Impact of Quick Response Code Training on Clinical Competency and Perception among First Year Nursing Students

Hanaa E. El-Sayad[1], Manal E. Fareed[2], Samah E. Masry[3]

[1, 3]*Assist. Professor of Medical Surgical Nursing,* [2] *Professor of Medical Surgical Nursing, Faculty of Nursing, Menoufia University, Egypt*

Abstract

Background: Uses of quick response codes in medical education were largely aligned to different themes. These themes involved enhancing member involvement, simulation training, and just-in-time learning. **Aim:** To determine impact of quick response code training on clinical competency and perception among first year nursing students. **Design**: A quasi-experimental design (study-control) was used. **Setting:** The study was conducted at clinical laboratory skills and the lecture hall for the first year nursing students in Faculty of Nursing-Menoufia University. **Subjects**: A convenient sample of 640 first year nursing students who were enrolled in first semester of Fundamental nursing course in 2022-2023. **Tools:** four tools were utilized (1) structural interviewing questionnaire, (2) Nursing students' knowledge sheet, (3) students' perception of QR code learning, and (4) observational checklist using competency. **Results:** 0.3% and 1.2% of study and control groups respectively had good knowledge level at pre QR code training that were highly significantly improved among study group to 86.6% compared to 9.4% of control group post QR code training. Also; there were significant improvement of the mean scores of perception and clinical competency level of vital signs among study group compared to control group post QR code training. **Conclusion:** there was a significant improvement of knowledge level about QR code learning, students' perception of using QR Code in their studying activities and they had more competent performance after QR code training. **Recommendations:** Developing QR codes for different units of nursing curriculum to make learning more expressive, interesting and less time consuming as well as replication of the study on other activities using greater sample to allow for generalizability of results.

Keywords: Quick Response Code training, Clinical competency, Perception, First year nursing students.

Introduction

Today teachers are challenged with remodeling teaching strategies because the advancement of information technology had delivered a lot of innovative educational approaches. Innovative teachers collaborating learning experiences with technology to go along with the modern generations of students who grew up in media-saturated in order to excel them academically. Students favor manipulating information using smartphone applications and removing from the traditionally "teacher-centered" learning methods (**Škobo, 2020).**

One of innovative technology is the utilization of Quick Response (QR) codes with smart phone. An extensive data, such as texts, links, and websites can be accessed by scanning QR codes' images. Students appreciate QR code as a direct and quick way for obtaining a desired material because it can increase their participation, confirm information and encourage learning (**Al-Emran et al., 2021**).

QR code acquired a greater desirability and was used to an extensive series in commercial applications and it has generated attention for its usage in education lately. Healthcare education is developing quickly to incorporate novel technology, fluctuating from virtual provision of courses to using QR codes to access learning material especially after COVID-19 pandemic (**Karia et al., 2019; Brodie et al., 2020 & Masih, 2022**).

The usage of QR codes can help students to attain a better perception of the course content, enrich their knowledge, and understand concepts. Also teachers listed among the advantages of QR codes, the easy and short-time preparation, portability, updated capability, time saving, prevention of paper waste and the provision of immediate access to targeted information. QR codes have unlimited impending in education as they are vehicle for many creative ideas and as students find them interesting in comparison to their otherwise routine exercises **(Chee & Tan, 2021).**

Smart phone applications have widely used in medicine as a method of disseminating information. They were designed for medical or nursing students. QR code is an application option of mobile technologies which have more advantages. One of these advantages is a scheme which creates routing practice with a different process, Quick response codes were involved in a Medical Surgical lectures to suggest a method to incorporate technology into the classroom to deliver learners with fast ongoing clinical education keeps up the significant opportunities offered by mobile-learning **(Onimowo et al., 2020 and Güleç & Çoklar 2021).**

It was reported that the students' perceptions toward smart phone applications as quick response codes in education was positive. Also it was found that QR codes can be motivating especially when its activity was well-planned, organized and the technology was functioning well. Educators can really make the most out of QR codes technology or future developments of this type of technology with mobile devices to enrich knowledge acquisition **(AlNajdi, 2022).**

QR code in higher education contributes to enhance and improve student's competency. Competency plays a crucial role for providing safe patient's care through confirmation of nursing skill and knowledge. In order to power technology and maximize mobile resources, a method for electronic competency validation was established. Use of quick response code allows for easy application and efficient training which results in cost savings, time management,

and overall perception **(Coughlin, 2023 & AlNajdi, 2022).**

Inclusion of technology within nursing education has been suggested by numerous governments. Moreover the American Association of Colleges of Nursing involved in their educational requisites the need for nursing informatics competencies to be included in courses that will enhance students' knowledge and skills to enhance safe and effective patient's care. Now, the majority of students have a mobile device. The use of mobile devices that show rapid development is increasing, students now benefit from mobile devices for social and academic purposes **(Al-Emran et al., 2021).** So the researchers want to determine the impact of quick response code training on clinical competency and perception among first year nursing students.

Significant of the study

A lot of teachers in university hope to improve their students' achievement and perception. However, traditional method of doing so is very difficult and time consuming. So a need for a technology to bridge these gaps is becoming obvious in the quickly moving world. The development and implementation of quick response code, to leverage student interaction in the classroom, enhance the connectivity between the teacher and the students by giving them a chance to view and manipulate their practice several times. Thus, QR code may benefit the teachers as well as the students and improve the delivery of lectures and clinical work by getting a timely feedback and by automatically analyzing student's answers **(Nur, 2020).** So the aim of this research was to determine impact of quick response code training on clinical competency and perception among first year nursing students.

Aim of the study

To determine impact of quick response code training on clinical competency and perception among first year nursing students.

Hypotheses:

1.Students who participate in a quick response code training (study group) will have higher knowledge level than those who participate in traditional training (control group).

