Effect of Virtual Reality as a Teaching Strategy on Pediatric Nursing Students' Performance Regarding Cardiopulmonary Resuscitation

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Abstract

Background: Virtual reality is an innovative technology for nursing education associated with high empirical realism and virtual reality is a computer-generated three-dimensional (٣-D) simulation that delivers a wide range of sensory information to the user to allow them to interact with objects in a virtual environment and make them feel like they are physically there. VR can be used to help nursing students develop skills in virtual hospital settings. Therefore, this study compares a convential cardiopulmonary resuscitation (CPR) training with a virtual reality (VR) training. **Aim of the study:** to evaluate the effect of virtual reality as a teaching strategy on pediatric nursing students' performance regarding cardiopulmonary resuscitation. **Research design:** A Quasi-experimental design (one-group pretest-posttest) was utilized, it is non randomized empirical interventional study typically used when testing knowledge acquisition following a teaching project on the target group or research participants is pretested. In this design, the dependent variable is measured once before and after given specific treatment. The effect of treatment is determined by measuring the difference between pretest and posttest scores. **Sample:** A systematic random sample (٨٠) of pediatric nursing students was selected from the pediatric nursing students who were studying the pediatric nursing course/third year/second semester during the academic year ٢٠٢٢/٢٠٢٣. **Tools of data collection:** Two tools were used, **tool I:** A structured interviewing questionnaire. **tool II:** Student's clinical evaluation checklist (pre/ posttest). **tool (III):** Virtual reality–teaching material usability questionnaire (posttest). **Results:** there was a highly statistical significant positive correlation between total opinions and total knowledge scores in the study group post intervention. Additionally, this table reflects that, there was a highly statistical significant positive correlation between total opinions and total practice scores in the study group post intervention. **Conclusion:** CPR training using VR is a feasible and effective training method and considering the overall learning gain, VR training is superior to the classic training. **Recommendations:** integration of VR technique in to the classic CPR training to use the advantage of both teaching techniques.

Keywords: Virtual Reality, Cardiopulmonary, Resuscitation, Nursing students.

Introduction

Recently, more innovative learning tools have been provided with the development of educational technology. In particular, the field of nursing practice is regarded as a very important process for learners to develop the ability to apply skills and expertise. Therefore, it is very important to identify which learning methods are the most effective for proficiency development to ensure the competence of graduates ***(Mantovani et al., ٢٠١٩).***

Traditional medical and nursing teaching is lecture-centric and didactic. This mode of teaching is largely based on attendance and memorization. These methods attract obvious limitations. Traditional lectures are boring, monotonous and also had an absence of standardization and realistic models which results in many students unable to master practical skills fully (***Izard et al., ٢٠١٨ & Kyaw et al., ٢٠١٩).***

Furthermore, among the practical competencies to be acquired, the most difficult to learn are those that are not easy to experience in practice and complicated to perform directly due to certain practical experiences which are essential for the safety of students to compensate for this, efforts have been made to supplement such practice through equipment that incorporates cutting-edge technology, such as using virtual reality into nursing education programs ***(Helle & Saljo, ٢٠١٩).***

Virtual reality is a forward-looking innovative simulation technique. It is a computer-generated simulation of the real or imaginary world that offers real time interaction opportunities. Special hardware, such as VR glasses and controller, allows the user to experience surroundings and situations nearly as if being really there. Because of this high level of immersion, VR is an interesting and promising new way of teaching in a medical context, and its use is quickly expanding, the user feels like a real actor and not like a spectator. Every conceivable scenario can be implemented in a virtual world via the software and offers the user numerous possibilities. VR may support both undergraduate and postgraduate medical education ***(Lessleib et al., ٢٠٢١).***

There are several advantages of utilizing VR. It boosts students' concentration, confidence, motivation, creativity and allows them to put theory into practice. It also provides them with the opportunity to practice whenever and however the student wants in a realistic environment without fear of making mistakes and harming pediatric patients. Students participating in VR simulations are more likely to become comfortable and successful in real clinical setting because learning in an applied format ***(Gurcan et al., ٢٠١٨ & Nehring et al., ٢٠١٨).***

Traditional CPR training does not allow learners to accurately grasp power, depth and frequency. VR system makes it easier for students to learn CPR, making CPR training more common. VR training includes video health education, assisted real-time interactive operation tools, learning tests and other self-learning functions. Learners can practice on their own after watching the training film. The system reverberates the learner's power and frequency through a force-sensitive model to ensure that they are properly trained. It encourages users to learn CPR skills through immersive VR settings that guide somatosensory interactions and support game-based learning ***(Yang et al., ٢٠٢٠).***

Cardiopulmonary resuscitation training using the VR technique is a feasible and effective training method, which is highly valued by nursing students**.** VR training could overcome important barriers for layperson CPR

training ***(Jaskiewicz, et al., ٢٠٢٠).*** To improve the training quality, the optimal combination of chest compression depth and rate in VR resuscitation training was proven to be an easily available vector to disseminate CPR skills. The use of simulation manikins allows feedback to be experienced by the user. Both a simulation system and VR environment could be used to create a more realistic training environment for Cardiopulmonary resuscitation ***(Semeraro et al., ٢٠١٩ & Nas et al., ٢٠٢١).***

