

## ORIGINAL ARTICLE

# Implementation of Quick Response (QR) Code as a Teaching-Learning Tool-An Interventional Study

Datta A,<sup>1</sup> Tiwari P,<sup>2</sup> Goswami D,<sup>3</sup> Shukla S,<sup>4</sup> Galoria D,<sup>5</sup> Rana P.<sup>6</sup>

Associate Professor,<sup>1,2</sup> Senior Resident,<sup>3</sup> Resident.<sup>4,5</sup>

1,4-6. Forensic Medicine, Pramukhswami Medical College & Sri Krishna Hospital, Bhaikaka University, Karamsad.

2. Community Medicine, Pramukhswami Medical College & Sri Krishna Hospital, Bhaikaka University, Karamsad.

3. Forensic Medicine, Gujarat Adani Institute of Medical Sciences, Kachchh University, Bhuj.

## Abstract:

The potential enhancement of teaching and learning through Quick Response (QR) codes and mobile devices offers students customized, relevant, and real-world learning experiences. As students control their education more, institutions must ensure convenient access to online content. This study's plan involves implementing QR codes in the departmental museum to provide students with supplementary information and interactive content. We plan to use QR codes in our departmental museum to enhance the learning experience. QR codes will allow students to access additional information and interactive content related to the exhibits. **Settings and Design:** An interventional study conducted in a Forensic Medicine museum setting. Created Quick Response codes (QR codes) linked to study materials for each museum specimen. Divided students into two groups: one scanned QR codes during museum visits for instant access to study material, while the other used traditional catalogs. A Multiple-Choice Question (MCQ) test assessed the effectiveness of QR codes as a teaching tool. The collected data underwent a thorough error-checking process, followed by data entry in MS Excel. Subsequently, the data was analyzed using the latest SPSS 11.0 software. The response indicates that students generally agree that QR codes are helpful in improving their comprehension, analysis, and exploration of subjects linked to museum exhibits and medicolegal work. QR codes can completely transform education and give students access to interactive, adaptable and lifetime learning opportunities.

**Keywords:** Museum visit; Quick response code; Self-directed learning.

**Key Messages:** QR codes possess transformative educational potential, providing students with interactive, adaptable and lifelong learning opportunities. Teachers adapting to the evolving needs of today's students must embrace tools like QR codes as technology advances.

## Introduction:

A museum is "an organization that collects, preserves, and presents for public viewing a collection of artifacts and other objects of scientific, artistic, or historical significance through either temporary or permanent exhibits."<sup>1</sup> A significant and easily accessible resource for individual and group study, medical school museums are valuable resources for developing professional communication skills and self-directed learning, essential aspects of the competency-based medical education (CBME) curriculum.<sup>2,3</sup> These museums have historically been the primary source for teaching anatomy, pathology, and forensic medicine. They are regarded as superior to most other educational resources because of their exceptional capacity to support individual inquiry and group learning.<sup>4,5</sup> Strong communication skills were developed in this interactive setting, an important goal still at the heart of medical education today.<sup>6</sup>

## Corresponding Author

**Dr. Arijit Datta**

Email : arijitdatta18@gmail.com

Mobile No.: +91 8777439056

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Self-directed learning (SDL) is crucial for medical students. It helps them develop skills like increased responsibility, assertiveness, and accountability, essential for their future careers as medical professionals. Similarly, medical educators hope to incorporate SDL into the curriculum to develop students who can independently oversee their further education and will never give up on their quest for knowledge via critical thinking. Self-directed learning improves memory and helps students make better decisions based on the information they retain. An excellent location for supporting SDL activities with undergraduate students is the Forensic Medicine Museum.<sup>7</sup> There is a lot of promise for improving teaching and learning experiences with modern technology like QR codes and mobile devices. This is so that students can interact socially and with content in various circumstances and obtain knowledge, resulting in customized, pertinent, and real-world learning experiences.<sup>8,9</sup> As students take charge of their education in higher education, the onus shifts to the institution to give them quick, easy, adaptable, and user-friendly access to online content and resources.<sup>10</sup> We plan to use QR codes in our departmental museum to enhance the learning experience. QR codes will allow students to access additional information and interactive content related to the exhibits.



Figure 1. Snake specimen in museum.

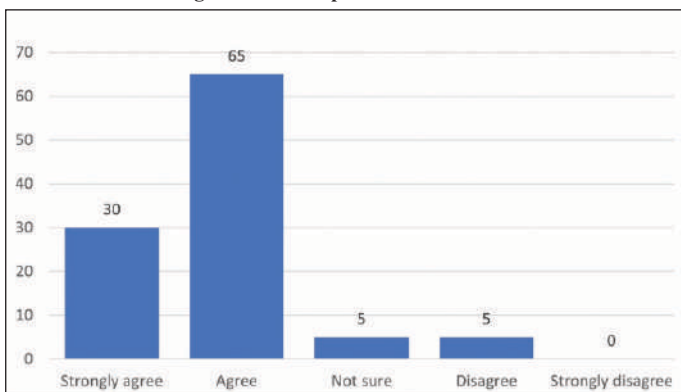


Chart 1. I was able to have a better understanding of specimen.