2.Students who participate in a quick response code training (study group) will experience higher level of perception toward quick response code training than those who participate in traditional training (control group).

3.Students who participate in a quick response code training (study group) will have better competency score than students who participate in traditional training (control group).

Subject and methods

Research design:

A quasi-experimental design (study-control) was utilized in the current study.

Setting:

The study was conducted at both clinical laboratory skills and the lecture hall of first year nursing students in Faculty of Nursing - Menoufia University.

Sampling:

A purposive sample of all newly first year nursing students (713) who were admitted to Faculty of Nursing, Menoufia University, enrolled in Fundamental nursing course of the academic year 2022-2023 throughout first semester and met the inclusion criteria was recruited in this study. Seventy one students were excluded for pilot study and two students refused to participate, so the final student's number was 640 students. The students were chosen according to the following criteria:

• The newly first year nursing students.

• Have smart phone connected to internet as well as QR code reader instillation program on their phone.

They were divided alternatively and randomly into two equal groups, 320 for group I (study group) and 320 for group II (control group).

• Group I (study group): Exposed to the quick response code training.

• Group II (control group): Exposed to the traditional lecture training.

The researchers trained the two groups about unit of vital signs and randomly assign students to either the quick response code group or the traditional group (see Figure 1).

Figure 1: **Subjects map**
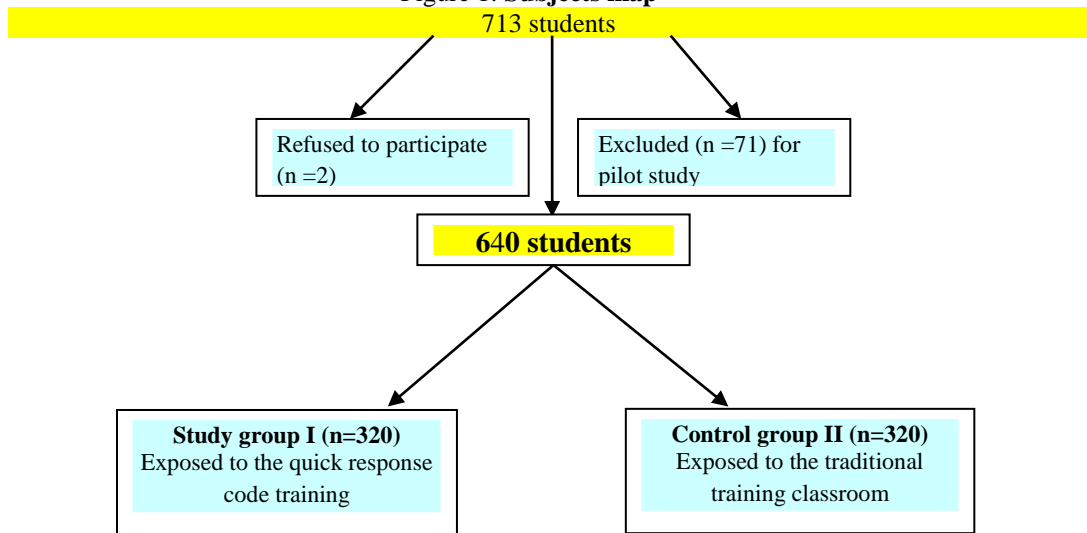
Tools of data collection:- four tools were used:

Tool one: Structural interviewing questionnaire: It was developed by researchers to assess basic students' personnel data such as: age, gender, residence and previous training about mobile website quick response (QR) code

Tool two: Nursing Students' knowledge sheet: It was developed by the researchers in an English language after reviewing the related literatures (AlNajdi, 2022; Ruth et al., 2022; and Abdel-Salam, 2018). It includes two parts:

- **Part (I): Nursing student's knowledge about mobile quick response (QR) code learning:** It was used to assess nursing students' knowledge regarding mobile website QR learning. It included five questions about definition, reasons for using and benefits of mobile website QR learning as well as types of devices and difficulties facing mobile QR learning application.

- **Part (II): Nursing students follow up activity regarding vital signs:** It was designed by the researchers to assess students' knowledge regarding theoretical part of vital signs unit. It consists of 10 questions such as vital signs' normal range, core temperature, breathing abnormalities, sites of measuring pulse and appropriateness for measuring blood pressure. The questions were in the form of multiple choices and complete

Scoring system: The researchers gave 2 scores for correct and complete answer, 1 score for correct and incomplete answer and 0 for wrong or unknown answer. All scores for each part were summed, and then the total score was converted into percent score and was categorized as follow:

- Good → > 75% of the total score
- Fair → ≥ 60% - 75% of the total score
- Poor → < 60% of the total score.

Tool three: Students' perception of QR code learning: it was developed by the researchers after reviewing related literature (Mavropoulou & Galani, 2022; Abdul Rabu et al., 2019) to assess students' perception toward QR code learning. It consists of four parts of 17 items as following:

- **Part (I): Easiness for using QR code learning:** It consists of five items as easy to access to website, easy to scan QR codes, easy to learn how to scan QR codes using mobile device, sufficient speed of scanning a QR code and simplicity and convenience QR code for use.

- **Part (II): Usefulness of QR code learning:** It consists of four items as usefulness to access the QR codes outside the classroom, its information helping to complete the activities, provided access to a variety of useful information, and useful in solving the problems in the worksheets.

- **Part (III): Attitude about QR code learning:** It consists of four items as it is a good idea to use QR code to support learning activities, QR activities are very interesting way to learn, enjoying interacting with the QR activities, and positive feelings toward using QR codes in the classroom.

- **Part (IV): Intention for use of QR code learning:** It consists of four items as would like to do QR activities again, intent to use QR codes in the future, encouraging other students to use QR codes to support in-class activities, would like for the QR codes activities to be part of the curriculum.

