Feasibility of using QR code for registration & evaluation of training and its ability to increase response rate – The learners' perception

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A R T I C L E   I N F O

A B S T R A C T

Taking learners' attendance and obtaining an evaluation of teaching is a routine activity performed by teachers. The traditional method of taking attendance using pen and paper posed a huge challenge during the COVID-19 pandemic. This has been time-consuming as compared to pre-COVID as well as frustrating for learners waiting in a queue for their turn to sign the register. Quick Response (QR) Codes were used to complete registration to buy back the time consumed using traditional methods of registration. Learners' evaluations are used as an instrument to evaluate teaching quality. At the researcher's workplace, a traditional paper-based evaluation method has been used for decades. However, over time a significant decrease in the response rate of evaluations was noticed. The pandemic provided an opportunity of using QR Codes to obtain learners' evaluation of teaching quality. This study assessed the learners' perception of using QR Codes for registration and evaluation, and the likelihood of learners completing the evaluation surveys, thus increasing the response rate. Participants of the study were asked to complete an electronic survey to help assess their perception of using QR Codes and a comparison was made between the responses gathered using paper-based evaluations over 5 months and QR Code evaluations over the same 5 months in the following year. The results of this study demonstrate that using QR Codes for registration and evaluation is easy and straightforward, thus increasing the likelihood of learners completing the evaluation. The comparison between paper-based and QR Code evaluations confirms that a substantial increase in response rate can be achieved by using QR Code evaluations.

1. Introduction

QR codes can be easily created that link to websites, show a geographical location, access a document or specific application. QR codes were developed by Denso Wave in 1994, initially to track car components during manufacturing. Since the evolution of smartphones with cameras, QR codes got more attraction and were applied to a wide range of commercial applications such as marketing, social media, and more recently QR codes have generated interest for their use in education, presenting an opportunity to excite and engage learners in a way the teachers were unable to thus far (Karia et al., 2019). Healthcare education is evolving rapidly to integrate new technology, ranging from virtual delivery of courses to using QR codes (Brodie et al., 2020) to access learning material, register attendance, and gather evaluations. Taking learners' attendance during each class has been time-consuming using the traditional method of signing the register (Masalha and Hirzallah, 2014). It has been more frustrating for learners; queuing and waiting for their turn to sign the register, especially when following social distance rules during the COVID-19 pandemic.

The COVID-19 pandemic has proven itself as the biggest threat in the living human memory affecting health and wellbeing and the economy (Kickbusch et al., 2020). The pandemic has affected the clinical practice within the healthcare (Koumpouras and Helfgott, 2020) and this has not been different in healthcare education and training. Where COVID-19 affected life in its entirety, it has also affected the course attendance registration process. The researcher noticed a considerable increase in time consumed for signing the attendance register as compared to pre-COVID, as well as frustration among learners. The process of obtaining physical signatures of attendees to record attendance was robbing the training time. It had become conspicuous to the researcher that there was an absolute need to find an alternative to the traditional attendance registration process. Masalha and Hirzallah (2014) recommended the use of QR codes to obtain attendance registers that convinced the researcher to pilot and evaluate this method of obtaining attendance registers. Modular Object-Oriented Dynamic Learning Environment (MOODLE) is used by the researcher's employing Trust for its electronic

learning courses. All staff members of the Trust have access to MOODLE and are familiar with using the platform. Therefore, MOODLE was used to create QR Code registers. MOODLE was given preference over other electronic registration platforms, such as Jot form and Google forms, to minimise the confidentiality breach of learners' personal data. MOODLE is purchased and used by the Trust, thus is trusted for maintaining confidentiality.