Significance of the study:

Current guidelines state that high-level scientific evidence on the optimal CPR training method is scarce. Face-to-face CPR training has always been the gold standard, but developments in new technologies may provide rapid, easily accessible CPR training. Therefore, providing up-to-date CPR training methods for both healthcare professionals, who could improve the training quality, is of vital importance ***(Wyckoff, et al., ٢٠٢١ & Greif, et al., ٢٠٢١).***

Undergraduate pediatric nursing students must be prepared to competently and confidently perform CPR in caring of critically ill children. Students need time and opportunity to practice CPR in order to become competent. Lack of time in the practice lab and/or lack of clinical placement experience including expert feedback on performance may limit opportunities for those students to master CPR skills. Nurse educators are challenged to seek out and implement innovative teaching strategies that provide opportunities for nursing students to practice CPR while ensuring child safety **(*Smith & Hamilton, ٢٠١٥*)**.

According to the ***Resuscitation Council UK* (٢٠١٥),** it is recommends that CPR training for children should prioritize achieving effective compressions and that, feedback and prompts should be integrated into training. Virtual reality devices allow the integration of features of real patients into training to facilitate interaction and feedback, thus improving performance.

In spite of combining virtual reality with training may be a unique and valuable method to promote deliberate practice of CPR in undergraduate pediatric nursing students, its value for teaching remains underexplored, however no research about its usability in Egypt, particularly in Benha city exists. Accordingly, the researcher conducts this study to improve pediatric nursing students' performance regarding CPR by using VR and to prepare them to cope in the real emergency situations.

Aim of the Study:

This study was aimed to evaluate the effect of virtual reality as a teaching strategy on pediatric nursing students' performance regarding cardiopulmonary resuscitation.

Research hypothesis:

- Pediatric nursing students who participating in virtual reality training will have higher knowledge mean scores than the control group.
- Pediatric nursing students who participating in virtual reality training will have higher practices mean scores than the control group.
- Pediatric nursing students participating in virtual reality training will have high total opinions mean scores about virtual reality–teaching material usability.

Subjects & Methods

Research design:

A Quasi-experimental design (one-group pretest-posttest) was utilized, it is non randomized empirical interventional study typically used when testing knowledge acquisition following a teaching project on the target group or research participants is pretested. In this design, the dependent variable is measured once before and after given specific treatment. The effect of treatment is determined

by measuring the difference between pretest and posttest scores.

Setting:

The study was conducted at the pediatric nursing skills laboratory for third year/ Faculty of Nursing/ Benha University. The laboratory is placed in the fourth floor at the Faculty of Nursing and it contains all the required equipment as (hard surface, doll of CPR (Mega Code Kid A٤٠١١٧ (٤)), ambo bag) for the pediatric clinical procedures except virtual reality equipment.

Sampling:

The sample size was calculated using this formula developed by ***(Mason, ٢٠١٣)*** where n is the required sample size, M= total population, S is ١.٩٦ at ٨٠٪ confidence level, the level of error ٥٠٪ (٠.٥٠).The estimated sample size was ٦٠٣ studied nursing students who attending at the previous mentioned setting (The pediatric nursing skills laboratory for third year/ Faculty of Nursing/ Benha University).

$$\mathbf{n=}\ \frac{M}{[(S^2 *(M-1))/P(1-P)]+1}$$

Which:

n= Sample size

M= Total population (٦٠٣)

S= This depends on level of confidence, for ٨٠٪ this is ١.٩٦

P= Error level ٥٪

٦٠٣

_____= ٨٠

١.٩٦٢*(٦٠٠-١) / ٠.٥(١-٠.٥) + ١=٧.٤٩٨

Based on the above formula, the sample size required was ٨٠

Type: A systematic random sample (٨٠) of pediatric nursing students was selected from the pediatric nursing students who were studying the pediatric nursing course/third year/second semester during the academic year ٢٠٢٢/٢٠٢٣.

Tools of data collection:

Three tools were utilized to collect data pertained to the study as follows:

Tool (I): A structured interviewing questionnaire:

It was designed by the researcher after reviewing recent and relevant literatures. It was translated into an Arabic Language and composed of two parts:

Part I: Characteristics of the studied students

It concerned with characteristics of the studied nursing students such as age, gender, residence and attending any CPR training courses using virtual reality (٤ items).

Part II: Students' knowledge assessment questionnaire (pre/ posttest):

It was developed by the researcher based on ***Barfield & Blitz, (٢٠١٨), Kliegman et al., (٢٠٢٠) and Al Nasri & Al Bulushi, (٢٠٢٠)*** to assess pediatric nursing students' knowledge regarding cardiopulmonary resuscitation and virtual reality. It included ٢٦ closed-end questions and compromised the following:

١- **Pediatric nursing students' knowledge regarding CPR**:

It involved ٢٠ multiple choice questions about:

Definition of CPR, Indication of cardiac and pulmonary arrest, Signs and symptoms of cardiac and pulmonary arrest, Complications that may occur to a child during CPR, indication of ending CPR, Appropriate nursing intervention when a child has stopped breathing, The nursing intervention was taken when a child's pulse has stopped, The nursing intervention to be followed for unconsciousness child, The nursing intervention that must be followed after making sure that the child does not respond, The nursing intervention to be followed after performing CPR, The nursing intervention if the child is unconsciousness but

breath normally, The nursing intervention if the child is not breath normally or no breathing, The landmark in which chest compression performed for a child, The method of giving chest compression to a child, The correct rate of pressure on the chest during cardiopulmonary resuscitation for a child , The ratio of pressure on the chest to the rate of breathing in children when there is only one paramedic, The ratio of pressure on the chest to the breathing rate of the child when there is two paramedic, The method of giving breathing to a child, The methods of opening airway and Which artery should check the child's plus.