Scoring system: A five point Likert scale was used by the researchers. It ranges from 1 (strongly disagree) to 5 (strongly agree). The researchers summed the total scores of each student in which the higher the score, the higher students' perception. Finally the researchers converted the total score into percentage score and student's perception was scored as follow:

- Very high → ≥ 80%
- High → ≥ 60% - <80%
- Moderate → ≥ 50% - < 60 %
- Low → 20%- < 50%
- Very low 0- <20%

Tool four: Observational checklist using competency:

It was developed by Medical Surgical Department staff of Faculty of Nursing - Menoufia University (2023) based on competency to assess students for their clinical performance competencies regarding vital signs unit. It included two procedures: TPR (body temperature, pulse and respiration) and blood pressure. TPR checklist consists of 20 step items (each of them was given 0.5 mark if student performed it correctly and zero was given if step was performed incorrectly or not done). Blood pressure checklist consists of 10 step items (each step was given 1 mark if student performed it correctly and zero was given if step was performed incorrectly or not done). All marks of both procedure (TPR and blood pressure) were summed up. According to the actual students' performance, their total level of performance competency (20 scores) was categorized as either:

• Low A= 0 (unable to perform , less than 10)
• Basic B=1 (limited ability, needs significant help from 10 to <14)
• Proficient C=2 (proficient capable and experienced, needs no assistance to complete the task from 14 to < 18)
• Expert D=3 (fully capable and experienced from 18 to 20)

Method

An official permission was obtained from ethical and research committee of the Faculty of Nursing, Menoufia University.

A written permission to carry out the study was obtained from the Dean of Faculty of Nursing, Menoufia University and the head of the Medical Surgical Nursing Department after explaining the aim of the study.

Tools development

The initial three tools were created by the researchers after reviewing the appropriate literature; while the fourth tool was created by Medical Surgical Department staff of Faculty of Nursing, Menoufia University (2023). All tools were tested for content validity by five experts specialized in Medical Surgical Nursing to ascertain relevance and completeness. Then these tools were tested for reliability by using a test- retest method and Pearson correlation coefficient formula was used. It was found to be 0.91 for tool one, 0.89 for tool two, 0.87 for tool three and 0.92 for the last tool. Modifications were done accordingly.

Ethical consideration:

A written approval was obtained from Ethical and Research Committee of the Faculty of Nursing, Menoufia University (No.995). A clear and simple explanation about the nature and aim of the study was given to each student of academic first year nursing students then a written consent was obtained from each student to get his/her acceptance as well as cooperation. All participant students were assured about confidentiality of the results. Also they were told that they have the right to withdraw from the study at any time without any effect on their learning or grades.

Pilot study:

Preceding to the actual study, a pilot study was conducted on 10% of the study sample (71 students) to examine study tools for its precision, feasibility, and applicability. Important adjustments were carried out consequently so students who participate in the pilot study were omitted from the actual study sample.

Data collections

• Data were collected over four weeks from half of November to half of   December 2022.
• Students who agreed to participate in the study and fulfill the inclusion criteria were randomly and alternatively divided into two equal groups. 320 students for each group (study and control groups).
• Students' personnel data, knowledge and perception of QR codes among both groups were assessed by shared link created by researchers through online Google form and sent to students via telegram group at pre intervention using tool one, part (I) of tool two

and tool three. The researchers waited about 3 days to complete student's assessment.

• The researchers prepared a follow up activity that covered the vital signs unit and distributed it through face to face to all students of both groups in first year classroom to assess their academic knowledge about vital signs pre QR code training or traditional training. It took about 15 minutes.

• The researchers follow the teaching plan of Medical Surgical Nursing department in which all first year students were divided into four groups as a result of their large number. Theoretical part of vital signs conducted within two weeks in four consecutive days for all groups (each group took two hours for TPR and another two hours for blood pressure) in the Fundamental lecture hall. It took about two hours for each day.

• Demonstration and re-demonstration were carried out for all students of both groups in two sessions in the affiliated nursing laboratory, one session for TPR and another session for blood pressure. The time of each session was about two hours.

• Four QR codes about vital signs were prepared by the researchers; two codes for TPR and the other two codes for blood pressure to help students of study group to scan QR codes to replay vital signs' clinical procedure videos several times as needed.

• The researchers guided all students of study group for utilizing QR codes (online activities) to navigate the clinical procedures videos related to vital signs unit.

• The four QR codes were copied in students' electronic book on top of page of vital signs unit to be accessible at anytime and anywhere for all students of study group.

• After two weeks when completing the required credit hours of training clinical procedures vital signs unit, all studied students of both groups were assessed by the researchers for their knowledge and perception about QR codes using the prepared shared link through online Google form and sent to students via telegram group at post QR code training. Part (I) of tool one and tool three were used. It took about 3 days to be finished.

• After two weeks when completing the required credit hours of training clinical procedures vital signs unit, students' knowledge

of vital signs was evaluated at post QR code training for both groups via face to face follow up activity in their classroom by using part (II) of tool two. It took about 15 minutes.

• All studied students of both groups were evaluated for their performance competency by using competency observational checklist (tool four). It took about five minutes for each student of both groups.

• A comparison was done between both groups to determine **i**mpact of quick response code training on clinical competency and perception among first year nursing students.

Results:

Table (1): Reveals the mean age of study and control groups was 18.16 ± 0.46 and 18.22 ± 0.63 years respectively. About half of both groups were female (55% for study group and 49.1% for control group). Majority of them were from rural area (88.8% and 82.5% respectively).

Table (2): Reveals that pre- QR code training, the mean total knowledge score for study group was 3.81±1.55 compared to 3.65±1.52 for control group. While post- QR code training there was highly significant improvement of mean total knowledge score for study group (8.93±1.19) compared to 4.92±1.72 for control group. There was highly significant improvement of all items of knowledge level among study group than control group post QR code training.

