Effect of Training Virtual Simulation Skill on Improving Learning Outcomes among Nursing Students

Basma Mohamed Ahmed1, Marwa Moustafa Hegazy2, Sabah Saied Mohamed3, Eman Sobhy Omran 4

(1) Assistant lecture of Medical Surgical Nursing, Faculty of Nursing, Benha university , Egypt, (2,3) Professor of Medical Surgical Nursing, Faculty of Nursing, Benha university and (4) Assistant professor of Medical Surgical Nursing, Faculty of Nursing, Benha University, Egypt.

Abstract

Background: A virtual simulation (VS) is an innovative approach to providing virtual clinical experiences through a digital platform where learners can complete specific tasks in various potential environments. **The aim** of the study was to evaluate the effect of training virtual simulation skill on improving learning outcomes among nursing students. **Research design:** Experimental research design was used. **Setting:** This study was carried out at Medical Surgical Nursing Labs and Virtual Lab Faculty of nursing- Benha University. **Sample:** A systematic random sample of 229 medical surgical nursing students in first year second semesters throughout the 2023–2024 academic year. Classified into two groups; traditional group and virtual simulation (VS) group. **Tools of data collection**: three tools were used **I:** Structure students' questionnaire to assess knowledge about nasogastric tube insertion& virtual simulation, **II:** observational checklist to assess practice related to nasogastric tube insertion and **III:** Students' class satisfaction measuring questionnaire. **Results:** The study revealed that 16.5% and 92.2% of the studied nursing students of traditional and VS groups had good level of total knowledge about nasogastric tube insertion and virtual simulation post month(follow up), respectively. While 81.6% and 62.1 of the studied nursing students of traditional and VS groups had competent level of total practice about nasogastric tube insertion at follow up. Also, the study revealed that79.6% and64.1% of the studied nursing students of traditional and VS groups had high satisfaction level at follow up of training, **Conclusion:** virtual simulation skill showed its effectiveness in improving nursing students' knowledge, practice and satisfaction. **Recommendation:** incorporating virtual simulation an effective teaching strategy, with traditional teaching in different nursing clinical courses to enhance nursing students' performance in clinical settings.

Key words: Virtual simulation, Learning Outcomes.

Introduction

Nursing education programs focus on integrating theory into clinical practice to stimulate students' critical thinking and problem-solving skills and to help them to adapt to real-life situations .The integration of theory with clinical practice in the teaching process enables students to assimilate knowledge and skills. Simulation is an alternative or complementary method for students who cannot obtain sufficient direct care experience, as they allow students to experience various clinical situations. Mixed learning is becoming increasingly common as a way to provide students with opportunities to experience real-life clinical scenarios (*Saragih et al., 2024).*

Currently, the technological development in information and communication technologies allows recreating patients and clinical conditions in virtual learning environments. These virtual patients are computer programs that simulate real-life clinical scenarios in which students act as health professionals, collecting the clinical history, performing the physical examination, defining the diagnosis, the intervention to be implemented, and evaluating the outcome of the clinical decision. Virtual simulation is defined as a type of simulation that places the student at the center of decision-making, motor and/or communication skills(*Padilha et al., 2024).*

A virtual simulation is an innovative approach to providing virtual clinical experiences through a digital platform where learners can complete specific tasks in various potential environments, use the information to provide assessment and care, make clinical decisions, and observe the outcomes of actions. Virtual simulation allows nursing students to familiarize themselves first with problems encountered in simulation by providing flexible and repetitive exercises (*Yang et al.,2024).*

Virtual simulation(VS) provide a realistic world on the computer screen, offering dynamic and consistent experiences in a safe reproducible, accessible, and standardized clinical environment. While a single HFS training session does not include repetitive practice, reassessment, and remediation, VS is thought to be sufficient to ensure a level of knowledge and skill required for clinical practice. With the increasing utilization of VS, it became necessary to determine how best to use VS as a teaching strategy for learners (*Yeo & Jang ,2023).*

Placement of a nasogastric tube (NGT) is a blind technique where the tube is inserted through the nostril, along the nasopharynx, through the esophagus and into the stomach. Is a frequently done technique in acute care wards and intensive care units (ICU), NGT should be used as the standard approach for enteral feeding. (*Reshid & Baee, 2024).*

Significance of the study

While nursing students must learn many medical procedures as nursing skills, they can only practice them in a school's laboratory where there are patient simulators and medical instruments (i.e. simulation-based training (SBT). After passing achievement tests for the skills, the students must remember them and perform the skills on patients. Therefore, teaching materials like virtual simulation teaching strategy are important tools that support SBT and help students retain learned skills (*Elendu et al., 2024).*

Nasogastric tubes (NGT) have been in use for over 100 years and are still considered as essential and resuscitative tools in multiple medical specialties for acute and chronic care(*Vadivelu et al., 2023).* Although there are some evidence-

based practice guidelines and recommendations for care of these tubes, variation in practice still exists. Additional research is needed to determine the best methodology for insertion and confirmation of nasogastric feeding tubes. Routine competency and training on feeding tube insertion, enteral nutrition, and post insertion care is crucial to improve patient safety events. It is important that health care institutions develop standardized procedures for insertion and confirmation to minimize risks and complications from temporary nasogastric feeding tubes (*Bloom& Seckel ,2022).*

Insertion of the gastric tube is relatively safe; nevertheless, accidental misplacement of the gastric tubes into the respiratory tract is not rare and, if unrecognized, such misplacement may lead to serious consequences, including pneumonia, pneumothorax, atelectasis, bronchopleural fistula, emphysema, and even death (*Mohamed et al., 2024).* Therefore, this study aim to teach nursing students at Benha University how to insert a gastric tube in an innovative and creative technique through training using virtual simulation and overcome a several barriers to skill competency and proficiency, which include limited staff members, lab time, and resources in the college that face the medical-surgical staff and student.