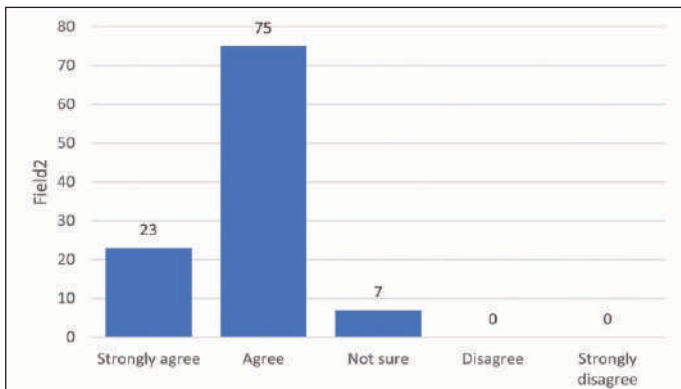


Chart 2. I was able to differentiate between various specimens and could analyze better.

**Objective-1.** To develop a quick response code as a teaching and learning tool.

2. To assess the effectiveness (performance of students and perception) of the quick response code as a teaching-learning tool.

**Methodology:**

Our technological team produced software called 'QR Code Generator,' making creating study materials with embedded QR codes easy. The QR code graphics are then printed, laminated, and attached to the appropriate museum artifacts by tying or sticking. Students in our medical college's MBBS Phase II, Semester IV, participated in this study. The students were split into groups A and B for the practical classes. As the control group,

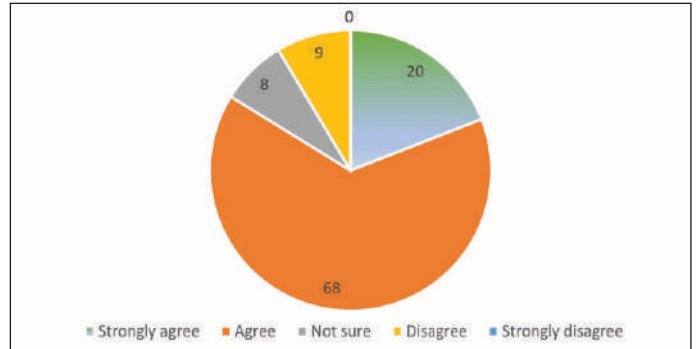


Chart 3. I was able to explore further opportunities for additional information about the specimen related to the given topic.

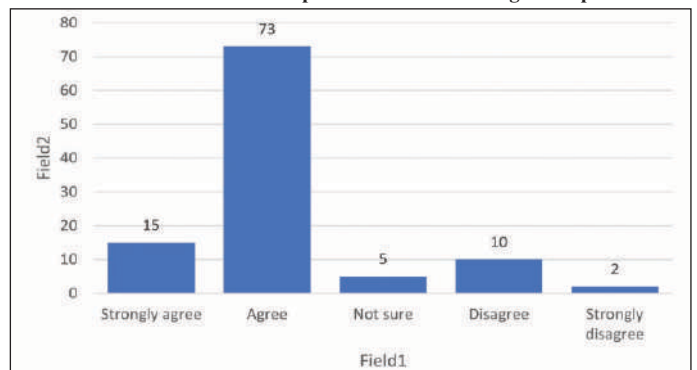


Chart 4. I was able to do quick revision for topics.

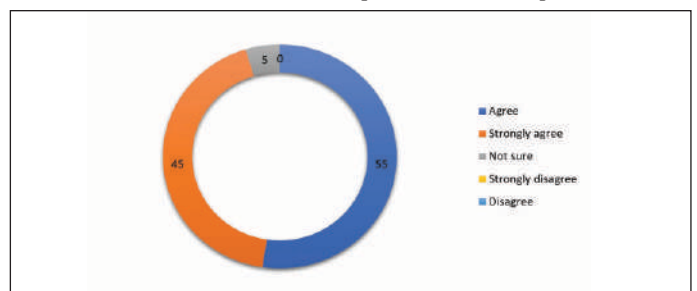


Chart 5. I will be able to identify various weapons & injury produced by it during medicolegal work better.