Figure (2): Shows that pre QR code training, the minority of both groups (0.3% and 1.2% respectively) had good total knowledge level. While post QR code training, majority of study group (86.6%) compared to 9.4% of control group had good total knowledge level. There was highly significant improvement of total knowledge level among study group compared to control group post QR code training (p<0.001)

Table (3): Reports that there was highly significant better total knowledge level among study group than control group post QR code training in which 56.9% of study group had good knowledge level compared to 25.6% of control group.

Table (4): Presents that there were non-significant differences between study and control groups' pre QR code training regarding subtotal and total mean scores of perception of QR code learning. While post QR code training there were highly significant improvement of total and subtotal mean

scores of perception among study group than control group.

Table (5): Reports almost none of both groups had very high total perception level regarding QR code learning pre-training (0% for study group and 0.9% for control group. While post training there was highly significant increase among study group (93.1%) than 1.6% among control group for very high perception total level.

Table (6): Shows that there was highly significant better total clinical competency level of TPR and blood pressure among study group than control group post QR code training in which 82.2% of study group had expert level of clinical competency compared to 35.3% of control group.

Figure (3): Shows that there was significant positive correlation between study group students' total knowledge about QR code learning and their perception pre-QR code training (P value= 0.02).

Figure (4): Shows that there was highly significant positive correlation between study group students' total knowledge about QR code learning and their perception post QR code training (P value 0.009).

Figure (5): Shows that there was highly significant positive correlation between students' total knowledge about vital signs and their clinical competency post QR code training (P value <0.001).

Table (1): Distribution of the studied students regarding personal data (n=640)

Personal data	Studied groups				Test of significance	P value
	Study group (n=320)		Control group (n=320)			
	No.	%	No.	%		
Age (years):						
Mean ±SD	18.16 ± 0.46		18.22± 0.63		**t- test**	0.15
Range	17.0 – 20.0		17.0– 23.0		= 1.42	
Gender:						
Male	144	45.0	163	50.9	χ^2	0.13
Female	176	55.0	157	49.1	= 2.26	
Residence:						
Rural	284	88.8	264	82.5	χ^2	0.02
Urban	36	11.2	56	17.5	=5.07	S

t= student t- test   S: significant (P value > 0.05)
NB: All studied students of both groups did not receive previous training about mobile website QR code

Table (2): Distribution of subtotal knowledge level about QR code learning among studied students pre and post QR code training versus traditional training (n=640)

Student's total and subtotal knowledge level about QR Code learning	Studied groups						χ^2	P value
	Study group (n=320)			Control group (n=320)				
	Wrong/ Unknown No (%)	Correct & incomplete No (%)	Correct &complete No (%)	Wrong No (%)	Correct & incomplete No (%)	Correct &complete No (%)		
Definition								
Pre-QR code training	286 (89.4)	0 (0.0)	34 (10.6)	264 (82.5) 217 (67.8)	0 (0.0)	56 (17.5)	6.25	0.01 S
Post-QR code training	28 (8.8)	0 (0.0)	292 (91.2)		0 (0.0)	103 (32.2)		<0.001 HS
Reasons for using								
Pre-QR code training	91 (28.4)	191 (59.7)	38 (11.9)	95 (29.7) 46 (14.4)	207 (64.7)	18 (5.6)	7.87	0.02 S
Post-QR code training	3 (0.9)	44 (13.8)	273 (85.3)		212 (66.2)	62 (19.4)	280.88	<0.001 HS
Benefits								
Pre-QR code training	56 (17.5)	226 (70.6)	38 (11.9)	60 (18.8) 29 (9.1)	235 (73.4)	25 (7.8)	2.99	0.22
Post-QR code training	0 (0.0)	73 (22.8)	247 (77.2)		227 (70.9)	64 (20.0)	215.73	<0.001 HS
Types of devices								
Pre-QR code training	73 (22.8)	205 (64.1)	42 (13.1)	85 (26.6) 40 (12.5)	217 (67.8)	18 (5.6)	10.85	0.004 S
Post-QR code training	5 (1.6)	76 (23.8)	239 (74.7)		224 (70.0)	56 (17.5)	213.75	<0.001 HS
Difficulties facing QR code application								
Pre-QR code training	60 (18.8)	224 (70.0)	36 (11.2)	68 (21.2) 34 (10.6)	227 (70.9)	25 (7.8)	2.50	0.28
Post-QR code training	0 (0.0)	75 (23.4)	245 (76.6)		229 (71.6)	57 (17.8)	229.04	<0.001 HS
Mean Total knowledge score								
Pre- QR code training Range	3.81±1.55 0.0 – 8.0			3.65±1.52 0.0 – 8.0			U= 1.66	0.09
Post- QR code training Range	8.93±1.19 5.0 –10.0			4.92±1.72 0.0 – 10.0			U= 20.31	<0.001 HS
Wilcoxon test (P value)	15.59 (<0.001 HS)			11.30 (<0.001 HS)				

