning environment. It also facilitates and enhances the educational content in a much easier way. QR codes found to be more helpful than traditional learning methods. It is the new generation cost effective method to easily increase participant or student engagement to upgrade learning in a faster & easier way [9][10]."Just-in-time learning" (JIT) is different from structured training or scheduled professional development, both of which are generally available at set dates and times. Just-in time learning is unique in that it is focused on the learner's needs when they arise, and not pre-scheduled education sessions. These are not appropriate for learners with immediate or broad needs. Just-in time learning is about anticipating the needs and making sure that it can be used in medical education [11]. "Simulation"or "Augmented Reality Integrated Simulation Education (ARISE)" scenarios merge the concepts of simulation with augmented reality and game-based situated learning theory for healthcare students. Augmented Reality can be described as a heightened version of reality that is created using technology. A media image, sound, or video is overlaid into the learning environment for

education purposes. This creates a more immersive and authentic learning experience for students. All components are focused using scenarios across storylines, and lead to the transfer of knowledge/skills/attitudes to real world experience [12]. There are times when a high-fidelity manikin is not being utilized for the simulation. During these times, a QR code might be used to reveal certain aspects of the patient's condition or provide resources not otherwise available in the laboratory setting [13]. "Administrative tasks in training" is also a feasible approach to enhance learning and improvise basic training. QR codes can be used to improve trainee experience and practice methods which can be done through enhancement in feedback methods or by noting down the training methods and steps in their log books.

Using QR codes for teaching evaluation is simple and could be adopted across many educational applications. As far as different criteria's concerned these are being used for various purposes like attendance taking, to review feedbacks in healthcare, for quick learning via case reports, to prepare case sheets, in Experimental labs and Museums for simplifying instrument reviews and learning [14].Here, we are targeting the use of QR Codes for better learning and assessing the response of the Medical students on the use of the above in the Department of Pharmacology, RUHS CMS, Jaipur.

MATERIALS AND METHODS
An observational, questionnaire-based study carried out under the Department of Pharmacology of R.U.H.S. College of Medical Sciences at Jaipur, Rajasthan. It was approved by Ethical Committee Ref No .IT/01/2022. A convenient approach was adopted in this study where Second year MBBS Medical students of R.U.H.S. College of Medical Sciences Jaipur, Rajasthan were invited to participate. A total number of 141 students of second year MBBS batch were involved in this study. Participation in the study was voluntary and students were offered no incentives.Not willing Medical students were excluded from this study.

Second Year Medical Students were asked to scan the QR Codes provided on the walls and near instruments of different Experimental Labs and Museum using a QR scanning app on their Smart devices [**Figure 1**].

Figure 1: Instruments Index
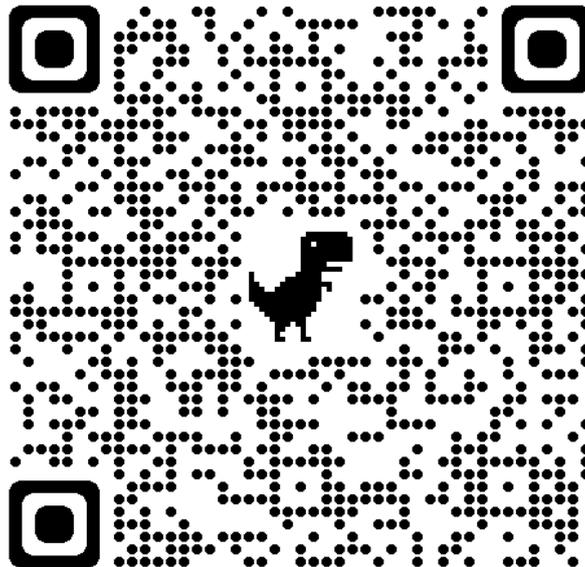
After a quick scan, students were asked to visit the respective document and read the information regarding Pharmacology Instruments with their description. Easy representation of diagrams in the form of flowchart was also included with a quick learning short video attached to it.