Teaching quality is paramount to delivering high-standard education that can be measured in different ways and sources (Feistauer and Richter, 2017) including electronic or paper-based evaluation forms. At the workplace of the researcher, the traditional method of paper-based evaluations has been used for decades and was the only trusted method for teachers to evaluate their performance and the course contents. The COVID-19 pandemic provided an opportunity for a different approach that reduces the risk of cross-infection, is cost-effective, and improves the learners' response rate compared to the traditional paper-based evaluations. A comparative study by Snyder et al. (2018) concluded that QR Code based evaluations were significantly associated with usability, cost-effectiveness, and time efficiency. The system also minimises the risk of cross-infection by eliminating the use of paper and pens that go into different hands and touch different places, increasing the risk of infection. Using the QR Code has dramatically increased the number of evaluations (Ramalingam et al., 2020). According to a study done by Bellot et al. (2015), creating and scanning a QR Code is easy; 83% of participants of the study agreed to the benefits of QR Code in healthcare education and were likely to use QR Code technology in the future. Considering the challenges to using traditional paper-based evaluations and the highly recommended usability of QR Code linked evaluations for being easy and quick, allowing faster completion of forms than paper, the researcher decided to use QR Codes to collect evaluations at the end of training.

2. Methodology

After considering the use of QR Codes, the researcher submitted a paper to the People Development Cabinet (PDC) which includes Deputy Director Training and Education – the chair of Cabinet and senior managers within the Trust asking for their approval to pilot QR Codes for course registration and evaluation, and conduct a study to assess the perception of using QR Codes among the learners. The paper was approved by the PDC.

Studies show that the perception of learners is a stronger predictor of effectiveness and outcomes of tools and/or strategies used in the training and education (Shrestha et al., 2019). It was noticed that over time the response rate of evaluations was hugely decreased and the survey forms were not completed properly. Therefore, there was a need to implement a new system that can accelerate the response rate and encourage the learners to complete the survey form properly in a timely fashion. The researcher took this opportunity to use the QR Code application to gather evaluations to find if there was an increase in response rate.

A mixed-method design was employed for this study to investigate the following hypotheses;

1. The course registration and evaluation using QR Code is easy and straightforward.
2. The use of QR Code affects the likelihood of learners completing the evaluation.
3. The use of QR Code increases the evaluation responses as compared to the traditional paper-based collection of evaluations.

The study was conducted over 5 months that recruited 570 attendees, including men ($n = 75$) and women ($n = 495$), of different courses: non-medical clinical induction, blood transfusion, administration of intravenous drugs and infusions, central vascular access devices, venepuncture, and peripheral cannulation, Standards for Students' Supervision and Assessment (SSSA) training, intravenous drugs and infusions calculations workshop and manual measurement of blood pressure and catheterisation. The study participants were from different professional backgrounds including registered nurses, midwives, operation department practitioners, allied health professionals, and healthcare support workers. Participants were made aware of the study and that their responses to the questions would be anonymised and used to investigate the hypotheses.

The COVID-19 pandemic has brought most of the conventional researches to a standstill, due to the need to socially distance and widespread lockdown, hence this promoted survey-based researches (Gaur et al., 2020). Surveys are considered a well-established tool to collect quantitative and qualitative data. Since 1986, there has been a shift from traditional survey methods of using in-person or telephone interviews and paper-based surveys to web-based surveys. Web-based surveys are becoming increasingly common in research, because they allow rapid development and administration, fast data collection and analysis, low cost, and fewer errors in data entry as compared to paper-based surveys (Maymone et al., 2018). Surveys are valued methods to collect data pertaining to individual self-report about their opinions and satisfaction (Gaur et al., 2020). Considering the benefits, a web-based survey was used to collect data. The survey was developed and administered using MOODLE with the opportunity for the learners to scan the QR Code and complete the survey using a smartphone or tablet. To make it equitable for staff to use QR codes, iPads were provided if they did not own a smartphone. Questionnaires, being the most common survey modality for data collection, were used to collect quantitative and qualitative data.