Aim of the study:-

The present study aimed to evaluate the effect of training virtual Simulation skill on improving learning outcomes among nursing students**.**

Research hypotheses:-

To fulfill the aim of the study, the following research hypotheses will be formulated:

H1: The training virtual simulation skill will have positive effect on knowledge of nursing students virtual simulation group compared with traditional group.

H1: The training virtual simulation skill will have positive effect on clinical practice of nursing students virtual simulation group compared with traditional group.

H1: The training virtual simulation skill will have positive effect on class satisfaction of nursing students virtual simulation group compared with traditional group.

Subject and Methods

Research design:

Experimental research design (Randomized controlled trials (RCT) with pretest and posttest design: was employed to accomplish the study's aim.

Study setting:

This study conducted at medical surgical nursing labs& virtual lab Faculty of nursing-Benha University second floor, Al Qalyubia Government.

Subjects

Systematic random sample of 229 students at the first year -second semester medical surgical nursing students in the academic year 2023-2024 at the Faculty of Nursing, Benha University. They classified into two groups, the traditional group (control group) used the traditional teaching strategy and the virtual simulation group (study group) used virtual simulation teaching strategy to conduct the aim of this study.

Sample size calculated according to the following equation n=N/1(Ne ^{2}) which adopted from *(Tejada& Punzala, 2012).*

Which:

n ➡ the required sample size

N ➡ the total number of students (535)

e ➡ error tolerance (0.05)

1 ➡ constant value (1)

535/1(535 ×0.5)^2=229

Based on the above equation, the sample size required was **229**

Tools of data collection:-

Three tools were used by the researcher to collect data for this study.

Tool I: Structure Students' Questionnaire

This tool aimed to assess students' knowledge, it was designed by the researcher based on review of recent related literature and scientific references such as *Byrne et al.,(2021)* and **Nelson& Blinman,(2021)** and it was written in simple clear English language.

It involved the following two parts to cover the following data:

Part I: Students' personal data:

This part concerned with assessment of students' personal data related to medical surgical nursing students, it comprised of five questions; age, sex, type of secondary school attained prior to enrollment in the college, place of residence and use virtual reality before.

Part II: Student structure knowledge assessment (pre/ posttest):

This part concerned with assessment of students' knowledge about nasogastric tube insertion and virtual simulation skill, It included 36 closed-end questions and comprised of two sections:

Section I: - Students' knowledge about nasogastric tube insertion, it included twenty questions, it was consisting of close ended questions in form multiple choices

Section II: **Students' knowledge about virtual simulation skill,** it included sixteen questions, it was consisting of close ended questions in form multiple choices.

Scoring system for Students' knowledge assessment:

Scoring system for Medical Surgical Nursing student's answers; were scored as each correct answer was scored (1), each incorrect answer was scored (0). The total score for knowledge was (36) marks. The knowledge scores were converted into a percent and categorized as follows:

- Below 60% of total knowledge score (<22 scores) was considered as Poor level of knowledge.

- From 60 % to < 80% of total knowledge score (22 < 29 scores) was considered as average level of knowledge.

- Equal 80% of total knowledge score and above (≥ 29 scores) was considered as good level of knowledge.

Tool II: observational checklist related to nasogastric tube insertion (posttest):

This tool was designed by the researcher after reviewing the related literature such as *Richardson&Keeling, (2021), Rowberry et al., (2023)* and *Perry et al., (2024).* It aimed to assess practice related to nasogastric tube insertion. This tool contained (27) steps divided into three main items:

- Preparation before Procedure (4 steps).
- Implementation of Procedure (18 steps).
- Post procedure (5 steps).

Scoring system for observational checklist:

The scoring system consisted of two points: give a score of one (1) for done and zero (0) for not done or incomplete done. The total score for practice was (27) scores and it converted into percentage and graded as the following:-

-Below 85% of total score of practice (<23 scores) were considered incompetent level of practice.

-Equal 85 % of total score of practice and above (≥ 23 score) were considered competent level of practice.

Tool III: Students' class satisfaction measuring questionnaire(posttest):

This tool was designed by the researcher after reviewing the related literature such as **El-Meanawi et al.,(2019) , Shaaban et al.,(2021), Zaragoza-García et al., (2021)** and **Sobhy et al.,(2022) .** It was written in simple clear Arabic language and used to assess the students' class satisfaction about teaching strategy used for training in the lab. The students were asked to rate their satisfaction with different aspects of their training. That includes 33 sentences grouped under the following three main items:

▪ **A. Teaching and teacher program(17 questions):** contain five sub items:
I.   The goal of the training program.
II.   Content of the training program.
III.   Timing of the training program.
IV.   Training program materials.
V.   The teacher.
▪ **B. Competence (Mastery) (5 questions).**
▪ **C. General skills and learning experiences (11 questions).**
Scoring system

The students' expressed and self-rating response of their satisfaction that was ranged from score(0) for not applicable, score (1) for do not agree, score (2) for agree.

The total score for this tool was ranged from 0-66, which was calculated by multiplying the highest score (2) by the number of items (33) to yield the final total score and was classified   as   the   following:
❖ From 1 to 32 points representing <50% was   considered   low   satisfaction.
❖ From 33-48 points ranged from ≥ 50% - 75%   was   considered   moderate satisfaction.
❖ From 49-66 points ranged from ≥ 75 % was considered high satisfaction

Training Program of Virtual Simulation Related Nasogastric tube insertion: It designed by the researcher after reviewing the related literature such as *Salatino et al. (2023) and Conelius et al. (2024)* for the purpose of the study based on related literature, it was given to students after pretest it included two parts:

 The theoretical part: It was about basic knowledge about nasogastric tube insertion, it include definition of nasogastric tube (NGT), indication, contraindications, types,

complications or side effects of nasogastric tube and basic knowledge about definition of simulation , history of simulation , types of simulations in nursing education, definition of virtual reality, basic features of virtual reality, basic types of VR ,virtual simulation, content of virtual simulation , fields of virtual reality, advantages of virtual simulation, disadvantages of virtual simulation, challenges of virtual simulation.