S: significant   HS: highly significant   U: Mann-Whitney

Figure (2): Distribution of both studied students regarding their total knowledge level of QR code learning pre and post QR code training versus traditional training (n=640)
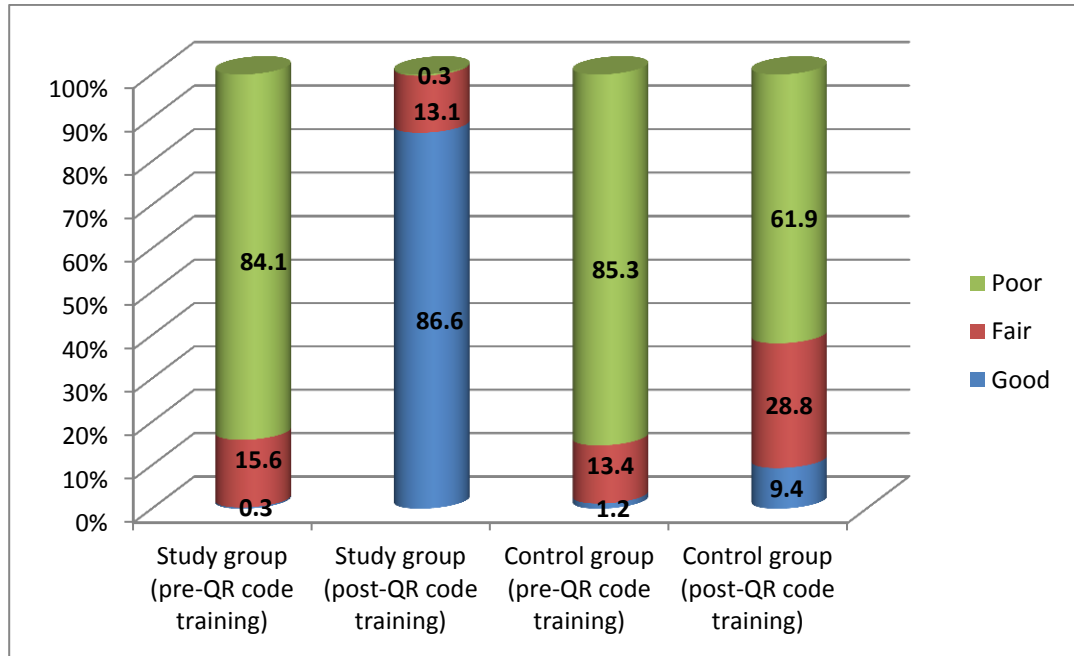

Table (3): Distribution of studied students regarding their total knowledge level about vital signs pre and post QR code training versus traditional training (n=640)

Student's total knowledge level about vital signs	Studied groups						χ^2	P value
	Study group (n=320)			Control group (n=320)				
	Good N (%)	Fair N (%)	Poor N (%)	Good N (%)	Fair N (%)	Poor N (%)		
Total knowledge score								
Pre- QR code training	0 (0.0)	10 (3.1)	310 (96.9)	2 (0.6)	16 (5.0)	302 (94.4)	3.48	0.17
Post- QR code training	182 (56.9)	63 (19.7)	75 (23.4)	82(25.6)	133 (41.6)	105 (32.8)	67.87	<0.001 HS
χ^2 (p value)	363.92(<0.001 HS)			263.41(<0.001 HS)				
	Mean ±SD Range			Mean ±SD Range				
Pre- QR code training	2.68±1.75 0.0 – 7.0			2.61±1.56 0.0 – 8.0			U= 0.74	0.45
Post-QR code training	7.42±2.06 1.0 – 10.0			6.26±1.95 0.0 – 10.0			t= 7.25	<0.001 HS
Wilcoxon test (P value)	15.20 (<0.001 HS)			14.68 (<0.001 HS)				

t= student t- test   S: significant   HS: Highly significant   U: Mann-Whitney

Table (4): Mean score and standard deviation of total and subtotal perception about QR code learning among both studied students pre and post QR code training versus traditional training (n=640)

Student's mean total and subtotal Perception score	Studied groups				Test of significance	P value
	Study group (n=320)		Control group (n=320)			
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention		
Easiness for using Mean ±SD Range	13.39±3.33 5.0 – 23.0	21.32±2.63 11.0 –25.0	13.98±3.02 8.0 – 23.0	14.33±3.55 5.0 – 25.0	t1=2.33 t2=28.26	0.02 S <0.001 HS
usefulness: Mean ±SD Range	11.10±2.88 4.0 – 20.0	17.66±1.95 11.0 –20.0	10.68±3.17 4.0 – 20.0	11.14±3.32 4.0 – 20.0	t1=1.73 t2=30.24	0.08 <0.001 HS
Attitude Mean ±SD Range	11.37±2.54 4.0 – 20.0	17.82±1.67 12.0 –20.0	11.50±2.63 4.0 – 20.0	12.14±2.93 4.0 – 20.0	t1=0.64 t2=30.0	0.52 <0.001 HS
Intention for use Mean ±SD Range	11.50±1.36 8.0 – 20.0	17.51±1.29 15.0 –20.0	11.48±1.85 4.0 – 19.0	11.87±1.85 4.0 – 19.0	t1=0.12 t2=44.58	0.90 <0.001 HS
Mean total score Mean ±SD Range	47.37±6.66 27.0 – 67.0	74.32±4.48 61.0 – 84.0	47.66±7.18 26.0 – 74.0	49.49±7.72 24.0 – 74.0	t1=0.52 t2=49.75	0.60 <0.001 HS
Paired t test **P value**	64.05 <0.001 HS		9.12 <0.001 HS			

t1= student t- test pre QR code training   **t2**= student t- test post QR code training
S: significant   HS: Highly significant

Table (5): Distribution of both studied students regarding their total perception level of QR code learning pre and post QR code training versus traditional training (n=640)

Total level of students' perception of QR code learning	Studied groups				χ^2	P value
	Study group (n=320)		Control group (n=320)			
	No	%	No	%		
Pre- QR code training**:**					4.0	0.26
• Very high	0	0.0	3	0.9		
• High	96	30.0	103	32.2		
• Moderate	162	50.6	148	46.2		
• Low	62	19.4	66	20.6		
• Very low	0	0.0	0	0.0		
Post- QR code training					544.66	<0.001 HS
• Very high	298	93.1	5	1.6		
• High	22	6.9	135	42.2		
• Moderate	0	0.0	127	39.7		
• Low	0	0.0	53	16.6		
• Very low	0	0.0	0	0.0		
χ^2 **P- value**	568.40 <0.001 HS		7.82 0.04			

HS: Highly significant

Table (6): Distribution of both studied students regarding their clinical competency level of vital signs post QR code training versus traditional training (n=640)