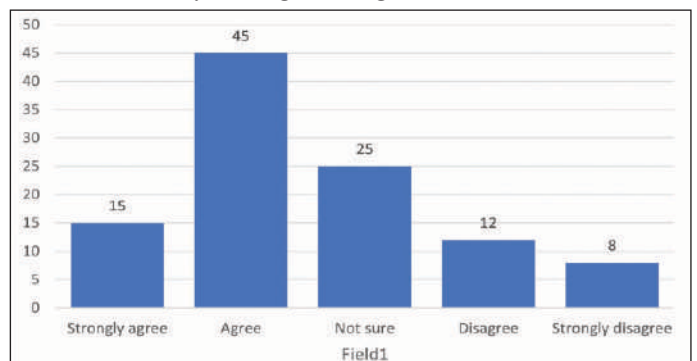


Chart 6. I will be able to identify the clinical features of poisons during case of poisoning better.

Group A went through standard museum-style tutorials where they looked through a hard copy booklet that listed every specimen in the Forensic Medicine Museum. The experimental group B was given "upgraded museum settings," which included cutting-edge educational tools like smartphone-based QR code



Figure 2. Study material for the weapon (lathi) specimen in the museum.



Figure 3. Study material for wet specimen (SAH) in the museum.



Figure 4. Demonstration of bedside test of poison (Celphos).

scanning. Students could correlate facts while standing in front of the exhibits, thanks to the method providing comprehensive information on each specimen. Students can now scan those QR codes to get all pertinent study information in front of the museum specimen [Fig. 1, Fig 2, Fig 3, Fig. 4]. Users had to download and install Google Lens from the Google Play Store if their smartphone did not have an inbuilt QR code scanner. Users must log in to their Gmail account through their smartphone before scanning the QR Code.

Type of Study: Interventional study.

Teaching Phase: Group B students were exposed to QR codes covering the same topics. In contrast, Group A students were given paper copies of the museum catalog as study material about wet specimens, weapons, and poisons. The purpose of an evaluation consisting of multiple-choice questions (MCQs) was to gauge how well students understood the presented content. Using Google Forms, the MCQ assessment was given to both groups after the museum visiting session that same day. After completing the multiple-choice question test, Groups A and B switched exposures in a crossover procedure. Group A was exposed to QR codes, while Group B was given traditional museum catalog study materials. Finally, a feedback form was given to the students to ascertain their opinions and preferences about using the hard copy museum catalog or QR Code as a teaching-learning instrument. This feedback collection technique aimed to gather insightful information from the students to provide a thorough grasp of their preferences and experiences in the classroom. The feedback questionnaire asked questions about the overall learning experience, engagement, information accessibility, and ease of comprehension. Pre-testing was used to validate this feedback form. A total of 105 students participated in the study; out of 105 students, Group A comprised 49 students,

Table 1.

Method	Total number of students (N)	Mean	Std. Deviation	P Value
Traditional Method	49	55.45	10.04	P value (0.01)
QR Code	56	60.03	9.56	significant

and 56 belonged to Group B.

Ethical Considerations/Consent: Participants' anonymity and confidentiality will be ensured throughout the study. The study was conducted after getting clearance from the Institutional Ethics Committee. (IEC NO- IEC/BU/2023/Ex. 83/3222023)

Statistical Analysis: The collected data underwent a thorough error-checking process, followed by data entry in MS Excel. Subsequently, the data was analyzed using the latest SPSS 21 software. The analysis focused on the MCQ test results for both the control and experimental groups and the mean value of the test result of both the methods measured.

**Results:**

Table 1 revealed that the mean value of the QR Code teaching-learning method is higher than the traditional teaching-learning method with a significant P value. The feedback survey shows that students favor using QR codes to comprehend and evaluate museum exhibits. A sizable majority of students said they agreed with the statement, "I was able to better understand museum specimens by using QR codes"; 65 students (61.9%) agreed, and 30 students (28.6%) strongly agreed. Just five students (4.8%) disagreed, while five students (4.8%) were unsure (Chart 1). Similarly, when questioned about their ability to distinguish between different specimens and analyze them more thoroughly using QR codes, most students gave good answers. Of the pupils, 75 (71.4%) agreed, and 23 (21.9%) strongly agreed. Seven (6.7%) students were unsure (chart 2). A significant portion of students considered this feature helpful when using QR codes to explore more information about specimens associated with a particular topic. Sixty-eight students (64.8%) agreed, compared to 20 (19%) who strongly agreed. Nine students (8.6%) disagreed, while eight students (7.6%) were unsure (chart 3). Many pupils attested to the efficiency of employing QR codes to revise various subjects quickly. Of the pupils, 73 (69.5%) agreed, and 15 (14.3%) strongly agreed. Ten students (9.5%) disagreed, two students (1.9%) strongly disagreed, and five students (4.8%) were unsure (chart 4). Lastly, most students gave favorable answers when asked how QR codes may be used to identify weapons and injuries sustained during medicolegal work. Forty-five students (42.9%) strongly agreed, and fifty-five (52.4%) agreed. Of the students, five (4.8%) had no idea (chart 5). The feedback from students regarding the use of QR codes in identifying the clinical features of poison during cases of poisoning reveals a varied response. A notable 57.2% of students (combining those who strongly agreed and agreed) found the QR codes helpful, emphasizing their perceived utility in understanding the clinical aspects of poison-related cases. However, 23.8% of students expressed uncertainty, indicating a lack of consensus or mixed opinions among the respondents. Additionally, 18.8% of students (combining those who disagreed and strongly disagreed) did not find the QR codes effective for identifying clinical features of poison. These results suggest a

need for further exploration of how QR codes can be optimized to cater to different learning preferences and address any specific challenges students may encounter in comprehending clinical features related to poisoning cases.