The practical part: It was about practice of students about nasogastric tube insertion by using virtual simulation as a teaching strategy through designing a 3-D virtual simulation scenario for virtual simulation group.

Tools validity and reliability:

Tools validity:

The tools were reviewed by a panel of five experts from medical surgical nursing field at faculty of nursing Benha University. Juries involved two professor and three assistant professors to test the relevance, clarity of tools' content, comprehension, understanding, applicability and necessary modification was done accordingly.

Reliability

The researcher used test – retest – methods to test the internal consistency of the tools, by administration of the same tools to the same subjects under similar condition on two different occasions. Testing the reliability of the tools through **Cronbach's alpha coefficient**. Tool reliability for structure students' questionnaire that used to assess students' knowledge = **0.861**, tool reliability for observational checklist that used to assess students' practice= **0.747.** While tool reliability for students' class satisfaction measuring questionnaire that used to assess students' class satisfaction=**0.991**. This only proves that this tool is an instrument with good reliability.

Ethical considerations:

A written approval was obtained from the scientific research ethical committee at the Faculty of Nursing/ Benha University research code **REC.MCN.P.87,** with an explanation of the aim and the importance of the study to the centers' authorities.

An official approval to carry out this study was granted from the dean, the vice dean of education and student affairs of the Faculty of Nursing, Benha University &Simple explanation was given to sample about the study aims and collection tools.

Once the researcher was granted approval, the students were required to provide oral &written informed consent before study enrollment. The objectives and the nature of the study were explained to the students. The researchers emphasized that participation in the study was voluntary; anonymity and confidentiality were assured.

Pilot study:

A pilot study was carried out after developing the tools and before starting the data collection phase. The pilot study was carried out on 23students (12) from virtual simulation group and (11) from traditional group which represented (10%) of the of all selected students at Faculty of Nursing, Benha University to test the clarity and applicability of the study tools and the

program, to estimate time needed for filling the questionnaire as well as to identify any possible obstacles that may hinder data collection. Based on the results of the pilot study, rephrasing of some questions was performed to ensure clarity of the questions and so that they could be understood easily by the participants. So students involved in the pilot study were excluded in the study.

Field work:-

Data were collected over the second semester for first year which the student study medical surgical nursing (1) practical course within two months from second week of march 2023 to the end ofApril2023, three day each week according to academic schedule, Saturday, Monday &Wednesday 6 hours for each day from 9: am to 3: pm The data collection included the following phases:

- Assessment phase.

- Planning phase.

- Implementation phase.

- Evaluation phase.

1-Assessment phase:

For both traditional &virtual simulation groups:

1- The researcher started by interviewed the medical surgical nursing students to collect base line data at the Faculty of Nursing/ Benha University. At beginning of interview: the researcher welcomed with the students, orientated the aim, technique, tools, and outcomes of the study and the training plan of the study and took their

written approval to participate with study prior data collection.

2-The researcher randomly classified the total number of the students into two equal groups; traditional group &virtual simulation group.

3-The researcher assessed personal data of student participant and knowledge about nasogastric tube insertion & virtual simulation skill for both traditional &virtual simulation groups within 2 weeks by using **Tool I** through sharing Google forms link

https://docs.google.com/forms/d/e/1FAIpQLSfczcBYD50HEMX2Jxvl_W7VDfbwNNXSrsDudbuWc1UrVfD2aQ/viewform?usp=sf_link .

Also, the researcher send a 3-D virtual simulation scenario to the virtual simulation group participants through whatsapp group and asked them to download on their smartphones before starting in the training program through link

https://drive.google.com/file/d/1AF88PKBfGoEFjbltPY4nCDd7jHyAst4b/view?usp=sharing .

2- Planning phase:

- the researcher designed **a 3-D virtual simulation scenario** that replicates a real hospital environment was designed by using pictures of real hospital with multiple interactive models, animations, real-world pictures, user-friendly graphical interface that generate sound by Unity VR Developer Engineer& 3-D modeler Engineer under direction of the researcher& researcher supervisors . The scenario can be accessed by any

student's participant via an Android phone and is accessible at all times for efficient training.

- Online Meetings was conducted through the researcher, supervisors and engineers (Unity VR Developer Engineer& 3-D modeler Engineer) several times to determine the required and suitable 3-D models of equipment and to design the scenario in an easy and simplified way that enables the student to practice the nursing procedure, train on it and acquire the skill of inserting the nasogastric tube in a professional manner. It took around two months to design the scenario and review it.

3-D virtual simulation scenario

- The practice starts with a scenario that describes an ill person in a patient room who needs a nasogastric tube inserted per a doctor's order. Since encouraging active learning is one of our main objectives, the scenario is built on a story that will attract students during the training process because one of our primary goals is to promote active learning.

- The students start the 3-D virtual simulation scenario by using joystick to move & their finger to rotate the view around the screen to interact with patient and medical equipment.

- The virtual simulation group participant can utilize the 3-D virtual simulation scenario frequently offline, and it also provides a guide to assist him accomplish the skill step by step effectively and proficiently.

3- _Implementation phase:_

For the traditional group:

-The traditional group (103) studentsv were divided into 4 sub-groups (every group was about26 students) These sub-groups took part in the traditional NGT demonstration enrolled in the first year medical surgical nursing1 course and trained by assistant teaching staff in the traditional clinical sessions within 2 weeks.

-The demonstration lasted for 3 hours a day for each sub-group the first sub-group from 9 am: 12 pm &another sub-group from 12 pm: 3 pm   at medical surgical nursing department skill lab. Covering the background about NGT insertion ,it include definition of nasogastric tube (NGT), indication, contraindications, types, complications or side effects of nasogastric tube and technique of NGT insertion, followed by practical training using the available equipment and NGT mannequin.

-The redemonstration for the immediate post trail was done by the students of the traditional group and the first evaluation of their competency skill performance was observed by assistant teaching staff using **tool II (Nasogastric tube insertion checklist)** for 3 hours.