For hypotheses 1 (H1) and hypothesis 2 (H2), rated multiple-choice questions were asked to obtain quantitative data, and participants were asked to write further comments to support their selection to collect qualitative data. To investigate H1 'The course registration and evaluation using QR Code is easy and straightforward,' the responses for participants to choose were; (1) Strongly Disagree, (2) Disagree, (3) Agree, and (4) Strongly Agree. Along with these choices, the participants were provided free text space to write their comments to support their choice. For H2 'The use of QR Code affects the likelihood of learners completing the evaluation', the choices were; (1) less likely to complete, (2) No change – wouldn't do it anyway, (3) No change – would do it either way and (4) More likely to complete. A free-text box was provided to write further comments to support their choice. These multiple-choice survey questions and further comments to support the selection of respondents' choice, elicit the same and/or similar response that supports the reliability of the survey. According to Gaur et al. (2020), reliable surveys pose questions in a manner that evokes the same or similar responses from responders, regardless of the construction of the questions. The web-hosted survey gives assurance of its reliability having the advantage of storing data that bypasses the manual input, thus reducing data entry errors (Maymone et al., 2018).

To investigate the hypothesis 3 (H3) 'The use of QR Code increases the evaluation responses as compared to the traditional paper-based collection of evaluations', all attendees of the courses over the 5 months were given QR Code evaluations and the number of responses was compared to the total number of paper-based evaluations distributed and responses received over the same 5 month period of the previous year. The distributed number of paper-based evaluations and responses were counted retrospectively from the Trust's records for the previous year, because the study was not planned at that time. Therefore, the attendees of courses completing the paper-based evaluations were not aware of the study. Three courses from the aforementioned list; blood transfusion, SSSA Training, and Intravenous drugs and infusions calculations workshop were excluded from the investigation of this hypothesis as they were not run during the period of 5 months when paper-based evaluations were distributed. A total of 520 participants were given QR Code evaluations and 508 participants were given paper-based evaluation forms.

3. Data collection and analysis

After completion of the prescribed timeframe for data collection, the data analysis functionality of MOODLE was used to pull the data from all responses and analyse the results. This functionality anonymised the data and gave the number of total respondents and number of total responses for each of the four selections of rated multiple-choice questions and free-text responses. The data was then exported to Microsoft (MS) Excel to analyse and convert this to the percentage of responses for each selection of rated multiple-choice questions. MOODLE exported free-text data to a separate cell for each response. The next step was to analyse and synthesise the free text (qualitative) data. Thematic analysis was used to synthesise the qualitative data to develop analytical themes (Young and Waddell, 2016). This approach is often used by primary research as a method to identify themes and to analyse and interpret these themes to contribute towards hypotheses investigation (Clarke and Braun, 2017). Thematic analysis is sufficiently efficient and flexible to allow interpretation required by a qualitative research (Walters, 2016). Thematic analysis despite its flexibility and wider use, presents a unique challenge as identifying themes is the most difficult task due to the intuition involvement; there is not enough practical explanation about developing a theme (Vaismoradi et al., 2016). However, the thematic analysis provides a systematic element to data analysis and is considered the most appropriate methodology for qualitative research that supports or rejects the hypotheses using an interpretation that allow the researcher to determine the concepts and relate them to the hypothesis to reach a conclusion (Alhojailan and Ibrahim, 2012). A theme is the main product of data analysis which is a kind of agreement that is more concise, accurate, simple, and short as compared to the whole text from where the theme is extracted (Javadi and Zarea, 2016). Analysing the information in the main text is a complex process which demands a huge amount of work involving repeatedly going through the text to find the themes. However, the thematic analysis provides an accessible and systematic approach to generating codes from the qualitative data. Codes are building blocks for themes that capture relevant features of data potentially viable for investigating the hypotheses (Clarke and Braun, 2017). A computerised software 'NVivo' was used to create codes and then these codes were categorised into potential themes. NVivo automatically counts the number of times a category is referred to within the main text (Jugder, 2016).