Overall, the response indicates that students generally agree that QR codes help improve their comprehension, analysis, and exploration of subjects linked to museum exhibits and medicolegal work.

### Discussion:

Traditional techniques did not significantly affect the motivation of second-year MBBS students to learn pathology, according to the study by Kumar VVSR and Kumar M. On the other hand, the students in the experimental group who were shown QR codes in the pathology museum environment showed notably higher levels of motivation.<sup>11</sup> In educational applications, QR codes are versatile. According to Lee et al. (2011), these codes let teachers create customized field study guides for each student, increasing student learning efficacy by supplying only relevant material. It has been observed that incorporating field trips with QR code activities helps to engage students and seamlessly blend online learning with real-world applications. Essentially, QR codes facilitate a variety of instructional approaches.<sup>12</sup> QR codes enhance student motivation and passion and support learner-centered learning when used with learner-centered instruction. Rikala and Kankaanranta report that pupils are curious about this novel method and find QR codes engaging.<sup>13</sup> Some colleges use QR codes to improve mobile phone efficiency, allowing students to access information and services swiftly.<sup>14</sup> Studies reveal that students actively seek instructional resources that provide more convenience and flexibility to fit their busy schedules. Students' responses to numerous studies investigating mobile learning, or m-learning, in the classroom have been overwhelmingly positive. Most students concur that using mobile devices makes studying flexible, portable, and convenient.<sup>15-17</sup> The significant qualities of QR Codes as instructional aids, such as their independence from time and place and ability to hold relevant content, highlight the strong arguments for using them in the classroom. While time independence expands the learning experience beyond traditional classroom hours, location independence permits learning outside a prescribed context. Video and photo footage must be included for complete coverage to be considered meaningful. Using QR codes containing course material enhances the mobile learning platform's functionality even further in an educational setting.<sup>18</sup> According to the Law and So study, students reported that QR codes provided the required variance in the classroom and made it easier to learn specific module themes. The information was well-structured and articulated and the sample exam items helped students grasp challenging ideas more deeply. QR codes in mobile learning have the potential to be highly beneficial since they keep students interested, involved, and connected- all of which will improve the learning process and promote lifetime learning. Additionally, it has been discovered that QR codes are valuable instruments for engagement and motivation that promote solo and group learning.<sup>19</sup> Building on these findings, the present study aligns with the observed benefits of QR codes in education. When employed alongside learner-centered instruction, QR codes have

been found to amplify student motivation and enthusiasm, fostering learner-centered learning. Students in the present study recognized QR codes as valuable tools that introduce variety in the classroom and enhance understanding of challenging module themes. The well-structured information and sample exam items provided clarity on complex concepts. Overall, QR codes in mobile learning are highly beneficial, keeping students interested, involved, and connected- enhancing the learning experience and promoting lifelong learning.

### Conclusion:

The study emphasizes how effective QR codes are as game-changing tools in the classroom, especially for mobile learning. The findings align with earlier research by Kumar VVSR and Kumar M<sup>11</sup> that highlights the shortcomings of conventional instruction compared to the increased motivation that students who encounter QR codes experience. Regarding education, QR codes are helpful since they provide customized field study guides and boost participation through creative methods like field excursions. According to Rikala and Kankaanranta,<sup>13</sup> the current study confirms the beneficial effects of learner-centered training, where QR codes encourage students' enthusiasm and interest. Moreover, the result aligns with broader patterns in educational research, suggesting that students are looking for more adaptable and convenient learning materials and that mobile learning is their preferred method.<sup>15-17</sup> The distinct qualities of QR codes, which provide time and location independence, support their use in educational settings. The integration of multimedia information and the capacity to extend learning outside regular hours and venues improve the overall learning experience.<sup>18</sup> The current study supports the conclusions made by Law and So, highlighting that QR codes, add diversity to the classroom and help students comprehend complex subjects more deeply.<sup>19</sup> Simply put, the study adds to the increasing amount of data showing QR codes as great learning tools that can be used in solo and group situations. The research's conclusions highlight how QR codes can completely transform education and give students access to interactive, adaptable, and lifetime learning opportunities. Teachers who want to meet the changing requirements of today's students must use tools like QR codes as technology advances.

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