For virtual simulation group:

- Before beginning the training session, the researcher instructed the virtual simulation group group participants to make sure they downloaded and installed the Google Drive's 3-D virtual simulation scenario on their smartphones. The virtual simulation

group (103) students were divided into 4 sub-groups (each sub-group was about26 students).

- The program implementation was conducted in 3sessions, including periods of discussion according to the students' progress and feedback.

- Different teaching and learning methods were used during the sessions which included; group discussions, demonstration and re-demonstration, create instructional videos, technology-based learning to learn student's new practice by using virtual simulation technology.

- The training program was given to each student under the study in order to help for reviewing and support teaching it was written in a simple language and supplemented by photos and illustrations to help the student understanding of the content.

- The training program for the virtual simulation group implemented by using designed 3-D virtual simulation scenario at virtual lab at Faculty of Nursing, Benha University and trained by the researcher over 2 weeks.

The demonstration lasted for 3 hour a day for each sub-group the first sub-group from 9 am: 12 pm &another sub-group from 12 pm: 3 pm.The parts of the training program were divided into 3 sessions ;two sessions for theoretical part and one sessions for practical part . Each session ranged between 45-55 minute , including the period of discussion.

The first session which included theoretical part as follow: knowledge about nasogastric tube insertion; it include definition of nasogastric tube (NGT), indication, contraindications, types, complications or side effects of nasogastric tube the session

The second session which include basic knowledge about definition of simulation , history of simulation , types of simulations in nursing education, definition of virtual reality, basic features of virtual reality, basic types of VR ,virtual simulation, content of virtual simulation , fields of virtual reality, advantages of virtual simulation, disadvantages of virtual simulation, challenges of virtual simulation.

The third session   covered the practical part, the researcher just shared 3-D virtual simulation scenario on the screen in the virtual lab and demonstrated for the study group after ensured that the scenario available on their smartphones (offline) which each student apply the procedure individually on his smartphone, and asked them to train which the scenario allowing the students to repeat the process step-by-step several times after leaving the laboratory.

-**The Redemonstration** for the immediate post trail was done to participants of the VS group and the first evaluation of their competency skill performance was observed by the researcher using **tool II** (Nasogastric tube insertion checklist) for 3 hours for each sub-group in medical surgical nursing lab.

4- Evaluation phase:

It was done four times of implementation of virtual simulation program by using the same data collection tools (Tool I & tool II) ,

for the knowledge by using Tool I at pre and post program implementation(immediately, follow up after one week and after one month) through sharing Google forms link https://docs.google.com/forms/d/e/1FAIpQLSfOIR3G10w6gt3BprKTFJt_Y4KDuuTOoFUODVpMbOaae8HcVA/viewform?usp=sf_link. While for the practice evaluated post program implementation (immediately, follow up after one week and after one month) by using Tool II (observational checklist) in medical surgical nursing labs for both studied participants (traditional &virtual simulation groups):

First evaluation: was done immediate post of implementation of virtual simulation program (during the redemonstration of the procedure).

Second evaluation: was done after 1st week of implementation of virtual simulation program.

Third evaluation: was done after 1st month of implementation of virtual simulation program (at final practical exam). Then comparing the results of immediate post, 1st week& after 1st month of the evaluation for both traditional &virtual simulation groups:

-Finally, the researcher assessed the students' class satisfaction for both groups post one month of training of the virtual simulation skill and traditional training by using **tool III** through sharing Google forms link
https://docs.google.com/forms/d/e/1FAIpQLSfOIR3G10w6gt3BprKTFJt_Y4KDuuTOoFUODVpMbOaae8HcVA/viewform?usp=sf_link

- Each student in both groups (traditional &virtual simulation groups) took about 5 to 7 minutes in evaluation the procedure.

Data Analysis

The collected data were tabulated and statistically analyzed using an IBM computer and the statistical package for social science (SPSS) advanced statistics, version 25 (SPSS Inc., Chicago, IL). Numerical data were expressed as mean and standard deviation. Qualitative data were expressed as frequency and percentage. Chi-square tests were used to compare nominal variables in the two groups. Fisher's exact test was applied on smaller sample sizes, alternative to the chi-square test, when the frequency count is < 5 for more than 20% of cells. For comparing the mean scores in two groups were used to the independent t-tests .Pearson method was used to test correlation between numerical variables. A p-value < 0.05 was considered significant, and <0.001 was considered highly significant.

Results

Table (1): illustrated that distribution of studied nursing students according to their personal data ,which 96.1% and 98.1% with mean age of 19.04 ± 0.19 and 19.02 ± 0.13 traditional and VS groups aged 18-21years old, respectively. Concerning gender, it was found that females were 56.3% and 64.1% of studied nursing students traditional and VS groups, respectively. Regarding of type of secondary school attained 84.4 % and 84.5% were governmental Arabic schools of traditional and VS groups, respectively. While 71.8% and 66.0% of studied nursing student's traditional and VS groups, respectively were place of residence in rural. While 86.4% and 79.6% of studied nursing

student's traditional and VS groups, respectively whose didn't use virtual reality before. There were no statistically significant differences at (p > 0.05).

Figure (1): showed that total knowledge level about nasogastric tube insertion and virtual simulation between the studied groups pre and post training virtual simulation phases. Which 3.9%& 6.8% of traditional and VS groups had average level of total knowledge pre training, respectively. While,14.6%& 58.3% of traditional and VS groups had average level of total knowledge immediate post training, respectively. Also, 8.7%& 83.5% of traditional and VS groups had good level of total knowledge post one week of training, respectively. At the end, 16.5%& 92.2of traditional and VS groups had good level of total knowledge post month of training, respectively

Figure (2): revealed that total practice level about nasogastric tube insertion between the studied groups post training virtual simulation through three phases. which 68% of traditional group had competent level of total practice immediate post training, then lowered to 64.1%& 62.1% had competent level of total practice post one week, post one month, respectively. while 82.5% of VS group had competent level of total practice immediate post training, then increased to 84.5% had competent level of total practice post one week then lowered to 81.6% had competent level of total practice post one month .