٢- **Pediatric nursing students' knowledge regarding virtual reality**:

It consisted of ٦ questions related to definition, indications, types, advantages, disadvantages, applications of virtual reality in pediatric nursing education.

Scoring system for students' knowledge:

A scoring system was estimated in which correct answer was given a score (١), while incorrect answer or don't know was given a score (٠). The students' responses were compared with the model key answer and their total level of knowledge was categorized as follows:

- The total students' knowledge scores were ranged from (٠ - ٢٦) grades which classified into three categories as the following:
    - Low level knowledge: < ٦٠٪ (< ١٦ marks) of total knowledge score.
    - Average level knowledge: from ٦٠٪ to < ٨٠٪ (from ١٦< ٢١ marks) of total knowledge score.
    - Good level knowledge: from ٨٠٪ to ١٠٠٪ (from ٢١-٢٦ marks).

Tool (II): Student's clinical evaluation checklist (pre/ posttest):

It was adopted from ***Lopez-Herce et al., (٢٠١٧)*** to evaluate the pediatric nursing students' practices regarding applying steps of pediatric cardio-pulmonary resuscitation. It was consisted of ٥٠ steps grouped under ٧ domains, as safety (١ step), checking the state of consciousness (١ step), asking for help (٤ steps), child assessment A-B-C opening the airway, checking breathing, checking circulation (١٨ steps), following recommended sequences of CPR (CAB) compression, airway and breathing (١٩ steps), the indication of ending of resuscitation (٤ steps), practices after CPR procedure (٣ steps).

Scoring system of students' practices:

Each done step was given (١) score and (٠) score was given for not done step. According to the students' responses, their total level of practice was categorized as follows: The total scores ranged from ٠-٥٠. Accordingly, the total level was categorized:

- Incompetent for less than < ٨٥٪ at total score (<٤٣).
- Competent form ٨٥ to ١٠٠ % at total score (from ٤٣: ٥٠).

Tool (III): Virtual reality–teaching material usability questionnaire (posttest): Appendix

It was adopted from ***Semeraro et al., (٢٠٠٩) & Shibuya et al., (٢٠١٩)*** to evaluate students' opinions regarding VR usability. It was consisted of ٢٧ questions grouped under nine domains, as Understanding (٣ questions), Motivation (٣ questions), Side effects (١ question), Confidence and competence (٤ questions), Expectations and enjoyment (٦ questions), User-friendliness (٣ questions),

Realism (٤ questions), Interaction/immersion (٢ questions) and Future potential (١ question).

Scoring system of students' opinions:

The students were asked to rate items on a ٥-point Likert scale, ranging from (١) strongly disagree, (٢) Disagreed, (٣) Neutral, (٤) Agreed to (٥) strongly agree. The total scores ranged from ٢٧-١٣٥. Accordingly, the total level was categorized to:

- low level of satisfaction < ٥٠٪ at total score (< ٦٨)
- moderate level of satisfaction ٥٠ < ٧٥٪ at total score (٦٨ < ١٠١)
- High level of satisfaction from ٧٥-١٠٠٪ at total score (١٠١- ١٣٥).

II-Operational design:

The operational design includes preparatory phase, content validity, reliability, pilot study, field work and ethical considerations.

Preparatory phase:

It included reviewing the current local and the international related literature covering various aspects of the study to get acquainted with the research problem and to develop study tools.

Content validity:

Tools of data collection were designed and submitted to a jury of three experts (٢ professors pediatric nursing and ١ assistant professor pediatric nursing) in the field of paediatric nursing from the Faculty of Nursing/Benha University to test the content validity of tools and judge its clarity, comprehensiveness, relevance, simplicity and accuracy. Based on experts' comments and recommendations, minor modifications had been made such as rephrasing, rearrangements or deleting some sentences to reach the final version of the tools. The tools were considered as valid from the experts' perspective.

Reliability:

The reliability of the developed and validated tools for students' knowledge assessment questionnaire, clinical evaluation checklist and virtual reality-teaching material usability questionnaire was estimated using the Chronbach's Alpha co-efficient. Test retest results using Chronbach's Alpha co-efficient revealed that all items were significantly differ and has a correlation above the threshold of significance. The internal consistency was ٠.٨٩ for students' knowledge assessment questionnaire, ٠.٨٣ for clinical evaluation checklist and ٠.٨٥ for virtual reality-teaching material usability questionnaire.

Pilot study:

A pilot study was conducted on ١٠٪ (٨ students) of the total study sample size to ascertain the clarity, relevance, feasibility, applicability of the study tools and sequence of questions to maintain consistency. Also, it helped to estimate the time needed to fill tools of data collection. Based on the results of the pilot study, no modifications were done and subjects under the pilot study were not excluded from the main study sample. It was start from the beginning of February ٢٠٢٣ to the end of February ٢٠٢٣.

