

Effect of Virtual Lab Training for critically care Nursing students on Achievement Competency Basic Skills

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Abstract

Background: Virtual lab training can give nursing students a safe clinical experience involving high risk conditions where access to intensive care units is limited. So, competent and safe intensive and critical care nursing is based on the knowledge, experiences and skills that can be acquired through several forms of simulation education such as virtual lab training. **Aim:** This study aims to assess the effect of virtual lab training for critically care nursing students on achievement competency basic skills. **Design:** A quazi experimental design was be utilized. Setting: At Faculty of Nursing -Ain Shams University at Cairo - Egypt. **Sample:** A purposive sample of ($N = 150$) second year nursing students were be recruited in the current study. **Tools:** three tools were be used to collected data related to achieve the aim of the present study as following I- self-administrated questionnaire and II- Nursing students' observational checklist & III- Students' satisfaction scale regrading achievement competency basic skills post virtual lab training. **Results:** reveals that, the total competent level of students' skills through three times of observation was improved gradually, whereas 52.7% of them had competent level of skills at first observation, 79.3% of them had had competent level of skills at second observation and 92.7% had competent level of skills at third observation. **Conclusion:** The implementation of virtual lab training had a significant positive improvement on achievement competency basic skills among critically care nursing students. **Recommendations:** Designing the virtual reality simulation programs can expand the nursing students' practice experience in safe virtual spaces and enhance their performance, self-efficacy and learning satisfaction.

Key words: *Competency basic skills, Critical care nursing students, Virtual lab training*

Introduction

Nursing is a complex profession, requiring a good knowledge base and critical thinking skills. Therefore, the aim of nursing education is to produce a competent practitioner, adept in basic knowledge and with the ability to apply critical thinking. Competency involves both the ability to perform in a given context and the capacity to transfer knowledge and skills to new tasks and situations. Performance criteria' outline steps should be followed to achieve competency. The goal of practical clinical education in nursing is to improve the clinical abilities of nursing students by giving them first-hand experience in applying their skills to patients under complex, real-world conditions (Azam et al., 2019).

However, lacks legal protections against liability for nursing students' actions, and the

health rights of medical consumers and the importance of patient safety management must be considered. Thus, students' practical training focuses more on observation and ancillary tasks than on direct skill application to patients, and many obstacles must be overcome to enhance students' clinical practice abilities (Osman et al, 2019). In compensating for these constraints, several forms of simulation education have been developed. These include use of the following scenarios such as virtual reality (VR). The simulation learning methods involves the creation of an artificial environment experienced through sensory stimuli (such as sights and sounds) provided by a computer, and with high-level VR simulation, the user's actions partially determine changes in the environment (Yu et al., 2021).

Virtual lab is considered effective learning approach used to incorporate realistic

clinical training in a controlled environment and help students to expand their cognitive and psychomotor skills. It provides the students with the knowledge, skills and confidence in applying different procedures like advanced cardiac life support, electrocardiogram (ECG) analysis via the appropriate setting for clinical training (Tawalbeh & loai 2020). virtual lab training (case scenario) is based on using a computer or a smart phone with open access of network. It includes different levels through which the students get information and answer questions to pass from level to level about case scenario (Dante et al., 2021).

Competence is the written statement which refers to the combination of knowledge, skills and attitudes of a person who performs at a predefined level and takes into consideration the broader practice implications and its effects on patients. Additionally, competence is defined as: “The combination of skills, knowledge and attitudes, values and technical abilities that underpin safe and effective critical care nursing care and interventions”) (Baumgartner et al., 2021)

Competency basic skills means that critically care nursing students had ability to master all knowledge available, professional skills, behaviors and values in their daily performing of their duties that promote them to provide competent and superior care for patients in various contexts of health care setting. The focus on continuing competence requires creative deliberation and redefinition of the categories of practice competencies and related skills. These competencies are efficiently encompassing the following domains (professional and ethical practice, holistic patient-centered care, informatics and technology) (Hung et al., 2020).