Student's clinical competency level	Studied groups		Test of significance	P value
	Study group (n=320)	Control group (n=320)		
	Mean ±SD Range	Mean ±SD Range		
Mean clinical competency score of TPR.	9.43±0.63 7.0 – 10.0	8.50±0.84 6.0 – 10.0	t=15.72	<0.001 HS
Mean clinical competency score of blood pressure	9.25±0.67 7.0 – 10.0	8.40±0.86 6.0 – 10.0	t=13.82	<0.001 HS
Mean total clinical competency score	18.68±1.13 14.0 –20.0	16.90±1.56 12.0 – 10.0	t=16.46	<0.001 HS
Total clinical competency level No (%)				
• Low	0 (0.0)	0 (0.0)	χ^2 =145.63	<0.001 HS
• Basic	0 (0.0)	3 (0.9)		
• Proficient	57 (17.8)	204 (63.8)		
• Expert	263 (82.2)	113 (35.3)		

t= student t- test   HS: Highly significant

Figure (3): Correlation between total knowledge of study group students about QR code learning and their perception pre-QR code training (n=640)
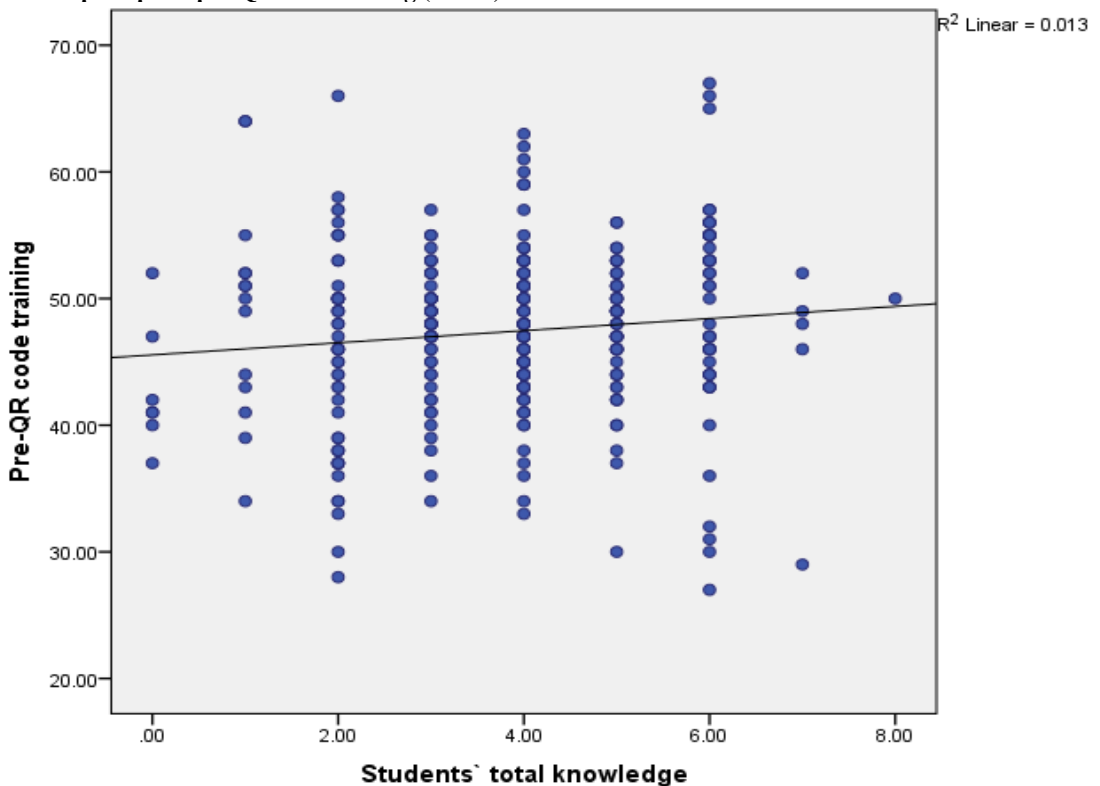
Figure (4): **Correlation between total knowledge of study group students about QR code learning and their perception post-QR code training (n=640)**
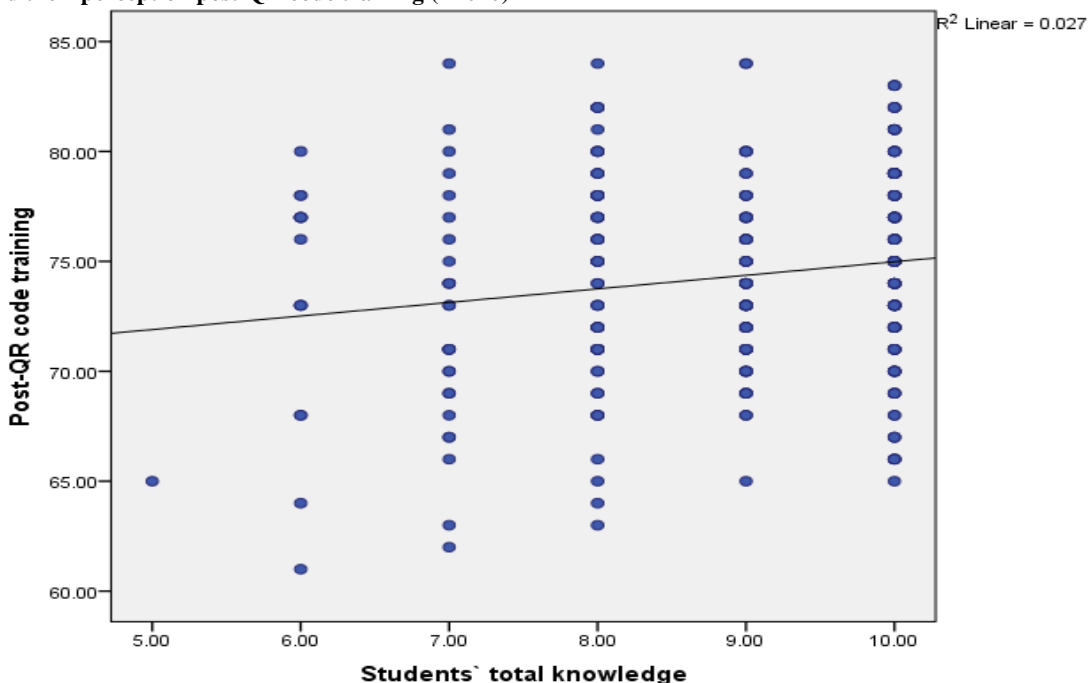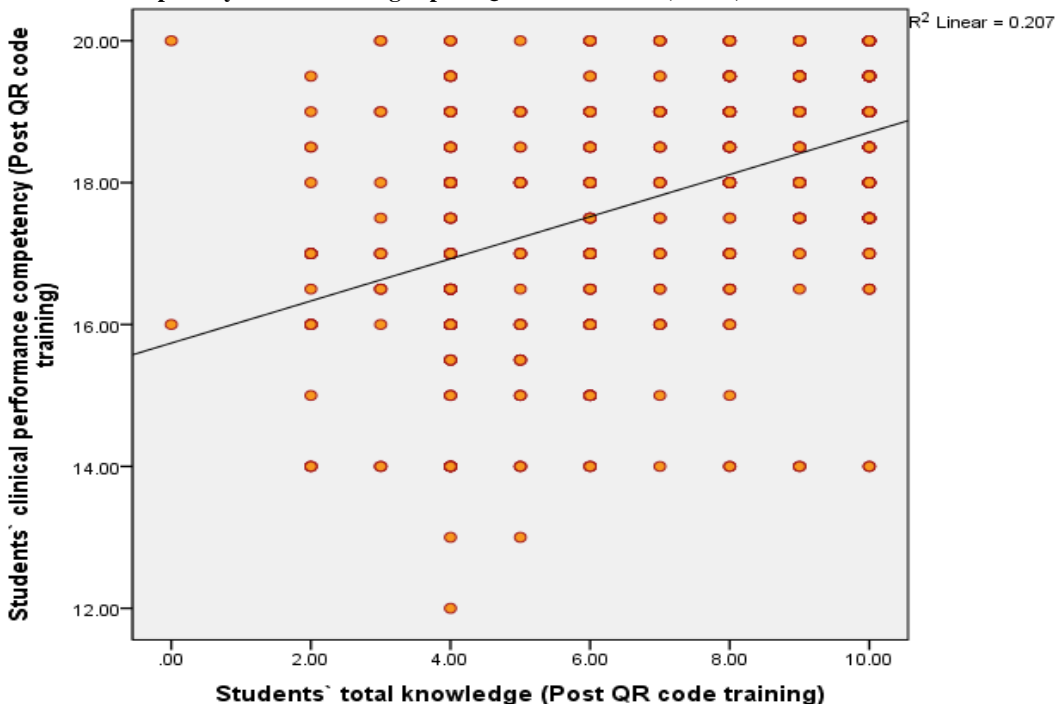

