Location-Linked QR Code as a Safe Tool for Recording Classroom Attendance During COVID-19 Pandemic: Perspectives of Medical Students

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Abstract
COVID-19 lockdowns affected educational programs. Online learning has suddenly become the main form of medical education. However, attendance enhances a student’s competency and professionalism. Rising student numbers and the COVID-19 pandemic make in-class learning challenging. This study investigates medical students’ perceptions of a recently implemented tool for recording attendance using a QR code that detects students’ location while scanning. An online questionnaire was designed to collect responses. One hundred thirty-two students completed the survey. Students agreed that the method was usable, reliable, accurate, secure, and convenient. This method should be investigated as a standard tool for attendance recording.

Keywords QR code · Attendance · Medical students · Location · Absenteeism

Background
The pandemic of COVID-19 has affected medical education worldwide. Multiple colleges have implemented emergency remote teaching (ERT) in response to whole and/or partial lockdowns [1]. Numerous colleges were able to begin face-to-face learning in 2021 because of the COVID-19 vaccine’s approval and subsequent vaccination campaign. Universities have modified their academic activities to restore pre-COVID-19 conditions, yet social distance limitations persist in all phases of education [2].

Attendance is an important student-centered factor that can influence academic success, particularly for medical students who require clinical contact and training to acquire competence and professionalism. Most studies discovered a correlation between medical student attendance and academic performance [3–5]. Marburger found a correlation between absenteeism and exam performance; students who miss class are more likely to answer exam questions incorrectly [6]. Due to the correlation between class attendance and academic progress and professionalism, medical schools need to establish attendance regulations.

The traditional pen-and-paper method for documenting in-class attendance was extensively employed among the several methods adopted [7]. It has disadvantages, such as the possibility of human error, the need for significant time and effort if the cohort is large, and attendance by proxy. There is a need for alternatives that were rapid, secure, accurate, and convenient. Medical schools and other health-related institutions could utilize QR codes to monitor attendance. It is a two-dimensional matrix barcode that can be read by smartphones and tablets and may be created easily and rapidly on free websites [8].

In September 2021, Sultan Qaboos University (SQU) initiated face-to-face undergraduate learning. As the pandemic has affected every aspect of our daily lives, medical education must address a number of measures to return to a pre-COVID-19 educational environment. We have used a QR code method to record students’ attendance in order to
maintain safety and distance standards, as well as to offer an alternative to the conventional approach. This study aims to evaluate medical students’ perceptions of SQU’s new way of recording attendance, utilizing a QR code that indicates students’ location while scanning.

**Activity**

The participants were third year medical students from Sultan Qaboos University (SQU) in the Sultanate of Oman. One hundred forty students were selected at random to participate. The study utilized an online survey (ESM Appendix A) administered to students during October and November of 2021. The Google Forms survey was sent via email to participants. Participation was voluntary. Each student was given a survey and study objectives.

Using open-source software, a dynamic QR code for class attendance was created [9]. At the start of each session, students were instructed on how to log their attendance. QR codes that could be scanned directed students to Google Forms where they could enter their information. Prior to submitting their response, they could share their location via a link attached to Google Form. Attendance locations, geocodes, and geonumbers were determined in advance (and uploaded to an Excel spreadsheet linked to a Google Form. Those whose locations did not match or were not shared were deemed absent. A link to these files was provided with the Google Forms for attendance and is required for submission. Submitted data was automatically uploaded online, and an Excel spreadsheet including fully recorded attendance data, including start time, location (geocode and geo number), and all mandatory attendance form questions, was linked to the document [10].

The survey comprised ten questions, including sociodemographic data (gender, phase). The effectiveness and disadvantages of the new attendance method were explored. The study also inquired as to whether students preferred the new approach to attendance after the health crisis. The questionnaire employed a Likert scale (respondents’ attitudes are agree/disagree). The participants’ responses to the survey were considered consent to participate in the study, as stated in the Introduction of the disseminated Google Forms.

**Ethical Approval**

The SQU Medical Research Committee approved the study protocol (SQU-EC/625/2021).

**Results**

Phase II third semester medical students from the SQU College of Medicine and Health Sciences completed an online survey for this study. Among 140 participants, 132 responded (94.3%). There were 79 (60%) female responses and 53 (40%) males. Ninety-five students (72%) reported attending 15–20 lectures, practicals, and tutorials per week.

Table 1 displays the evaluations of the QR code location–linked classroom attendance record tool by medical students.

| Items                                                                 | Strongly agree | Agree | Disagree | Strongly disagree | Weighted mean | Chi-square p-values |
|----------------------------------------------------------------------|----------------|-------|----------|-------------------|---------------|---------------------|
| 1. Do you have the IT competency to use the new method for taking the in-class attendance? | 91             | 34    | 5        | 2                 | 3.62          | < 0.0001            |
| 2. The newly adopted method (QR code scan) is easier to use and ensures safety | 77             | 28    | 15       | 12                | 3.29          | < 0.0001            |
| 3. To your opinion, was QR code–based method equivalent in accuracy to the classical paper-based method and reduced attendance-by-proxy? | 87             | 35    | 8        | 2                 | 3.58          | < 0.0001            |
| 4. Was it convenient to you to share your location during the QR code scan to ensure in class attendance? | 76             | 31    | 21       | 4                 | 3.36          | < 0.0001            |
| 5. In advance instructions for taking the attendance were clear and appropriate | 89             | 29    | 12       | 2                 | 3.55          | < 0.0001            |
| 6. If there was any technical problem, the course coordinator could provide help to overcome | 81             | 32    | 12       | 7                 | 3.42          | < 0.0001            |
| 7. To your opinion, should the QR code scan method used during COVID-19 pandemic continue after the health crisis? | 62             | 28    | 24       | 18                | 3.02          | < 0.0001            |