Critical care nursing students should be providing direct care to critical ill patients in numerous settings with high level of competency. On other hand, one of the challenges for nursing educators was the assessment of nursing students’ clinical knowledge, skills, and competence. Now, with improvements in technology situations can be standardized, and performances can be easily monitored and recorded in and through the

virtual worlds. Adaptation to the changing demand for quality and safe nursing care, as well as the emergence of innovation in health care technology, educators and the academe is commissioned to train the students in such a manner that the outcome of learning exhibits the proficiency expected (sheykhasadi et al., 2019).

Significance of the study

The implementation of virtual lab training enables the students to learn various skills and make mistakes safely without being burdened with guilt or anxiety though reflection and retention of experience (Shorey & Ng 2020). In the current study the researchers were designed virtual lab training (case scenario) for critical nursing students regrading care of patients with acute respiratory distress syndrome (ARDS), because, it is high risk health condition affect respiratory function among critical ill patients. So that, the present study aimed at, assess the effect of virtual lab training for critically care nursing students on achievement competency basic skills.

Aim of the Study

This study aims to assess the effect of virtual lab training for critically care nursing students on achievement competency basic skills through the following:

1. Assessing knowledge of critically care nursing students regarding care of patients with acute respiratory distress syndrome pre and post theoretical lecture.
2. Developing and implementing virtual lab training (case scenario) for critically care nursing students regarding care of patients with acute respiratory distress syndrome based on nursing students identified needs explored during pre-assessment.
3. Evaluating the effect of virtual lab training (case scenario) on critical care nursing students’ skills regarding care of patients with acute respiratory distress syndrome through three observations.

4. Assessing students' satisfaction regarding achievement competency basic skills post virtual lab during third observation.

Research Hypothesis:

To achieve the aim of this study, it was hypothesized that the implementation of virtual lab training will have gradually significant positive improvement on achievement competency basic skills among critically care nursing students.

Research design:

a quasi-experimental (pre/post-test design) used to achieve the aim of this study to assess the effect virtual lab training on achievement competency basic skills among critical care nursing students. Quasi-experimental research is comparable to experimental research that an independent variable is manipulated. It is distinct from experimental research because there is either no control group and no random selection (Sirisilla, 2023).

Study setting:

The study was carried out at Faculty of Nursing -Ain Shams University. The students get access to the computer or a smart phone based on virtual lab training (case scenario) regarding care of patients with acute respiratory distress syndrome through the link exists in the educational platform for second year critical care nursing students in addition to WhatsApp group. Then, assessment nursing students' basic skills regarding care of patients with ARDS was done in their training area at Ain Shams University hospitals through critical care units of Ain Shams University hospital

Sample:

A purposive sample of ($N = 150$) second year nursing students were informed about the study by advertisements placed on Blackboard, a web-based platform, and invited to participate by undertaking a virtual lab training. An information statement was provided and students were asked to participate in the current study. The sample size was calculated according to the total number of

nursing students in year 2022-2023 was 536 and based on the following assumption:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

n = the required sample size

t = the confidence level at 95% (standard value of 1.96)

p = estimated prevalence of virtual lab simulation problems among critical care nursing students.

m = the margin of error at 5% (standard value of 0.05).

Tools applied:

The researchers used three tools to assess the effect of virtual lab training for critical care nursing students on their achievement of competency basic skills regarding care of patients with ARDS.

Tool 1: self-administrated questionnaire: It was developed by the researchers and include two parts:

Part I: nursing students' demographic data include five questions about (age, gender, overall grade of pervious year, attendance of training courses regarding care of patients with ARDS and previous experience regarding virtual lab.