Feedback of learning by using QR Code was assessed by creating Google Form. Google Form consists of digital questionnaires in English language which was prepared to evaluate

the feasibility and the approach of the students towards new learning. This questionnaire was self developed and pre validated consisting of ten questions.An online survey was performed to get the response from Medical students. The participants were contacted with the Digital Questionnaire through WhatsApp Group. Likert scale was used to assess the information in 5 scale points; Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree .Statistical Analysis was done using Chi Square Test with SPSS version 20 and comparative P Values were calculated.

RESULTS

The present study was carried out among 141 second year MBBS students. Out of 141, 90.07% (127) of students in the course responded to the questionnaire. Of the survey respondents, 49.6 % (63) were females and 50.4 % (64) were males [**Figure 2**].

Figure 2: Variation in Female: Male Responses
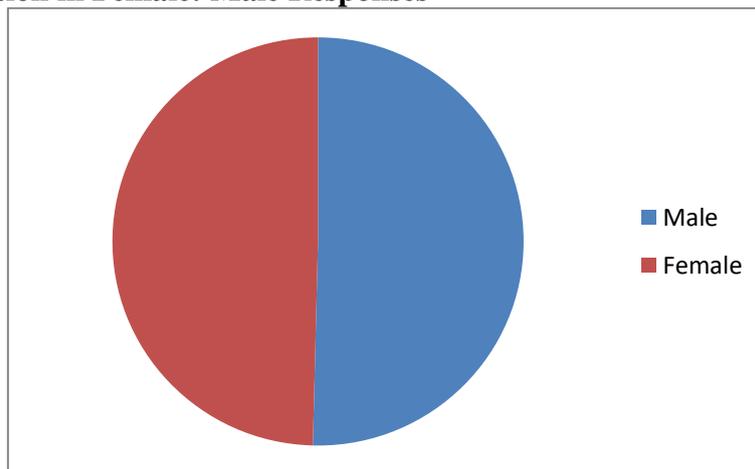
The mean age of the students was found to be 20 years. Chi Square test with SPSS version 20 was used to calculate the P values of the questionnaires for all study participants (n = 127) who responded to the survey.
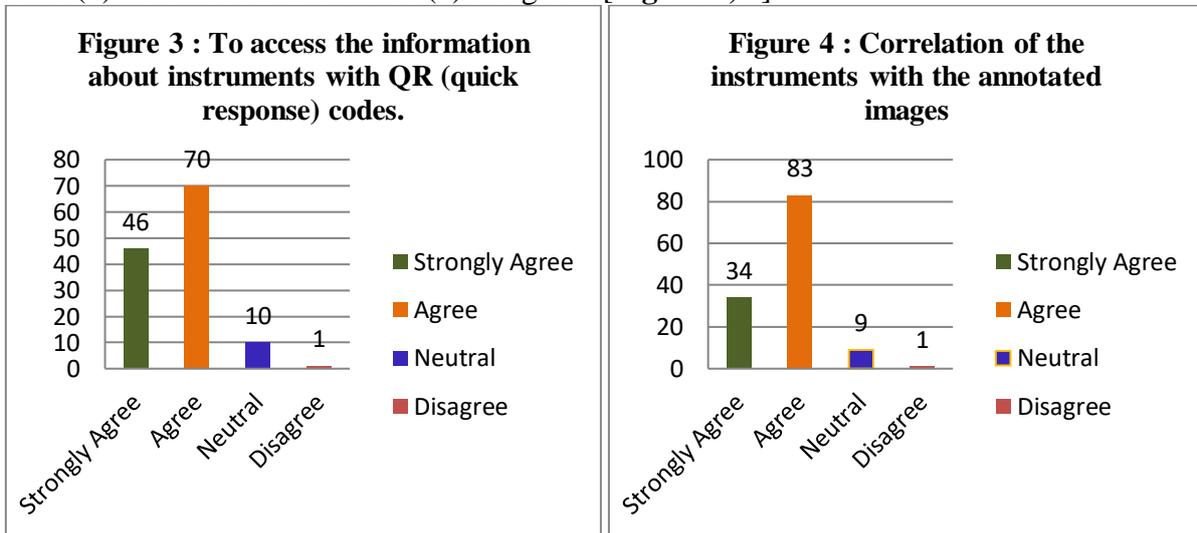
As shown in **Table No 1**, maximum of the students agreed towards QR Code as a New Era learning method for undergraduate teaching on basis of the questionnaires that were asked.