To investigate H3 'The use of QR Code increases the evaluation responses as compared to the traditional paper-based collection of evaluations', data was collected retrospectively from the Trust records for the time period when paper-based evaluation forms were given to the participants. The number of total participants was manually counted from the paper-based registers which were scanned and saved in a shared drive folder with the dates of study days. In the same way, total responses were manually counted. The QR Code evaluations were simultaneously added and stored to the MOODLE platform without manual input, thus reducing the data error. The total number of participants was pulled from the QR Code registers and the total number of responses from QR Code evaluations hosted on the MOODLE. This data was exported to MS Excel sheet. MS Excel was used to convert the data into percentages to compare if there was a percentage increase in evaluation responses using QR Code evaluations.
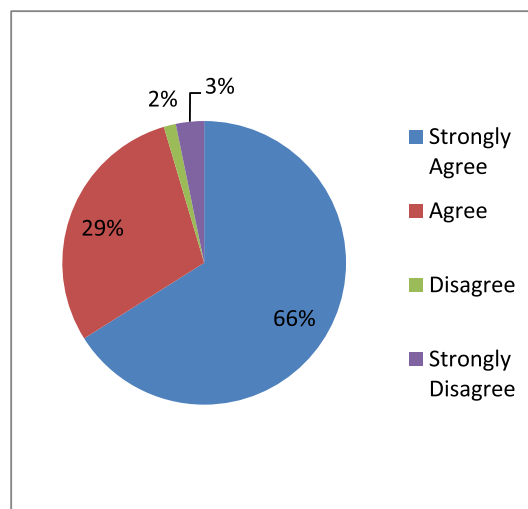
4. Results

To investigate H1 and H2, the survey was distributed to 570 attendees of different courses; 436, including men ($n = 59$) and women ($n = 377$), completed the survey. For each course, the number of participants and their responses were exported to MS Excel, where these responses were converted to percentages for easy interpretation and using the data to investigate hypotheses. Table 1 and Fig. 1 show the data and its conversion to percentage based on each response for H1. Table 2 and Fig. 2 show data and its percentage for H2.

Table 1
Tabulated responses for testing H1: The course registration and evaluation using QR Code is easy and straightforward.

The course registration/ evaluation using QR Code is straightforward?	Total responses	Strongly agree	Agree	Disagree	Strongly disagree
Non-medical clinical induction	186	121	57	3	5
Blood transfusion	6	4	1	1	0
IVI study day	65	40	24	1	0
CVAD study day	14	12	2	0	0
Venepuncture & cannulation	89	61	21	1	6
SSSA training	3	3	0	0	0
IVI workshop	13	10	1	0	2
PSA workshop	16	8	7	0	1
Catheterisation	35	22	13	0	0
Manual BP	9	7	2	0	0
Total	436	288	128	6	14

Fig. 1. Results for testing H1 as percentages.

Table 2
Tabulated responses for testing H2: The use of QR Code affects the likelihood of learners completing the evaluation.

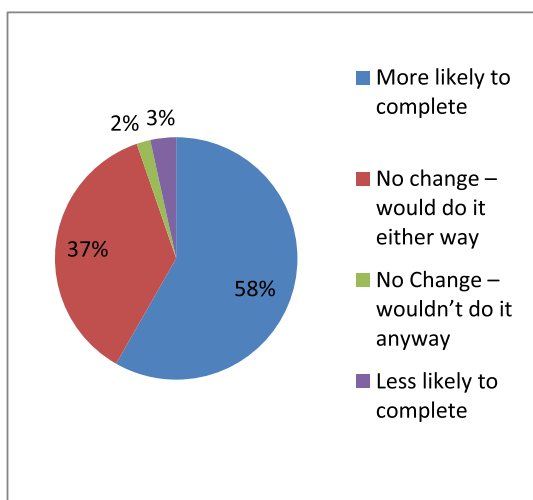| Does the electronic method affect the likelihood of you completing the evaluation?	Total responses	More likely to complete	No change – would do it either way	No change – wouldn't do it anyway	Less likely to complete
Non-medical clinical induction	186	113	65	4	4
Blood transfusion	6	3	2	0	1
IVI study day	65	37	24	2	2
CVAD study day	14	9	5	0	0
Venepuncture & cannulation	89	52	33	1	3
SSSA training	3	1	2	0	0
IVI workshop	13	6	3	1	3
PSA workshop	16	8	8	0	0
Catheterisation	35	20	13	0	2
Manual BP	9	5	4	0	0
Total	436	254	159	8	15

Fig. 2. Results for testing H2 as percentages.