Figure (5): **Correlation between total knowledge of study group students about vital signs and their clinical competency level of vital signs post-QR code trainin   (n=640)**

Discussion

Recently nursing education has been transformed from traditional teaching to electronic based one. The use of recent technology in higher education teaching and learning is a shift in perspective from seeing it as IT infrastructure to seeing it as a space for active, digital learning. Quick response codes were used in the Medical Surgical curriculum to enhance the incorporation of technology and to actively involved students in their educational process. In higher education, perceptions towards the usage of QR codes were usually positive challenges. QR code training can enhance students' academic achievement through facilitating their active learning activities **(Mavropoulou & Galani, 2022).**

This study showed that the range of age for both studied groups was 17- 20 and 17-23 years respectively. These results disagree with **Mavropoulou & Galani (2022)** who studied "Students' perceptions for the use of QR codes in literature-theater course" and found that the age of their study participants were ranged between 18 and 25 years. Also **Abu ElEla & Fayed (2020)** studied using QR code on improving the engagement, satisfaction and learning for nursing students. They reported that a mean age of their sample was 20.47±1.34 and 20.63±1.33 for study and control group respectively. While **Abdul Rabu et al., (2019)** studied "QR code utilization in a large classroom" and stated their respondents' age was from 21–23 years. These discrepancy might be attributed to the current study's sample was limited to first year nursing students. Concerning students' gender the present findings showed that about half of the study sample was female. This was in line with **Abdel-Salam (2018)** who studied academic performance of nursing students with using QR code and reported that the majority of students were female. In the current results the majority of sample was from rural area. This may because the setting of data collection was rural governorate. This finding is in the line with **Abdel-Salam (2018)** who mentioned that around three quarters of the study participants were reside in rural area, while **Abu ElEla & Fayed (2020)** declared that the majority of the sample came from an urban region.

Knowledge level about QR code learning,

The current study's results revealed there was highly significant improvement of mean total knowledge level about QR code learning for study group compared to control group post QR code training. This may be related to the effect of QR code training that was performed by the researchers for the study group. This result agrees with **Raman (2015)** who studied "mobile technology in nursing education" and mentioned that all of the students being well-informed about using mobile web QR. Also **Abdel-Salam (2018)** stated that there was a highly statistically significant difference in knowledge score about QR code mobile learning for study group when compared to the results of the control group post intervention. These results supported the first study hypothesis.