**Table 1: Questionnaires Survey to assess the feasibility of students towards QR Codes.**

	SURVEY QUESTIONNAIRES	Strongly Agree N (%)	Agree N (%)	Neutral N (%)	Disagree N (%)	Strongly Disagree N (%)	P Value
1	Is it easy to access the information about instruments with QR (quick response) codes?	46(36.2%)	70(55.1%)	10(7.9%)	1(0.8%)	-	0.0031
2	Are you able to correlate theinstruments with the annotated images?	34(26.8%)	83(65.4%)	9(7.1%)	1(0.8%)	-	0.0004
3	Is QR code is usefulin your learning?	38(29.9%)	71(55.9%)	18(14.2%)	-	-	0.0001
4	Does the QR code motivate you to visitPharmacology lab again?	27(21.3%)	67(52.8%)	29(22.8%)	2(1.6%)	2(1.6%)	0.0001
5	Is QR code useful for						0.0004

	quick revision of the respective topic or instrument?	42(33.1%)	72(56.7%)	12(9.4%)	1(0.8%)	-	
6	Is QR code useful for independentlearning?	35(27.6%)	76(59.8%)	16(12.6%)	-	-	0.0001
7	Is QR code learning interesting thantraditional learning methods?	34(26.8%)	68(53.5%)	17(13.4%)	6(4.7%)	2(1.6%)	0.0033

A total of 10 minutes were given to the students to answer the following questionnaire and to record their responses. Accessibility of the information regarding instruments with the help of QR Codes was found to be highly significant (P value = 0.0031) in which 55.1 % (70) agreed; while 36.2 % (46) strongly agreed, 7.9% (10) were neutral and 0.8% (1) disagreed. Similarly, the correlation of the annotated images with the instruments was also highly significant with P value =0.0004, in which 65.4% (83) agreed, 26.8 %(34) strongly agreed, 7.1% (9) were neutral and 0.8 % (1) disagreed [**Figure 3, 4**].

Figure 3 : To access the information about instruments with QR (quick response) codes.

Figure 4 : Correlation of the instruments with the annotated images

In this study, 55.9% (71) of study participants agreed that QR code is useful in their learning, while29.9 %(38) strongly agreed, and 14.2% (18) were Neutral (highly significant with P value < 0.0001). There were no disagreements in this so far [**Figure 5**].
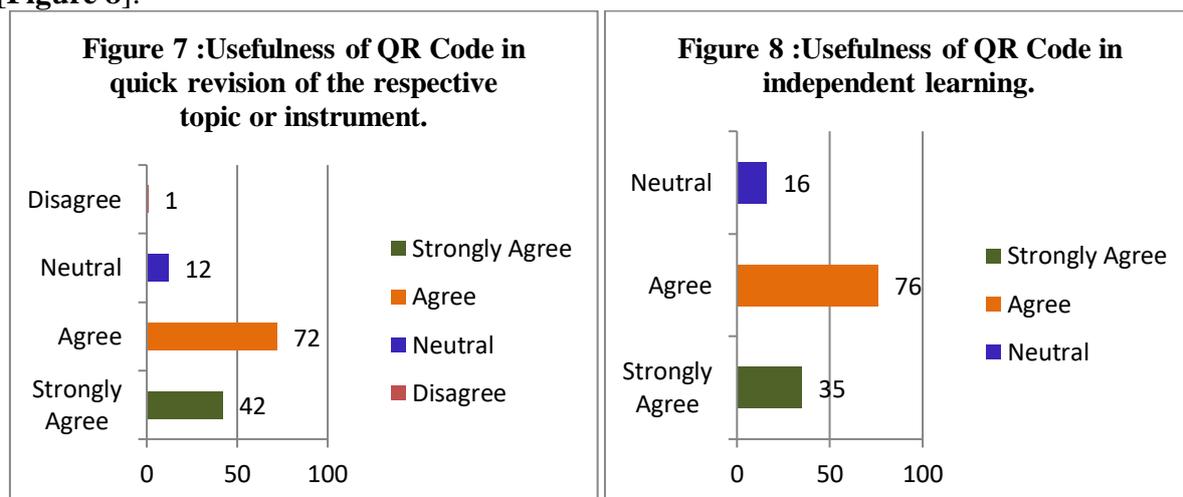