To investigate H3, 'The use of QR Code increases the evaluation responses as compared to the traditional paper-based collection of evaluations', 508 participants of different courses over 5 months were given paper-based evaluations and 520 participants were given QR Code evaluations for the same courses over the same 5 month period of the following year. For paper-based evaluation (Table 3), only 268 participants completed and returned the evaluation form. Whereas, using QR Code evaluations (Table 4), 467 participants completed the evaluations which were simultaneously stored on MOODLE.

5. Analytical themes

The following four overarching analytical themes were identified while analysing the qualitative data obtained from the submitted surveys.

5.1. The use of QR codes for registration and evaluation is excellent, efficient, easy, and straightforward

This theme reflects the perception of learners; what they think about using this method of registration and completion of evaluations at the end of a course they have attended. A vast majority of respondents evaluated the use of QR codes as an excellent and brilliant tool that is easy and straightforward to use. The respondents said that this does not require someone to be a technology expert, but is absolutely easy to manage if they have the right equipment, such as a mobile phone or a tablet with the ability to scan the code, and it is a way forward. Scanning the QR Code instantly redirects to the page for submission of the enrolment key, provided by the teacher, to complete the registration and for evaluation to the questionnaire page. However, 1.29% of the entire

Table 3
Paper-based evaluation responses over 5 months.

Course	Number of attendees	Number of responses received	Responses %
Non-medical clinical induction	150	71	47%
IVI study day	107	37	35%
CVAD study day	40	18	45%
Venepuncture & cannulation	97	60	62%
PSA workshop	73	61	84%
Catheterisation	38	18	47%
Manual BP	3	3	100%
TOTAL	508	268	53%

Table 4
QR code evaluation responses over the same 5 month period in the following year.

Course	Number of attendees	Number of responses received	Responses %
Non-medical clinical induction	264	248	94%
IVI study day	61	53	87%
CVAD study day	14	14	100%
Venepuncture & cannulation	118	106	90%
PSA workshop	19	13	68%
Catheterisation	34	24	71%
Manual BP	10	9	90%
TOTAL	520	467	90%

text from all responses is not in agreement with the system being easy and straightforward and argues that scanning the code seems to be confusing for some people if they are not hands-on with technology. However, instructions in the form of a step-by-step guide were provided to ensure that novice users could successfully register and complete evaluations on the first attempt at using QR codes. The application is cost-effective, as compared with paper forms and supports the Global green agenda.

5.2. Scanning the QR code at the end of a course encourages completing the evaluation that can be done from anywhere and at any time, enabling more learners to complete the evaluations

57.78% coverage of the entire text of all gathered responses has generated this theme. Scanning the QR Code enhances the accessibility of the evaluation questionnaire which can be accessed from anywhere and at any time. This can be even completed at home or on the way out of the classroom after finishing the training, rather than staying behind to complete the evaluation and handing it over to the teacher. The QR Code is displayed at the end of a classroom session to prevent the learners from forgetting to complete the evaluation. Thus, it is a prompt and therefore completion of the evaluation is much more likely. However, 5.28% coverage of the entire text reflects that some people are more likely to complete paper-based evaluations.

5.3. QR code registration and evaluation saves time and is essential for continuous improvement

This theme was merged while coding the survey data. The use of QR Codes for registration and evaluation is not only easy and straightforward, but is also a fast and efficient system that saves time for enrolment and evaluation. This encourages more learners to complete the evaluation, which is essential for continuous improvement.

5.4. Using QR code is safe and efficient in preventing cross-contamination

This was another unintentional merging theme, which recommends the use of QR Codes to improve the safety of fellow learners and teachers by taking away paper registers and evaluations especially during the COVID-19 pandemic. This method of registration and evaluation reduces the possibility of cross-contamination, as compared to signing a paper-based register and passing it on to the next learner to sign. There is a similar risk of cross-contamination when completing the paper-based evaluation and handing it over to the teacher.

6. Discussion

The study examined the feasibility of using QR Codes to complete in-class registration from learners' perspective and the increase, if any, in the likelihood of learners completing the evaluations, thus increasing

the evaluation response rate as compared to the traditional paper-based evaluations. The results are in favour of the hypotheses. QR Codes are versatile and novel tools for improving the classroom experience in a fast, easy and fun way to engage learners (Crompton et al., 2011).