Ethical considerations:

A written approval was obtained from the scientific research ethical committee at the Faculty of Nursing/ Benha University. A written consent was taken from the students to participate in the study. The students were informed that their participation in the study is completely voluntary and also they have the right to withdraw from the study at any time without any penalty. Anonymity and confidentiality were assured through coding the data. Moreover, participants were informed that data will not be reused for any research purposes without their permission. The study

maneuver could not entail any harmful effects on students.

Field work:

The actual field work was carried out over a period of three months (from march ٢٠٢٣ to may ٢٠٢٣). At first, the researcher interviewed the pediatric nursing students to collect base line data at the Faculty of Nursing/ Benha University three days/week; Saturday, Monday and Wednesday according to their academic schedule from ٩.٠٠ AM and extended to ٣.٠٠ PM (by rotation in groups). At beginning of interview: the researcher welcomed available pediatric nursing students, explained the aim, technique, tools and outcomes of the study and took their written approval to participate with study prior data collection. An average of ٣-٤ pediatric nursing students were interviewed per/day.

Then, the researcher gave pediatric nursing students (Tool I) for filling it to assess their knowledge toward CPR and VR and they finished answering within ١٥-٢٠ minutes at the beginning of the day. After that, the researcher observed each pediatric nursing students separately during their practices by using observational checklists (Tool II) to assess their practices toward CPR at pediatric nursing skills laboratory. The average time needed to observe each student was between ٣٥-٤٠ minutes.

The researcher classify the pediatric nursing students into control and study groups equally and the researcher start to assess control group first to avoid bias. This took about one month (From the beginning of March to the end of March ٢٠٢٣).

For the control group:

The control group (٤٠) students were divided into sub-groups (every group was ٥ students) and distributed to ٣ pediatric nursing skills laboratory. These sub-groups took part in the traditional CPR demonstration enrolled in the third year pediatric nursing practical course and trained by assistant teaching staff in the traditional clinical sessions. The demonstration lasted for one hour, covering the background and technique of CPR, followed by practical training using the available equipment and CPR mannequin.

For the study group:

The researcher conducted a one day workshop (Sunday) for the pediatric nursing students in the study group and was conducted in the ٣rd year pediatric nursing students' classroom. It was for orientation the participants regarding VR and CPR. The session of VR from ٩.٠٠ AM to ١١.٠٠ AM and content of virtual reality lecture included (definition, indications, types, advantages, disadvantages it's applications of virtual reality in pediatric nursing education and tutor role) and anther session about CPR from ١٢.٠٠ PM to ٢.٠٠ PM and content of CPR lecture included (Definition of CPR, Indication of cardiac and pulmonary arrest, Signs and symptoms of cardiac and pulmonary arrest, Complications that may occur to a child during CPR, indication of ending CPR, Appropriate nursing intervention when a child has stopped breathing, The nursing intervention was taken when a child's pulse has stopped, The nursing intervention to be followed for unconsciousness child, The nursing intervention that must be followed after making sure that the child does not respond, The nursing intervention to be followed after performing CPR, The nursing intervention if the child is unconsciousness but breath normally, The nursing intervention if the child is not breath normally or no breathing, The landmark in which chest compression performed for a child, The method of giving chest compression to a child, The correct rate of pressure on the chest during cardiopulmonary resuscitation for a child , The ratio of pressure on the chest to the rate of breathing in children when there is only one paramedic, The ratio of pressure on the chest to the breathing rate of the child when there is two paramedic, The method

of giving breathing to a child, The methods of opening airway and Which artery should check the child's plus). Then, The study group (٤٠) pediatric nursing students were assigned to the pediatric nursing skills laboratory in sub-groups of around (٥) students each. The pediatric nursing students were trained regarding cardiopulmonary resuscitation by using VR ٣D glasses (The Meta Oculus Quest ٢) which illustrating the steps of CPR and the technique of chest compressions that developed by the researcher through specialized engineer under supervision of the supervisors.

Before training the researcher provided brief instructions on how to use the VR technology, which was directly followed by the VR-CPR training. Each student in the study group wore the VR glasses and was guided through VR-CPR scenario individually. First, the student was a passive viewer and the scenario is repeated and each step was explained by the researcher. Then, the student as active CPR provider, the scenario is repeated and the student carried out every step of the CPR independently. The scenario can only be continued, if all steps have been implemented. The practical training was conducted in the clinical pediatric nursing skill laboratory. The practical training took about ٣٠-٤٥ minutes for each student to practice on CPR using VR eye glasses. This took about six weeks (from the beginning of April ٢٠٢٣ to the middle of may ٢٠٢٣).

Evaluation

Evaluation of the effect of virtual reality as a teaching strategy on students' performance regarding CPR was carried out through using the same pre-test tools (Tool I & II) in both study and control groups. Finally, the researcher assessed opinions of the pediatric nursing students in the study group regarding virtual reality-teaching material usability using posttest (tool III). This was done after the intervention and took about two weeks (from the middle of May ٢٠٢٣ to the end of May ٢٠٢٣).