Figure 5 :Usefulness of QR Code in learning
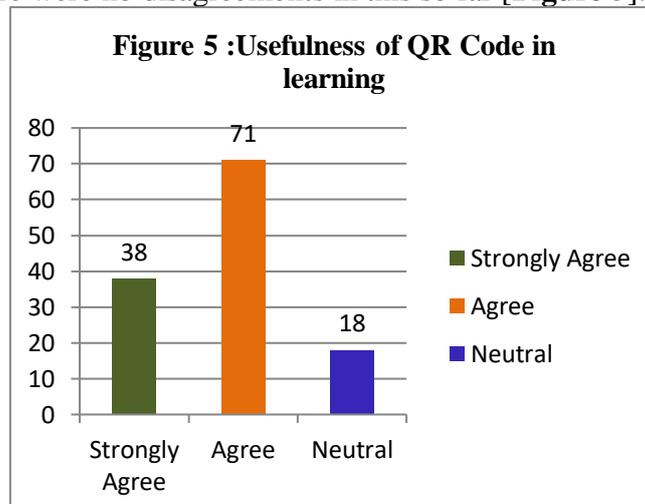
Similarly, the motivation of visiting experimental lab in future with this learning method was also found to be highly significant with P value <0.0001, in which 52.8% (67) agreed, 21.3

%(27) strongly agreed, 22.8% (29) Neutral, 1.6%(2) disagreed and 1.6%(2) strongly disagreed[**Figure 6**].

Figure 6 :Motivation to visit Pharmacology lab again.
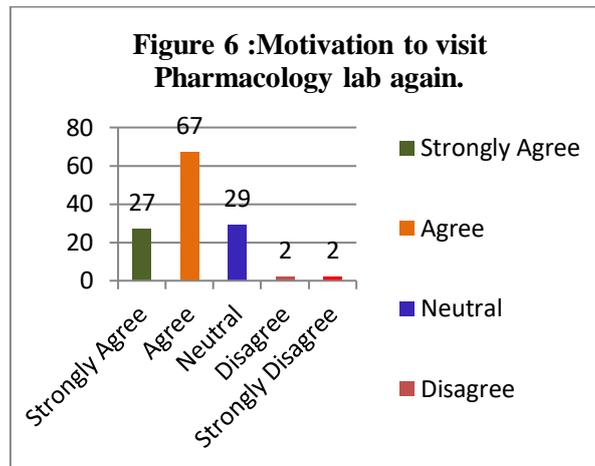
As shown in **Figure No 7**, 56.7% (72) study participants agreed that QR code useful for quick revision of the instruments. While 33.1 %(42) strongly agreed, 9.4% (12) were Neutral, and 0.8% (1) disagreed (P value =0.0004).QR code as a specific tool for independent learning was also found to be highly significant with P value < 0.0001, in which 59.8% (76) agreed , 27.6 %(35) strongly agreed, 12.6% (16) have given Neutral as their responses [**Figure 8**].

Figure 7 :Usefulness of QR Code in quick revision of the respective topic or instrument.

Figure 8 :Usefulness of QR Code in independent learning.

Nevertheless , the responses towards QR codes as being more interesting than traditional learning methods were found to be highly significant with P value = 0.0033, in which 53.5% (68) agreed, 26.8 %(34) strongly agreed, 13.4% (17) were Neutral, 4.7%(6) disagreed and 1.6%(2) strongly disagreed [**Figure 9**].

DISCUSSION

QR code or quick response code is a type of matrix barcode (or two-dimensional barcode) developed by the Japanese automotive company Denso Wave. Healthcare education has a great impact on learning therefore QR Code can be used as an easy study tool to improvise skills and knowledge of students in a feasible way. Two different types of QR codes included static QR code and a dynamic QR code.