Students' knowledge level about vital signs

Present study showed that there was no significant difference between study and control groups regarding total knowledge level about vital signs pre QR code training versus traditional training while there was a highly significant better knowledge level about vital signs among study group than control group post QR code training versus traditional training. These results were consistent with the results of **Joyce & Kellie (2017)** who studied "using quick response codes in the classroom" and explored the possibility that mobile technology could improve clinical understanding. Moreover **Mavropoulou1& Galani (2022) and Chung et al., (2019)** stated that the use of QR codes helped more than half of students to enrich their knowledge. But these findings disagree with **Wyatt (2018)** who studied "The perception of integrating QR code in associated degree nursing education" and reported no significant differences were illustrated in the mean scores of exam between study and control groups. From the researchers' perspective an improvement in clinical knowledge might be attributed to QR code was more expressive as the concepts were conveyed more deeply, which suits students who found it difficult to be actually present in the classroom

and more reasonable than a traditional classroom since it simplified learning with the enriched multimedia material. These results supported the first study hypothesis.

Student's mean total and subtotal Perception score

Regarding usefulness and easiness for using QR code, the participants in current study found QR code was easy and useful at post QR code training. Also the results revealed that highly significant improvements were existed in the mean score of easiness and usefulness of using QR code among study group than control group. This may be due to the actual training of study group about QR code learning by the researchers. This result agrees with **Zurmehly (2017)** who studied "Using Quick Response codes in the Classroom" and reported that students stated that QR codes scanning was helpful and easy than traditional textbook. Moreover **Lin (2018)** studied "using Quick response codes to increase students' participation" and stated that using QR codes in learning activities was easy and useful. Also **Mavropoulou & Galani (2022)** found the majority of students stated that QR code was useful. Additionally; **Nath & Varghese (2020)** studied "factors influencing the effective usage of QR code" and stated QR code was easy for usage among majority of respondents. Also **Sharara & Radia (2022)** studied "Quick Response codes for patient information delivery" and reported that the majority of subjects reported QR codes easy to use. From the researchers' point of view QR code fit students who find it difficult to be actually present in their classrooms and more understandable than a traditional lesson since it facilitates studying with the enriched multimedia material.

Concerning attitudes toward using QR codes and intention for using it in the future, the mean results of the present study revealed that the study group had positive attitudes toward using QR codes in the classroom and intended for using it in the future which was in accordance with **Lin (2018)** and **Abdul Rabu et al., (2019)** who stated that most participants had positive attitudes toward the use of quick response codes in case-based learning courses

and expressed their intention to use this application in the future. The rational of students' intention for using QR codes in the future in the teaching process of their courses was because it makes the course more interesting, more creative, enjoyable, interactive, modern, demonstrative, accessible and exciting. From the researchers' point of view students' positive attitude towards QR code was stimulated by their perceived usefulness and easiness for using this code.

Also the current results showed that there was no significant difference between both groups (study and control group) regarding total perception level about QR code learning pre QR code training. While post QR code training there was highly significant improvement of overall perception level of QR code learning among study group than control group. This finding was consistent **with Karia et al., (2019)** who studied "Uses of quick response codes in healthcare education" and stated a positive perceptions towards usage of QR codes. Moreover **Mavropoulou & Galani (2022)** found the use of QR codes helped majority of students to obtain a better perception of the course content. From the researchers' point of view students' perception of using QR codes for healthcare education lie in the ability to offer timely multimodal information due to ease of use, accessibility and immediacy compared to other traditional methods of accessing information. These results supported the second study hypothesis.

Students' total clinical competency

The present study revealed that there was highly significant better total clinical competency level of vital signs among study group than control group post QR code training versus traditional training which agree with the findings of **Al-Najdi (2022)** who examined the effects of using augmented reality to improve student performance, it was shown that using QR codes by students in their education having higher levels of performance than those who did not and also demonstrated that students had no technical matters in assimilating technology into learning processes. Moreover **Marcus et al., (2021)** who studied "evaluating nursing students' perceptions of using quick response

codes to enhance learning" and mentioned that Quick Response (QR) code technology provides hands-on clinical experiences and activity enhanced learning for first-semester baccalaureate nursing students. Also **Tan & Chee (2021)** studied "exploring the motivation of pupils towards the implementation of QR codes" and found out the participants' competence was well in the activity. From researchers' point of view students can scan code several times and try their best to practice their procedure and carry out the activity without the necessity of assistance from their teachers. These results supported the third study hypothesis.

The present study showed that there was highly significant positive correlation between knowledge and perception of QR code learning study group students' post- QR code training. This finding is consistent with **Wyatt (2018)** who reported that there was a positive association between student's perception of their learning with QR codes and total exam scores. Also **Yu et al., (2020)** studied "Risk perception and response toward climate change for higher education students in Taiwan" and showed that students with a lower knowledge level represent a greater challenges for their perception. Inversely, **Lounis et al., (2023)** studied "Perception and knowledge of Algerian students about climate change and its putative relationship with the COVID-19 pandemic" and found a negative relationship between knowledge and perception. This discrepancy might be attributed to different sample and nature of the study.

Moreover the present study showed that there was highly significant positive correlation between students` knowledge about vital signs and clinical competency level of the study group students' post- QR code training. These findings were in line with **Haupt & Kanzow (2023)** who studied "The relation between students' theoretical knowledge and practical skills in endodontics" and stated that students' practical skills and theoretical knowledge are significantly correlated.

Conclusion:

• There were significant improvements of total knowledge level about QR code learning, and vital signs among study group than control group post QR code training versus traditional training.

• There was a significant improvement of total perception score among study group than control group post QR code training versus traditional training.

• Students of the study group were more clinically competent about vital signs than control group students after QR code training versus traditional training.

• There was highly significant positive correlation between knowledge and perception of study group regarding QR code learning. Also there was highly significant positive correlation between students` knowledge and their performance after QR code training.

Recommendations:

1. Develop QR codes for different units of nursing curriculum to make learning more expressive, interesting and less time consuming.
2. Providing educational workshops or seminar for teaching staff to learn how to effectively integrate QR code application in teaching process.
3. Replicate the study on other theoretical and practical activities as well as with greater sample to allow for generalizability of results.

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