III -Administrative design:

Before starting the practical work, an official letter explaining the purpose of and nature the study was taken from the Dean of the Faculty of Nursing and Head of the Pediatric Nursing Department to carry out the study. A clear explanation was given about importance and the expected outcomes of the study.

IV-Statistical design:

The collected data were revised, organized, coded, tabulated, and analyzed using Statistical Package for Social Sciences (SPSS) version ٢٠. Quantitative data were expressed as mean (□) and standard deviation (SD). Qualitative data were expressed in form of frequency distribution tables, numbers and percentages. Qualitative variables were analyzed using Chi- Square test (x^2) & correlation coefficient (r) to determine the relation between variables of the study. Independent (t) test was used to compare mean score between two groups. The observed differences were considered as follows: Non-significant at P> ٠.٠٥, significant at P< ٠.٠٥ and highly significant at P< ٠.٠٠١.

Results:

Table (١) reflects that, the vast majority (٩٠٪) and all (١٠٠٪) of both study and control groups were in the age group of ٢٠ < ٢٢ years, with a mean age of ٢٠.٥٣± ٠.٧٥ years and ٢٠.٦٨ ± ٠.٤٧ years respectively. As regards residence, this table reveals that, more than half (٥٢.٥٪) and less than two thirds (٦٥٪) of the studied students in both study and control groups were from rural area respectively. Concerning attending any CPR training courses using virtual reality, all (١٠٠٪) of students in both study and control groups didn't attend any CPR training courses using virtual reality.

Figure (١): It is obvious from **figure (١)** that, more than half (٥٥٪) and more than two thirds (٦٧.٥٪) of the studied nursing students in both study and control groups were females respectively.

Table (٢): represents that, the total mean score of students' knowledge was ٦.٣٧ ± ٢.٤٥ and ٦.٨١ ± ٣.٣٩ in the study and control group pre intervention respectively, with no statistical significance difference (P>٠.٠٥). While, post intervention, the total mean score of knowledge was ٢٢.٤٥±١.٩٧ in the study group compared to ١٥.٢٥ ± ٤.٤١ in the control group, with a highly statistical significance difference (P<٠.٠٠٠).

Figure (٢): represents that, the vast majority and majority (٩٢.٥٪ & ٨٧.٥٪) of nursing students in both study and control groups had low knowledge level pre-intervention respectively. However, post-intervention that the vast majority and one third (٩٠٪ & ٣٥٪) of nursing students in both study and control groups had good knowledge level respectively.

Table (٣): reflects that, the total mean score of the students' practice regarding CPR was ١٠.٨٥ ± ٣.١١ and ١١.٥٣ ± ٥.٦٩ in both the study and control groups pre-intervention respectively, with no statistically significance difference (P>٠.٠٥). However, post-intervention, the study group had higher mean score regarding CPR practice compared to the control group (٣٦.١٨±٣.٤٩ versus ٢٦.٦٥± ٨.٤٦٣), with a highly statistical significance difference between the two groups (P<٠.٠٠٠).

Figure (٣): It's evident from that, all (١٠٠٪) of the students in the study group and the most (٩٥٪) of the students in the control group had incompetent total practices level regarding CPR pre-intervention. However, post-intervention, majority (٨٧.٥٪) of students in the study group and more than half (٥٢.٥٪) of students in the control group had competent total practices level regarding cardiopulmonary resuscitation.

Table (٤): shows distribution of the students in the study group according to their opinions about virtual reality-teaching material usability. Apparently, it's clear from this table that, the students in the study group had high mean scores (٢٧.٥٨ ± ١. ٩١, ١٩.٢٠ ± ١.١٨ and ١٨.٨٢ ± ١.١٥) respectively regarding expectation and enjoyment, realism and confidence and competence post-intervention. Also, this table indicates that, the total mean score of the students' opinions in the study group about virtual reality-teaching material usability was ١٢٣.٧٣ ± ٣.٣٥.

Table (٥): clarifies that, there was a statistical significant positive correlation between total knowledge score and total practice score in the study and control group pre intervention (r=٠.٤٨٩, P=٠.٠٠١ versus r=٠.٤٢٦, P=٠.٠٠٦) respectively. Moreover, this table illustrates that, there was a highly statistical significant difference positive correlation between total knowledge score and total practice score in both study and control group post intervention (r=٠.٨١٥, P=٠.٠٠٠ versus r=٠. ٦٩٣, P=٠.٠٠٠) respectively.