Likert scale rating was used to detect students’ responses under each category: 4, Strongly agree; 3, Agree; 2, Disagree; 1, Strongly disagree. The chi-square test was used to detect the level of significance for the responses to each item. p-value < 0.05 was considered statistically significant. All items exhibited an acceptable level of significance with a p-value of less than 0.0001. Greater chi-square values imply a greater level of variation between the actual and expected responses of survey participants for each item.
Students agreed that our attendance-recording tool is effective, reliable, accurate, user-friendly, and secure. After the COVID-19 health crisis, students agreed that the QR code location-linked attendance-recording tool should be employed (with a mean of 3.62). Additionally, students found the instructions were clear and reasonable (weighted mean of 3.58). It was also found that students perceived the current method (QR code–linked attendance record) for in-class attendance recording to be simpler and more secure. This statement scored 3.55 points on average.

Students agreed (mean of 3.36) that the QR code–based approach is accurate and minimizes attendance fraud. The presence was recorded upon arrival. Prior to submission, students were required to provide their location.

They agreed that mobile scanning was clear, easy, reliable, and consistent (a weighted mean of 3.29). Students acknowledged that it was convenient to disclose their location while scanning the QR code and recording their in-class attendance (mean of 3.02).

**Discussion**

Class attendance is a crucial factor in determining academic achievement [11]. The COVID-19 epidemic has altered and transformed global learning [12]. This transition was accompanied by strategies and initiatives to limit its influence on the student-centered learning process [13]. Several teacher-developed technical abilities have been integrated into teaching [14].

In this study, we examined medical students’ perceptions towards a QR code location-linked attendance record tool. We created a unique, simple, and practical method for recording student attendance. Geocodes and geonumbers of attendance locations were linked to a Google Forms for attendance recording. A validated questionnaire was emailed to students. Responses from students were received and saved to Google Drive.

The students in our study responded favorably to the convenience and reliability of the newly adopted method (weighted mean of 3.55, \( p \)-value < 0.05). This is consistent with the findings of a different study conducted by David and his associates, which determined that QR code is a significantly more convenient method for both students and faculty that can benefit users who prioritize functionality, reliability, and maintainability when checking student attendance [15]. Additionally, compared to the traditional PAP approach, Koh and his colleagues deemed the QR code attendance record tool to be a safer, more favorable, and more convenient method for recording class attendance [16]. Moreover, another study by Molina demonstrated that employing QR codes for data access is not only time-saving and easy, but also environmentally friendly and cost-effective [17]. Students agreed that the applied method was accurate in terms of consistency over time, similarity to the PAP method, and contribution to lowering attendance by proxy (weighted mean of 3.36). This work’s strength was its use of QR codes to share the submitter’s location. Enabling geolocation and incorporating it as a crucial step in the scanning and submission process ensured that only in-class attendees submitted their attendance. This passes in agreement with Koh and his colleagues, who also mentioned the risk of fraud and proxy attendance from sharing or sending the QR code remotely to absentees [16].

Students agreed with the statement that it was convenient for them to share their location during recording their attendance (with the lowest weighted mean of 3.02). This enables close monitoring of students, as their actual attendance time is recorded. This finding highlights the findings by Ch that high student dropout rates may be attributable to a lack of strict monitoring and secure class attendance checks. As a result, students do not fear missing classes or returning home late because their schedule is not strictly checked [18].

Students agreed that the newly applied method is easy to use, and all possessed the minimal IT skills to use it (weighted mean of 3.42). This is consistent with the findings of Maleriado and Carron’s study, “The characteristics of QR-code as an Attendance Monitoring System: Its Acceptance and Implications,” which concluded that the QR code as an attendance record tool is more user-friendly, cost-effective, quick, and ecologically friendly [19]. Moreover, according to a different study by Nuhi et al., the QR code attendance record is not only used in schools and learning institutions, but also in any place a big number of workers are present [20].

**Conclusions**

The SQU medical students responded positively to the QR code location-linked attendance record tool. Regarding its efficiency in terms of usability, accuracy, reliability, and security, they responded positively. The implementation of this system in medical school was convenient for both instructors and students. After the health crisis, students agreed that it should continue to be implemented.

The inference of this work has various limitations. First, the QR code system relies on the reliability of the internet; any disruption would impede scanning and attendance tracking. Second, when students connected to the university’s Internet address, the primary server’s location was shared. This was accomplished by requesting that students update and refresh their location information or utilize their own cellular data connection. Thirdly, our results are based on the research of a specific institution; repeating it will generalize the data. The best way to record students’ attendance is a
complex procedure that depends on their motivations, academic talents, and personalities. The study did not measure these convincing variables, which is a disadvantage.

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Author Contribution All of the authors have read and approved the manuscript.

Declarations

Conflict of Interest The authors declare no competing interests.

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