Table(2): showed that total mean score of students' class satisfaction post one month (follow up) of training which there were statistically significant differences regarding total mean score of students' class satisfaction 51.23 ± 19.96&57.86 ± 15.04post one month (follow up) of training among traditional and virtual simulation group, respectively at p ≤ 0.05.

Figure (3): revealed that total class satisfaction among the studied nursing students post one month (follow up) of training which 64.1% of the studied nursing students of traditional group had high satisfaction level of training. While 79.6% of the studied nursing students of VS group had high satisfaction level of training.

Table (3): showed that correlation between total knowledge, practice and class satisfaction among the studied nursing students post one month (follow up) of training. Which there was a positive statistical significant correlation between total practice & class satisfaction among traditional group. While there was positive highly statistical significant correlation between total practice and total knowledge for traditional and VS groups, between total practice& class satisfaction for virtual simulation group, and also between total knowledge& class satisfaction for traditional & VS group at p ≤0.001.

Table (1)

Distribution of studied nursing students according to their personal data. Traditional group (n=103) & virtual simulation group (n=103).

Students' personal data	Traditional group (n=103)		virtual simulation group (n=103)		X^2 test P value
	No.	%	No.	%	
Age / years					0.687 0.407 [n.s]
18-<21 y	99	96.1	101	98.1	
21- <24y	4	3.9	2	1.9	
Mean ± SD	19.04 ± 0.19		19.02± 0.13		T= 0.826 0.410 [n.s]
Gender					
Male	45	43.7	37	35.9	1.297 0.255 [n.s]
Female	58	56.3	66	64.1	
Type of secondary school attained					
Governmental Arabic schools	87	84.4	87	84.5	4.620 0.202 [n.s]
Private Arabic schools	7	6.8	10	9.7	
Governmental Language schools	5	4.9	6	5.8	
Private Language schools	4	3.9	0	0.0	
Place of residence					
Urban	29	28.2	35	34.0	0.816 0.366 [n.s]
Rural	74	71.8	68	66.0	
Used virtual reality before					
Yes	14	13.6	21	20.4	1.687 0.194 [n.s]
No	89	86.4	82	79.6	

(n.s) Not significant (p > 0.05)

Fig 1. Comparison of total knowledge level about nasogastric tube insertion and virtual simulation between the studied groups pre and post training virtual simulation periods. Traditional group (n=103) & virtual simulation group (n=103).

X1=0.864, p =0.353   X2=101.829, p=<0.001**
X3=127.64, p=<0.001**   X4= 122.565, p=<0.001**
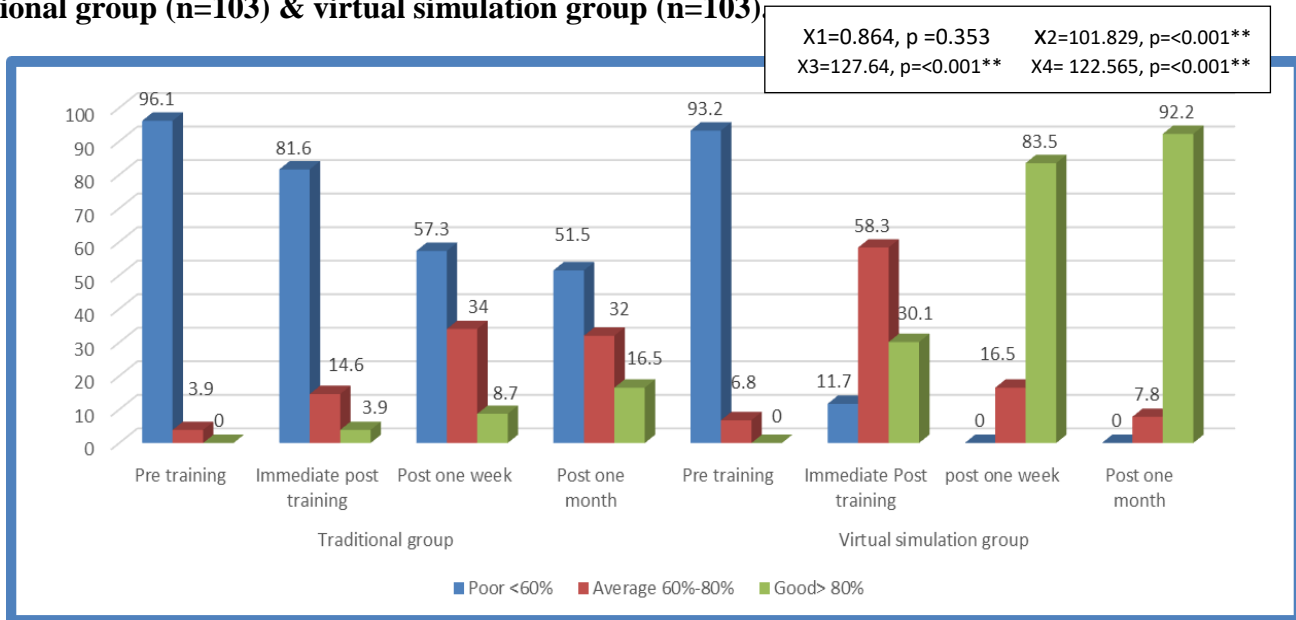
X1: p value for comparing pre training virtual simulation knowledge level between traditional and virtual simulation groups
X2: p value for comparing immediately post training virtual simulation knowledge level between traditional and virtual simulation groups
X3: p value for comparing post one week of training virtual simulation knowledge level between traditional and virtual simulation groups
X4: p value for comparing Post one month (follow up) (follow up) of training virtual simulation knowledge level between traditional and study.

Fig 2. Comparison of total practice level about nasogastric tube insertion between the studied groups post training virtual simulation through three phases. Traditional group (n=103) & virtual simulation group(n=103).