In previous study most participants held positive attitudes toward the use of Quick Response codes in case-based learning courses. The perception of participants towards theuse of QR codes was found to be easy and expressed their intention to use this application in the future. Inclassroom teaching also students improvised in asking questions and discussions than they

did before [15]. In another study conducted in Taiwan, major goal was to explore students' viewpoint towards the use of quick response codes in the pharmacology course and the results indicated that amajority of students considered quick response codes easy to use and helpful with learning intheir respective course [16].

Figure 9 :QR code learning interesting than traditional learning methods.
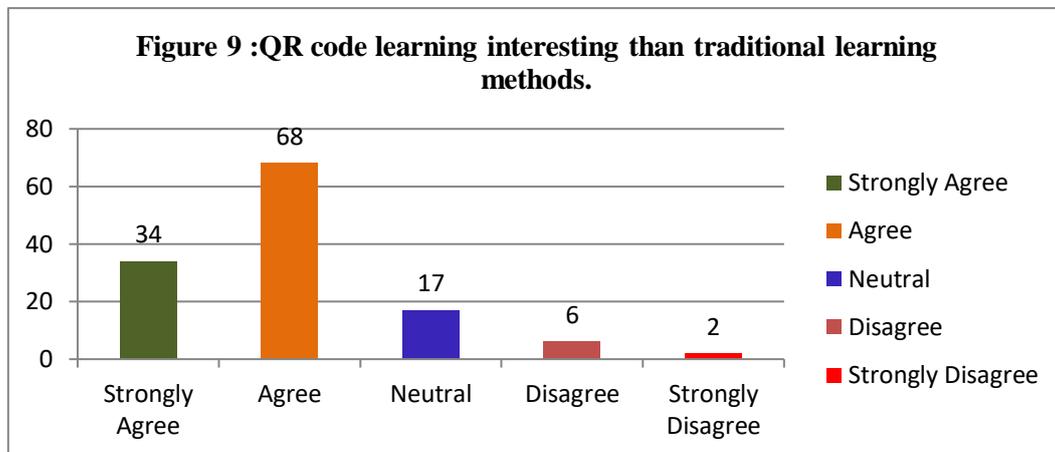
Similarly, in one more study aimed at personal feedback and recording an evaluation of resident competency immediately following surgical procedures in obstetrics and gynecology. In this, accessibility of the QR reader used in conjunction with such a streamlined electronic survey provided a valuable tool for direct, formative feedback at the time of a surgical procedure, as well as an electronic record to be used for longitudinal comparison of resident progress [17]. Another study focused on collection of feedback regarding medical student clinical experiences for formative or summative purposes that remains a challenge across clinical settings. The results of this study demonstrate that preceptors in the family medicine clerkship rate QR code-linked feedback as a high usability platform. Additionally, this platform resulted in faster form completion than paper or online forms [18].

In our study, it was found that students have a positive attitude towards the use of QR Codes as a New Era learning method. Maximum of the students agreed towards QR Code implementation for undergraduate teaching on basis of the questionnaires that were asked. 55.9% (71) of study participants agreed that QR code is useful in their learning (P value < 0.0001). QR code as a specific tool for independent learning was also found to be highly significant with P value < 0.0001, in which 59.8% (76) agreed. The responses towards QR codes as being more interesting than traditional learning methods were found to be highly significant with P value = 0.0033, in which 53.5% (68) agreed.

In the above context, it was found that QR Code is an effective study tool, more feasible and easily accessible towards New Era learning as well as for improvising skills and enhancing knowledge. Furthermore, its usability is interesting than traditional learning aids and also motivates students to visit experimental labs. With easy accessibility of the information regarding instruments and the correlation of the annotated images, it can be used as a new generation study tool in future. However some limitations are still there like problems with technical infrastructure, internet facilities, unavailability of smart devices and resistance to use in certain environments. Nevertheless, in the upcoming era it is an effective method to increase interest and to maintain the spectrum of the subject Pharmacology in an easier way.

CONCLUSION

The attitudes of the students towards usage of QR Codes as a new road towards learning were undoubtedly positive. QR Codes were embraced by students as it was easy, motivating and

interesting than traditional methodology.However, it will be a powerful method to increase interest in and maintain the range of Pharmacology.

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