In response to the questionnaire posed to investigate H1, results show that participants strongly agreed that using QR Codes for registration is easy and straightforward. According to the results, 66% of respondents strongly agreed and 29% agreed. Although, 29% of respondents selected their response 'Agree', they are in line with H1 ' the course registration and evaluation using QR Code is easy and straightforward,' making it a total of 95% respondents in agreement with using QR Code registration. Attendance of a course can be completed easily using the QR Code application, as compared to any other attendance system (Galib and Shehjad, 2019). However, there are some barriers to using QR Codes, such as cultural background and technical knowledge, that need to be addressed (Snyder et al., 2018). This study shows that having a good support mechanism in place, for instance, written instructions available in the classroom or sent to the learners prior to them attending the course, builds the confidence of novice users in using the QR Code application. A registration system that requires the input of a teacher every time a learner registers to the lesson, robs the class time of the learners, especially for late arrivals (Masalha and Hirzallah, 2014).

In response to the questionnaire posed for testing H2, the results show that there is an increased likelihood of learners completing the evaluations as compared to the traditional paper-based method. 58% of respondents said that they are more likely to complete the evaluations using the QR Code application, as this is a stimulant to do so when it is displayed at the end of the session. Using online feedback via QR Code is simple and less expensive, hence yielding a higher response rate and is instantly available to the teacher for a quicker analysis (Onimowo et al., 2020). Although 37% of respondents said, there will be no change as they will be completing the evaluations either way, a comparison of paper-based and QR Code evaluations shows a 37% increase in the response rate of evaluations when using QR Code application. This is a significant increase to support H3.

While analysing the qualitative data, two themes; 'QR Code registration and evaluation saves time and is essential for continuous improvement' and 'Using QR Code is safe and efficient in preventing cross-contamination', were unintentionally merged. Although they are important themes, the study was not aimed at investigating them; therefore specific questions were not asked. Thus, there was insufficient data in support of these themes to enable the researcher to conclude them as an outcome of the study. Therefore, further study is recommended to examine these themes. The perception of adopting new technology, such as QR Codes, can be affected by learners' age due to cognitive differences (Mendelson and Romano Bergstrom, 2013). This study has not considered the age of learners, thus a further study is recommended to investigate whether the age of learners influences their perception of QR Code-based registration and evaluation.

7. Conclusion

In line with the increasing use of technology in training and education, there is a need to bring all aspects of training and education under the same umbrella, including in-class registration and evaluations. To implement any innovation, acceptance among learners is an essential element. The study was aimed at learners' perception of using QR codes application. This study has concluded that using QR Codes is easy and straightforward. Course evaluations are a vital element to improve teaching, so a greater number of feedback responses gathered further aids this improvement. The use of QR Codes increases the likelihood of learners completing the evaluation surveys, thus increasing the response rate. QR Code application is easy for learners to use, hence encouraging learners to complete evaluations and yielding a higher response rate. The QR Code application's ability to instantaneously and automatically record the responses is an attractive aspect that encourages teachers to

use the application.

7.1. Limitations

This study could be improved upon by investigating the impact of additional variables which could factor into the perception of QR code technology and its usage. Certain demographic factors could affect the perception; for instance, age. According to Czaja et al. (2006), older adults are less confident in their ability to successfully use technology as compared to young adults. However, the number of older adults using technology is increasing and is similar in numbers to their younger counterparts (Olson et al., 2011). Thus, further study into the effect of age, and possibly other demographic factors, such as gender and ethnicity, upon the perception of QR codes usage for registration and evaluation of training is recommended.

CRediT authorship contribution statement

I have revised the manuscript as advised by the reviewer's feedback. I have submitted the following files:

1. Response to Reviewer
2. Revised manuscript with changes marked in colour (green and red) and have explained in the Response to Reviewer that green is for text deleted from the original manuscript and red is the additional text.
3. Revised manuscript – a clean copy

Declaration of competing interest

I 'the author' certify that there is no conflict of interest with any financial/research/academic organisation, with regards to the contents and/or research work discussed in the revised manuscript.

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