X1=5.863 , p=0.015*

X2=11.203, p=0.001**
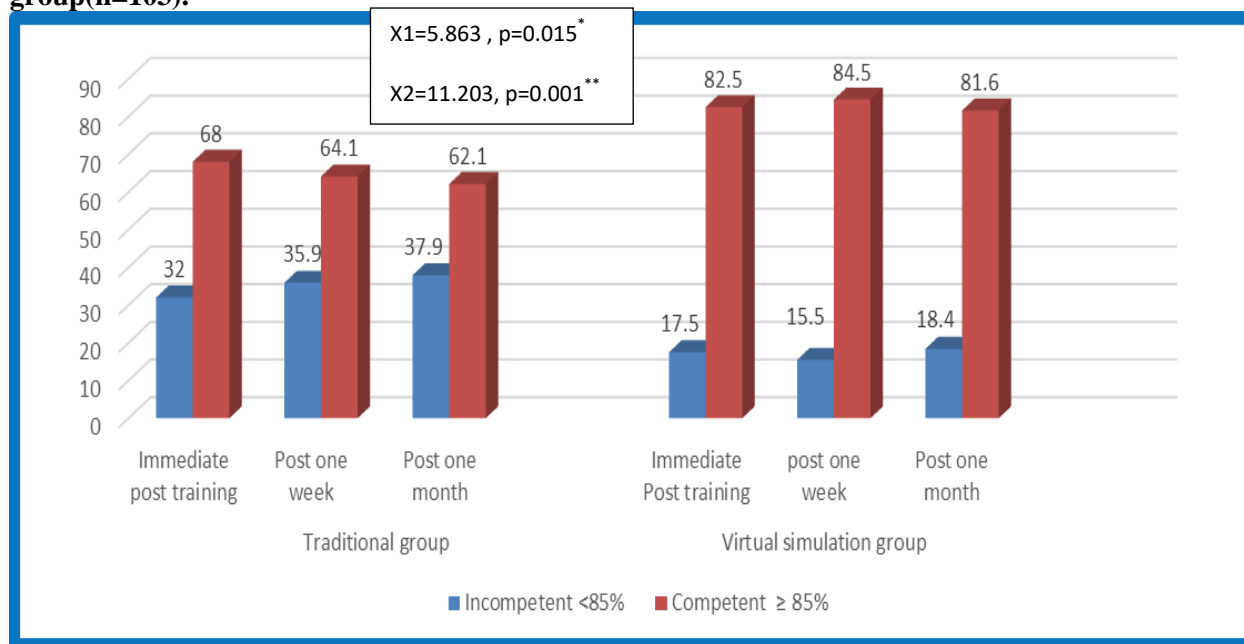
(1) p value for comparing total practice level immediately post training virtual simulation between traditional and VS groups
(2) p value for comparing total practice level post one week of training virtual simulation between traditional and VS groups
(3) p value for comparing total practice level Post one month (follow up) of training virtual simulation between traditional and VS groups

Table (2):Comparison of class satisfaction among the studied nursing students' regarding proficiency post one month (follow up) of training. Traditional group (n=103) & virtual simulation group(n=103).

Students' class satisfaction regarding Proficiency	Traditional group(n=103)						Virtual simulation group(n=103)						$X^{2\ test}$ P value
	Agree		Disagree		Not applicable		Agree		Disagree		Not applicable		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
The student confidently implements the necessary skills.	63	61.2	30	29.1	10	9.7	83	80.6	16	15.5	4	3.9	9.572 0.008*
The scenario covers the scientific content to master the necessary skill.	**60**	**58.3**	**32**	**31.1**	**11**	**10.7**	**82**	**79.6**	**16**	**15.5**	**5**	**4.9**	10.992 0.004*
This scenario provides the knowledge and skills the learner needs to perform the necessary skills.	66	64.1	28	27.2	9	8.7	89	86.4	11	10.7	3	2.9	13.823 0.001**
When the student is confused about any of the steps involved in this scenario, guidance is provided.	65	63.1	29	28.2	9	8.7	90	87.4	10	9.7	3	2.9	16.289 <0.001**
The student obtains a clear explanation of how to use the scenario.	**65**	**63.1**	**28**	**27.2**	**10**	**9.7**	**87**	**84.5**	**12**	**11.7**	**4**	**3.9**	12.156 0.002*

(*) Statistically Significant at ≤0.05 (**) Highly statistically significant at ≤0.001

Fig 3. Comparison of total class satisfaction among the studied nursing students post one month (follow up) of training. Traditional group (n=103) & virtual simulation group (n=103).
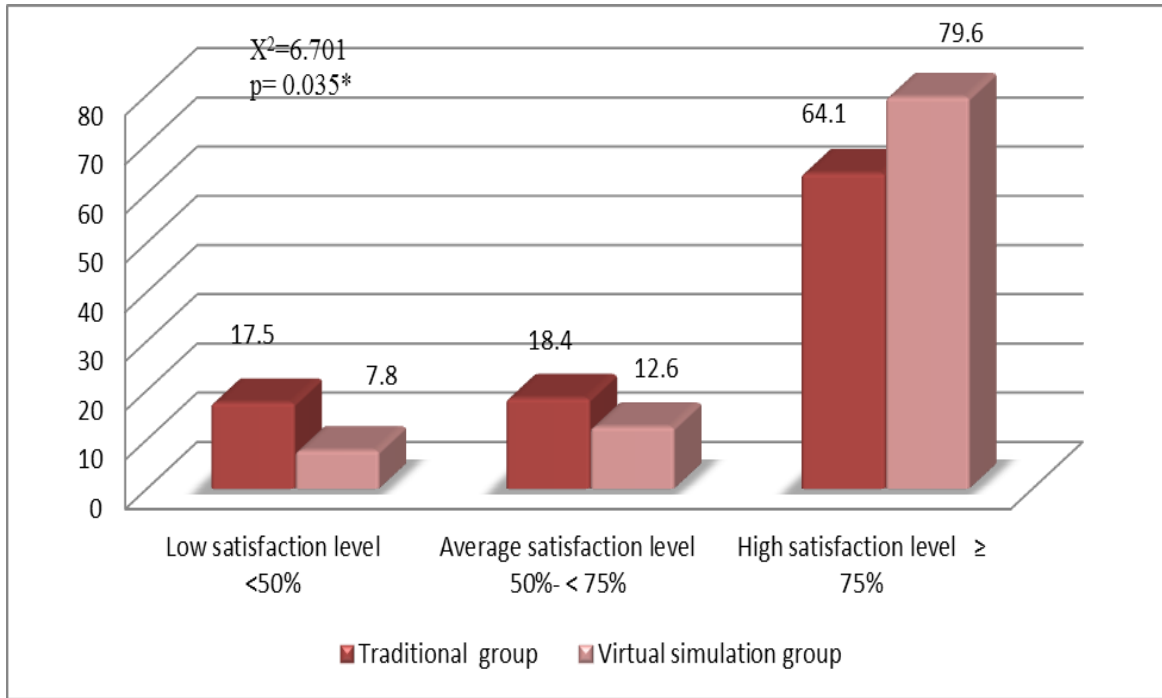