Table (٦): It is obvious from that, there was a highly statistical significant positive correlation between total opinions and total knowledge scores in the study group post intervention (r=٠.٦٣٧, P=٠.٠٠٠)**.** Additionally, this table reflects that, there was a highly statistical significant positive correlation

between total opinions and total practice scores in the study group post intervention (r=٠.٨٤٦, P=٠.٠٠٠)

Table (١): Distribution of the studied nursing students in both study and control groups according to their characteristics (n=٨٠)

Groups / Variables	Study group n=٤٠		Control group n=٤٠	
	No.	%	No.	%
Age (years)				
< ٢٠	٣	٧.٥	٠	٠.٠
٢٠ < ٢٢	٣٦	٩٠.٠	٤٠	١٠٠.٠
٢٢ < ٢٤	١	٢.٥	٠	٠.٠
Mean ± SD	٢٠.٥٣ ± ٠.٧٥		٢٠.٦٨ ± ٠.٤٧	
Residence				
Rural	٢١	٥٢.٥	٢٦	٦٥.٠
Urban	١٩	٤٧.٥	١٤	٣٥.٠
Attending any CPR training courses using virtual reality				
No	٤٠	١٠٠.٠	٤٠	١٠٠.٠

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Figure (١): Distribution of the studied nursing students in both study and control groups according to their gender (n=٨٠)

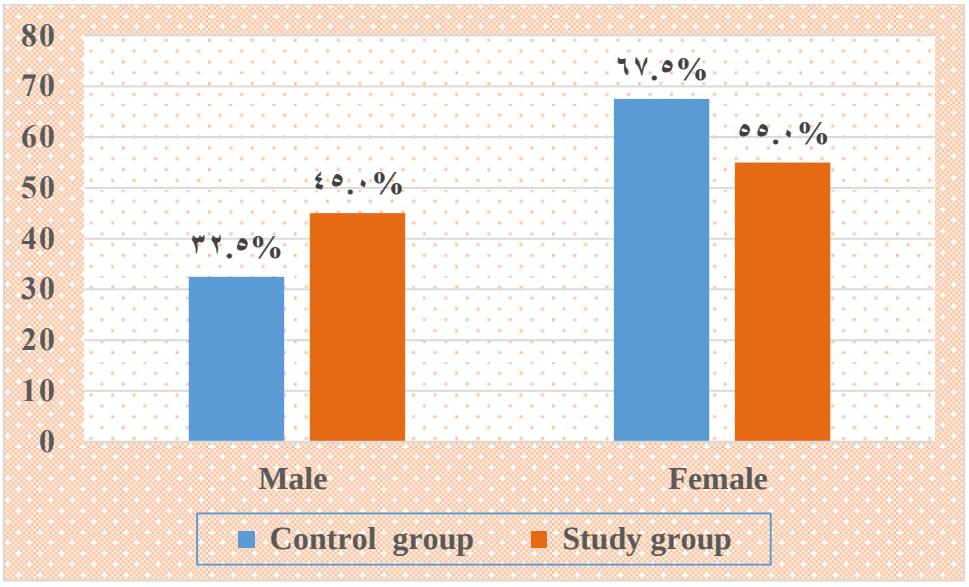

Table (٢): Mean subtotal and total scores of students' knowledge regarding cardiopulmonary resuscitation and virtual reality pre and post intervention in the study and control groups (n=٨٠)

Knowledge	Possible score	Phases	Study group n=٤٠	Control group n=٤٠	Independent t-test	P-value
			Mean ± SD	Mean ± SD		
Total	٢٦	Pre intervention	٦.٣٧ ± ٢.٤٥	٦.٨١± ٣.٣٩	٠.٦٤٣	٠.٥٢٢
		Post intervention	٢٢.٤٥ ±١.٩٧	١٥.٢٥ ± ٤.٤١	٩.٤٣٠	٠.٠٠٠**

Figure (٢): Distribution of the total nursing students' knowledge level in both study and control groups regarding cardiopulmonary resuscitation and virtual reality pre and post-intervention (n=٨٠).

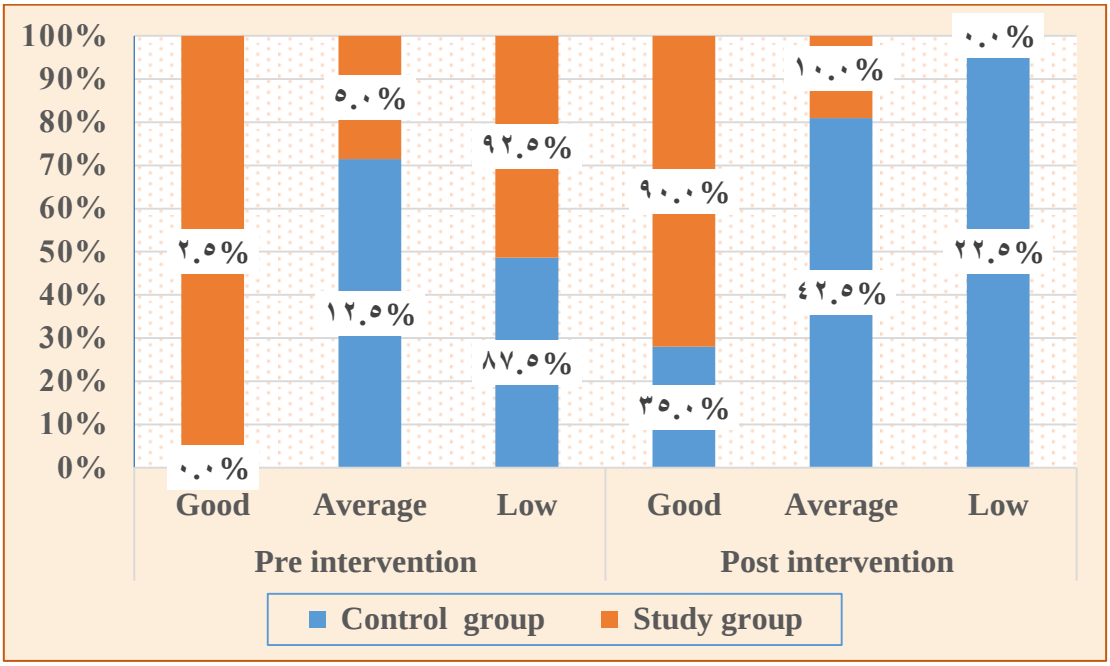

Table (٣): Mean subtotal and total cardiopulmonary resuscitation practice scores pre and post intervention in both the study and control groups (n=٨٠)