Part II: nursing students' knowledge regarding care of patients with acute respiratory distress syndrome assessment tool: it was developed by the researchers to cover the following competency "professional and ethical practice" after reviewing the recent related literature (Diamond, et al., 2023 & Wang, et al., 2021), it involved 28 questions in the form of multiple-choice questions and distributed on four subtitles as following (disease process 10 MCQ, medication 4 MCQ, lab investigations 5 MCQ & nursing intervention 9 MCQ).

Scoring system, the total score of knowledge was 28 grades. Each correct answer was given one mark and the incorrect answer

was given zero. Based on statistical approach. It was considered that:

- $\geq 85\%$ was satisfactory level of knowledge (≥ 24 grades correct answers).
- $< 85\%$ was unsatisfactory level of knowledge (< 24 grades correct answers).

Tool 2: Nursing students' observational checklist regrading care of patients with ARDS: this tool was designed by the researchers to cover the competency of holistic patient-centered care after reviewing the related literature (Renton, et al., 2020). It was used to assess nursing students' level of skills regrading care of patients with ARDS. It was included the following skills:

- Immediate care (ABCDE) 17 steps
- Care of mechanical ventilator 27 steps
- Care of endotracheal tube 37 steps
- Care of central venous catheter 19 steps
- Care of urinary catheter 23 steps
- Infections control measures 17 steps

Scoring system, the total score of nurses' practices was 140 marks, each step done correctly was given one mark and zero for the step which was not done or done incorrectly. Based on the critical care approach it was considered that:

- $\geq 85\%$ was competent level of skills when the total correct action ≥ 119 grades.
- $< 85\%$ was incompetent level when the total correct action < 119 grades.

Tool III: Students' satisfaction scale regrading achievement competency basic skills post virtual lab training; it was consisted of 18- items adapted from (Levett-Jones et al.,2011) & (Hung et al, 2020) to cover the competency of informatics and technology. It is divided into three subsections (debriefing & reflection, clinical reasoning and clinical learning). Debriefing and Reflection was included nine items aimed to evaluate nursing students' perception regarding debriefing and reflection after their virtual experience. Clinical reasoning subsection was included five items and the clinical learning subsection involved four items aimed to evaluate nursing students' clinical reasoning and clinical learning skills

Scoring system of nursing students' satisfaction regrading virtual lab training was categorized according to students' responses; (strongly agree= 5, agree= 4, neutral= 3, disagree=2 & strongly disagree=1). The range score was from 18 to 90. Higher scores meaning high students' satisfaction regrading three subsections (debriefing & reflection, clinical reasoning and clinical learning. The total score was categorized based on statistical approach as following:

- $\geq 85\%$ was students' satisfaction regarding virtual lab when the total grades ≥ 76 .
- $< 85\%$ was students' unsatisfaction regarding virtual lab when the total grades < 76 .

Validity and reliability: Testing validity of the tools was reviewed by a panel of five experts in the Critical Care & Emergency Nursing faculty staff to ascertain their clarity, relevance, comprehensiveness, simplicity, and applicability; there was no modification done. Testing reliability of the proposed tools was done statistically by alpha Cronbach test for nursing students' knowledge was 0.791, for nursing students' observation checklist was 0.806 and nursing students' satisfaction was 0.771 that indicate high reliability of the used tool.

Research implementation:

Administrative design:

The research approval was obtained from scientific research ethical committee in faculty of nursing at Ain Shams University before starting the study. the necessary approvals were obtained from the medical director of Ain Shams University Hospital.

Ethical considerations and human rights: the research approval was obtained from scientific research ethical committee in faculty of nursing at Ain Shams University before starting the study on March 2023 by study number 23.06.79. There was no risk for the participants in the study during application of the study, also there was no effect on their academic level. The researchers explained the aim of the study to participants included in the study. Confidentiality and anonymity were be

maintained for participants in the study also, they informed to choose to participate or not in the study and that they have the right to withdraw from the study at any time.

Pilot study was carried out on 10% of the total number of the study sample to test the applicability, clarity, and efficacy of the study tools. No modifications on tools were done, so that the critical care nursing students who included in the pilot study were included in the main study group.