Table (3) Correlation between total knowledge, practice and class satisfaction among the studied nursing students Post one month (follow up) of training. Traditional group (n=103) & virtual simulation group (n=103).

r-\ p values variable	Studied groups	Total knowledge		Total practice	
		R	P value	r	P value
Class satisfaction	Traditional group	0.384	<0.001**	0.125	0.029*
	Virtual simulation group	0.491	<0.001**	0.311	0.001**
Total knowledge	Traditional group	-	-	0.409	<0.001**
	Virtual simulation group	-	-	0.518	<0.001**

(*) Statistically significant at ≤0.05   (**) Highly statistically significant at ≤0.001

Discussion

Nursing professionals face difficult challenges when it comes to learning and understanding skills because their profession requires a lot of precision. One skill that requires accuracy is insertion of nasogastric tubing into the nasal cavity of patients who are experiencing complications that prevent them from swallowing solid food orally; incorrect tube insertion by a nurse can result in a complication such as an inability to ingest solid food orally. Using virtual simulation scenario in teaching helps to develop a realistic environment that exposes students to real-life situations. And it provides a step-by-step visual that puts the theory into a practical perspective (**Janiszewska et al., 2021**).

Concerning of students' personal data. Regarding age, the present study revealed that most of the students in study groups were with age 18-<21 y, whereas a minority of them was found in age 21- <24y years old. **Regarding gender,** more than half of studied nursing students both groups were females. **Regarding type of secondary school attained** near to majority of studied nursing students both groups were Governmental Arabic Schools. **Concerning place of residence**, about two third of studied nursing student's both groups were in rural. **Regarding using virtual reality before**, about one fifth of studied nursing students virtual simulation group use virtual reality before, while more than three quarters of them don't use virtual reality before. From the researcher view, this means that the students have not experience about virtual reality so it give the researcher high chance to develop their knowledge and practice through the training sessions by using virtual simulation scenario.

This finding supported by **Mahmoud et al., (2024)** who conducted the study entitled "*Effect of Using Virtual Reality Simulation versus Instructor-Led Demonstration on*

Nursing Students' Clinical Performance and Self-efficacy" reported that the less than three quarter of VRS (Virtual reality simulation) group and more than three quarter of the I-LD (Instructor-Led Demonstration) group aged between 20 to less than 21 years. While minority of VRS group& quarter of the I-LD group aged from 21 to 22 years. And about three quarters of the VRS group were females.

Also, This result supported with **Mohammed and Farag (2019)** who studied" *Effect of self-instructional module on knowledge and practice of nursing students regarding tube feeding insertion"* showed that more than quarter of the studied nursing students had the certificate of secondary school from governmental Arabic schools. And this result supported with **Apsari et al. (2023)** who studied" *Virtual Reality Effectivity To Increase Self-Efficacy In Suction Skill Among Nursing Student: Quasi Experiment Study "* that found the majority of respondents do not have experience about using virtual reality.

Concerning of total knowledge level about nasogastric tube insertion and virtual simulation between the studied groups pre and post training virtual simulation periods, the present study revealed that minority of the studied nursing students of traditional and VS group had average level of total knowledge about nasogastric tube insertion and virtual simulation at pre training, respectively. While immediate post training were minority for traditional group and more than half for VS group had average level of total knowledge about nasogastric tube insertion and virtual simulation. Also, post one week of training were less than minority for traditional group and more than three quarter for VS group had good level of total knowledge. At the end, level of total knowledge were less than minority for traditional group and raised to most of the studied nursing students VS group had good

level of total knowledge about nasogastric tube insertion and virtual simulation post month of training.

This finding supported the first research hypothesis (H1) which stated that the training virtual simulation skill will have positive effect on knowledge of nursing students VS group compared with traditional group. From the researcher's point of view, the training through virtual simulation skill had a long-term impact of level of knowledge for the nursing students. Over time, the students' level of knowledge increased as a result of their continuous practice of the skill through using virtual simulation scenario.

This result supported by **Lo et al., (2022**) who study *"Effectiveness of immersive virtual reality training in nasogastric tube feeding education: A randomized controlled trial "* which found in his study that the nasogastric tube feeding knowledge improved significantly after intervention in the immersive virtual reality(IVR)and control groups. The IVR group scored significantly higher in the IVR than the control group on task value, and satisfaction.

While this finding disagreed with **Chang et al., (2021)** studding *" The effects of a virtual simulation-based, mobile technology application on nursing students' learning achievement and cognitive load: Randomized controlled trial"* who mentioned that nursing students' knowledge in nasogastric tube feeding were significantly improved after intervention in both groups. Although there were no significant differences in students' knowledge between the two groups.

Concerning for total practice level about nasogastric tube insertion post training virtual simulation through three periods of training, the results of the current study revealed that more than two third of traditional group and more than

four fifth of VS group had competent level of total practice about nasogastric tube insertion immediate post training , while decreased to less than two third of traditional group and raised to near to majority of VS group had competent level of total practice about nasogastric tube insertion post one week then lowering to less than two third of traditional group while more than four fifth of VS group had competent level of total practice about nasogastric tube insertion post one month.