Variables	Possible score	Phases	Study group n=٤٠	Control group n=٤٠	Independent t-test	P-value
			Mean ± SD	Mean ± SD		
Total	٤٠	Pre intervention	١٠.٨٥ ± ٣.١١	١١.٥٣ ± ٥.٦٩	٠.٦٥٨	٠.٥١٢
		Post intervention	٣٦.١٨ ± ٣.٤٩	٢٦.٦٥± ٨.٤٦٣	٦.٥٩٩	٠.٠٠٠**

Figure (٣): Distribution of the studied nursing students in both study and control groups according to their total practices level regarding CPR pre and post- intervention (n=٨٠).

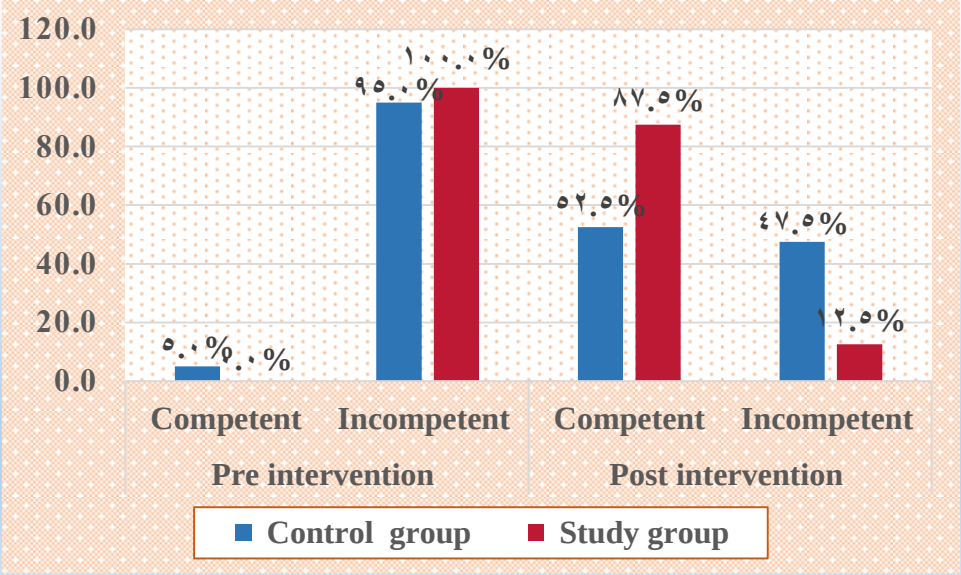

Table (٤): Mean opinions score of the studied nursing students in the study group about virtual reality-teaching material usability (n=٤٠)

Domains	Possible range	Mean ± SD	Mean %
Understanding	١٥	١٣.٦٢ ± ١.٤٦	٩٠.٨
Motivation	١٥	١٤.١٥ ± ١.٢٥	٩٤.٣
Side effects	٥	٤.٦٣ ± ٠.٤٩	٩٢.٦
Confidence and competence	٢٠	١٨.٨٢ ± ١.١٥	٩٤.١
Expectations and enjoyment	٣٠	٢٧.٥٨ ± ١.٩١	٩١.٩
User-friendliness	١٥	١٤.١١ ± ٠.٨٧	٩٤.١
Realism	٢٠	١٩.٢٠ ± ١.١٨	٩٦.٠
Interaction/immersion	١٠	٨.٤٨ ± ١.٥٧	٨٤.٨
Future potential	٥	٤.٧٨ ± ٠.٤٧	٩٥.٦
Total	١٣٥	١٢٣.٧٣ ± ٣.٣٥	٩١.٧

Table (٢٠): Correlation coefficient between total knowledge and practice scores regarding cardiopulmonary resuscitation and virtual reality pre and post intervention in both the study and control groups (n=٨٠).

Variables		Total knowledge score			
		Study group n=٤٠		Control group n=٤٠	
		r	P	r	p
Total practice score	Pre intervention	٠.٤٨٩	٠.٠٠١**	٠.٤٢٦	٠.٠٠٦*
	Post intervention	٠.٨١٥	٠.٠٠٠**	٠.٦٩٣	٠.٠٠٠**

Table (٢١): Correlation coefficient between total opinions about virtual reality usability and total knowledge and practice scores regarding cardiopulmonary resuscitation and virtual reality post intervention in the study group (n=٤٠)

Study group		
Variables	Total opinions score n=٤٠	
	r	p
Total knowledge score	٠.٦٣٧	٠.٠٠٠**
Total practice score	٠.٨٤٦	٠.٠٠٠**

Discussion

The common approaches in CPR training are face-to-face teaching, utilizing manikins, or independent e-learning courses. However, and more directed to health care professionals, these methods can lack the realism of the environment that a cardiac arrest is likely to be encountered. Furthermore, face-to-face teaching can be costly to run, difficult to access if high in demand, or if meetings are contraindicated ***(Wong et al., ٢٠١٨ & Zheng et al., ٢٠٢٢)***. In order to provide CPR training of the highest quality for health care professionals, technology enhanced education, such as cognitive aids and feedback devices, as well as gamified learning, for example, via virtual reality (VR) are suggested to be used. Technology enhanced education has been reported to improve retention and facilitate competency assessment, particularly in CPR, thus the European resuscitation council have advocated the use of virtual learning as a form of pre-course e-learning, thereby allowing for a blended learning approach (**Greif et al., ٢٠٢١).**

Virtual reality uses software technology to provide a three-dimensional training environment. This allows the user to

be immersed into the virtual scenario, which has been found to provide a more realistic method of teaching than conventional means, building on the users' psychomotor skills. VR has been identified to provide a method of constructive learning with instant feedback, developing the confidence of operators while at no risk to patients. These aforementioned factors may contribute to the exponential growth that has occurred in research of utilising VR in healthcare ***(Jaskiewicz et al., ٢٠٢٠ & Imran et al., ٢٠٢١).***

Conclusion:

CPR training using VR is a feasible and effective training method and considering the overall learning gain, VR training is superior to the classic training.

Recommendations:

Integration of VR technique in to the classic CPR training to use the advantage of both teaching techniques

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أداتين ، الأداة الأولى: استبيان منظم لإجراء المقابلات. الأداة الثانية: قائمة مراجعة التقييم السريري للطالب (الاختبار القبلي / البعدي). الأداة (III): الواقع الافتراضي - استبيان قابلية استخدام المواد التعليمية (اختبار بعدي). النتائج: كانت هناك علاقة إيجابية ذات دلالة إحصائية عالية بين مجموع الآراء ومجموع درجات المعرفة في مرحلة ما بعد مداخلة لجنة الدراسات. بالإضافة إلى ذلك، يبين هذا الجدول وجود علاقة إيجابية ذات دلالة إحصائية عالية بين مجموع الآراء ومجموع درجات الممارسة في مرحلة ما بعد مداخلة لجنة الدراسات. **الاستنتاج**: يعد تدريب الإنعاش القلبي الرئوي باستخدام الواقع الافتراضي طريقة تدريب مجدية وفعالة وبالنظر إلى مكاسب التعلم الإجمالية ، فإن تدريب الواقع الافتراضي يتفوق على التدريب الكلاسيكي. **التوصيات**: دمج تقنية الواقع الافتراضي في التدريب الكلاسيكي على الإنعاش القلبي الرئوي لاستخدام ميزة كلا تقنيتي التدريس.

الكلمات المفتاحية: الواقع الافتراضي ، القلب والرئة ، الإنعاش ، طلاب التمريض.

تأثير الواقع الافتراضى كإستراتيجية تعليمية على أداء طلاب تمريض الأطفال فيما يتعلق بالإنعاش القلبى الرئوى

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الخلاصة

الخلفية: الواقع الافتراضي هو تقنية مبتكرة لتعليم التمريض مرتبطة بالواقعية التجريبية العالية والواقع الافتراضي عبارة عن محاكاة ثلاثية الأبعاد (D-٣) تم إنشاؤها بواسطة الكمبيوتر توفر مجموعة واسعة من المعلومات الحسية للمستخدم للسماح لهم بالتفاعل مع الأشياء في بيئة افتراضية وجعلهم يشعرون وكأنهم موجودون جسديا. يمكن استخدام الواقع الافتراضي لمساعدة طلاب التمريض على تطوير المهارات في إعدادات المستشفى الافتراضية. لذلك ، تقارن هذه الدراسة تدريب الإنعاش القلبي الرئوي (CPR) مع تدريب الواقع الافتراضي (VR). **الهدف من الدراسة**: تقييم تأثير الواقع الافتراضي كاستراتيجية تدريس على أداء طلاب تمريض الأطفال فيما يتعلق بالإنعاش القلبي الرئوي. **تصميم البحث:** تم استخدام تصميم شبه تجريبي (اختبار قبلي لمجموعة واحدة) ، وهي دراسة تدخلية تجريبية غير عشوائية تستخدم عادة عند اختبار اكتساب المعرفة بعد مشروع تعليمي على المجموعة المستهدفة أو يتم اختبار المشاركين في البحث. في هذا التصميم ، يتم قياس المتغير التابع مرة واحدة قبل وبعد إعطاء علاج محدد. يتم تحديد تأثير العلاج عن طريق قياس الفرق بين درجات الاختبار القبلي والبعدي. **العينة**: تم اختيار عينة عشوائية منهجية مكونة من (٨٠) طالبا من طلبة تمريض الأطفال من طلبة تمريض الأطفال الذين كانوا يدرسون مقرر تمريض الأطفال/ السنة الثالثة/الفصل الدراسي الثاني خلال العام الجامعي ٢٠٢٣/٢٠٢٢. **أدوات جمع البيانات:** تم استخدام