From the researcher point of view, the study showed that there is a general improvement of practicing nasogastric tube insertion post three phases of the training for VS group. Which found that their practice level increased after the first week of training, then decreased to a level that the students acquired at the beginning of the training. Thus, their practice level was maintained over time due to the availability of teaching method that would help them to do the practice constantly. Therefore, the second hypothesis (H2) which stated that "The training virtual simulation skill will have positive effect on clinical practice of nursing students study group compared with control group " was accepted.

This finding was supported by *Mahmoud et al. (2024)* who reported that most of the students in VRS group and more than four fifth of the students in ILD group had a good level in total performance. On the contrary, this finding disagreed with *Chang et al., (2021)* who mentioned that there were no significant differences in students' skill between the two groups. ($t = 2.302$, $p = 0.026$).

Concerning of total mean score of students' class satisfaction post one month (follow up) of training between traditional and VS groups, the current showed that there were statistically significant differences regarding total mean score of students' class satisfaction

(51.23 ± 19.96&57.86 ± 15.04) Post one month (follow up) of training among traditional and virtual simulation groups, respectively at p ≤ 0.05.

This study finding agree with a study conducted by *Innab et al., (2022)* who studied" *The influence of sense of community and satisfaction with e-learning and their impact on nursing students' academic achievement"* that found the total students' satisfaction score was high (M = 3.99, SD = 1.00), indicating that students were satisfied with the e-learning system.

While this result disagree with **Yoon et al., (2024)** who studied ″ *Virtual Reality Simulation-Based Clinical Procedure Skills Training for Nursing College Students: A Quasi-Experimental Study"* that found There were no statistically significant differences in learning satisfaction between the experimental and control groups (F = 0.668, p = 0.416) .

Regarding total class satisfaction among the studied nursing students' post one month of training, the current study revealed that less than two third of the studied nursing students of traditional group had high satisfaction level about nasogastric tube insertion Post one month (follow up) of training. While more than three quarters of the studied nursing students of VS group had high satisfaction level about nasogastric tube insertion Post one month (follow up) of training. From the researcher point of view, increase student satisfaction level to high level as result of effect of this method (virtual simulation training) as an easy and straight forward way that enables students to continue without getting bored. Thus, it would enable the clinical procedures to be performed without allowing nursing students to feel overloaded and boring.

Therefore, the third hypothesis (H3) which stated that "The training virtual simulation

skill will have positive effect on class satisfaction of nursing students study group compared with control group " was accepted.

This study finding was in same line with a study conducted by **Bai & Manomozhi (2022)** who studied" The Satisfaction, Perception, Attitude, and Impact of Virtual Learning among Nursing Students" that found more than one half of the nursing students were satisfied with the virtual learning. But inconsistent with a study conducted by **Natarajan & Joseph (2022),** who studied" Impact of emergency remote teaching on nursing students' engagement, social presence, and satisfaction during the COVID-19 pandemic " Showed that, more than two third of the studied nursing students have low level of total academic satisfaction and more than one quarter of them have high level of total academic satisfaction.

Concerning correlation between total knowledge, practice and class satisfaction among the studied nursing students' Post one month (follow up) traditional and virtual simulation groups The current study revealed that, there was positive highly statistical significant correlation between total knowledge and both total practice & class satisfaction (learning outcomes) among group that uses virtual simulation as teaching strategy. **From the researcher's point of view,** virtual simulation was a successful teaching strategy because it fostered learning dependency, which in return improved students' knowledge and practice, ultimately leading to a high level of student satisfaction.

This finding is highly supported with *Mahmoud et al., (2023)* who titled ″ *Designing and Implementing Virtual Classes about Medication Safety among Intern Nurses"* who reported that there was positive statistically significant correlation between

total knowledge toward virtual classes and practice at immediately post and follow-up intervention phase.

Also, This finding with the same line with **Mahrous et al., (2024)** who titled *" The impact of biophilic attributes on university students level of Satisfaction: Using virtual reality simulation"* Which has resulted in a high positive correlation between performance assessments with the level of satisfaction by Using virtual reality simulation.

Conclusion

Based on the results of the present study and research hypothesis, the following can be concluded that:

The minority of the studied nursing students of traditional group had good level of total knowledge about nasogastric tube insertion and virtual simulation post month, while the most of the studied nursing students of VS group had good level of total knowledge about nasogastric tube insertion and virtual simulation post month of training. concerning total practice level less than two third of the studied nursing students of traditional group had competent level of total practice about nasogastric tube insertion post one month, while more than four fifth of the studied nursing students of VS group had competent level of total practice about nasogastric tube insertion post one month.

Concerning of total class satisfaction among the studied nursing students' more than half of the studied nursing students of traditional group had high satisfaction level about virtual simulation training post one month of training, while more than three quarter of the studied nursing students of VS group had high satisfaction level about traditional training post one month of training.

Recommendations

In the light of the results of the present study, the following recommendations are suggested:

A-For faculty:

1- Incorporating virtual simulation an effective teaching strategy that provides nursing students with a safe and effective teaching environment, with traditional teaching in different nursing clinical courses to enhance nursing students' performance in clinical settings.

2 -Provide courses at educational institutions about virtual learning for both nurse educators and students.

3-Evaluating obstacles in implementation virtual simulation and put different strategies for solving it.

B- For nursing students

1-Designing training program for nursing students about virtual simulation to increase the effectiveness in applying virtual skill.

2-Conducting training course periodically for nursing students about virtual simulation for improving their satisfaction regarding virtual simulation training.

C- For study (future study):

1-Replication of the current study on larger probability sample and different clinical nursing course is recommended to achieve generalizable results and wider utilization of the teaching strategy.

2-Examine the effect of virtual simulation as a teaching strategy in critical thinking, self-confidence, and creativity.

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