Field work:

Data collection for this study was carried out in the period from March 2023 to May 2023. The tools were developed by the researchers based on reviewing the recent and related literature to assess the effect of virtual lab training for critically care nursing students on achievement competency basic skills regrading care of patients with ARDS.

Once the approval was obtained from the scientific ethical committee at the faculty of nursing - Ain Shams University and the agreement was obtained from critical care nursing students who participated in the current study. in addition to, the agreement from the medical director of Ain Shams University hospital.

The researchers explain the purpose of the study to all nursing students included in the study prior to data collection inside the class room, then the researchers started to assess the background knowledge of the critical care nursing students regarding care of patients with acute respiratory distress syndrome by using the tool I, that was taken 30 minutes before and after the lecturing about ARDS that followed by focus group discussions in addition to audiovisual materials.

The link of virtual lab (case scenario) was sent for critical care nursing students regrading caring for patients with ARDS by the researchers through the group of WhatsApp. The case scenario was summarized in the following text “adult female patient 55 years old, had a motor vehicle accident while crossing an intersection. No significant head injury. She does present with bilateral pulmonary

contusions. The patient was unable to sustain a systolic blood pressure greater than 90 mmHg. The patient was transferred from the emergency room to respiratory ICU. She is on a ventilator with no spontaneous respiration present. Complete radiological and laboratory investigation was done. All prescribed medication was taken. Nursing care for this patient included immediate care (airway, breathing, circulation, & exposure) (ABCDE), care of mechanical ventilator, care of endotracheal tube, central venous catheter care, care of urinary catheterization through following infection control measures”.

The case scenario was included the learning objectives based on these competencies (professional and ethical practice, holistic patient-centered care, informatics and technology). It was consisted of four scenes as following:

First scene entitled with initial assessment; it concerned with pre scenario learner activities concerning with (perquisite competencies (knowledge and basic skills), patient’s profile (present, past & family history, physical examination, current medications, laboratory investigation & diagnostic study results).

Second scene entitled emergency management; revision on case regrading patients’ vital data, lab investigations & diagnostic procedures, medical orders, medication, supplies needed to provide nursing care. Third scene entitled with on admission to intensive care unit. fourth scene entitled with after 24 hours at beginning stage of ARDS.

Critical care nursing students were handled the link of virtual lab, with some explanations from the researchers regarding its importance.

After the virtual lab training was implemented for all students included in the current study the researchers used observational checklists (second tool) for assessing students’ competency level of basic skills regarding care of patients with ARDS through three times of observations according to hospital plan for students’ training at critical care units in Ain shams university hospital. 1st observation at the

end of March, 2nd observation at the beginning of April and 3rd observation at the end of April. The observational checklists were taken about 10 minutes for each student.

The total number of students 150 included in the study divided into six small groups, each group involved 25 students and each researcher was responsible for evaluating two small group during their attendance in clinical areas to follow their level of competency during their training period in hospital.

Students training at critical care units in Ain Shams hospital was held each Monday and Wednesday from 8:30 am to 2:30 pm. The researchers were available in the morning and afternoon shift through two days per week for 6 weeks in parallel. whereas two small group of the students included in the study were evaluated per clinical day by researchers. Tool II was taken about 10-15 minutes for each student.

Finally, the assessment of nursing students' satisfaction regarding virtual lab experience was implemented post third observation of virtual lab training. It was filled by students through 10 minutes

Results

Data in **table 1** shows that the mean age of the students included in the study was 21.3 ± 1.1 whereas 91.3% of them their age group ranged from less than to equal 20 years. Also, 88.7% of them were females. Regarding grade of previous year 37.3 of them were good, 100% of them were having experience about virtual lab. 80.7% of them not getting knowledge regarding care of patients with ARDS.

Comparison between total mean score of correct nursing students' knowledge regarding care of patients with ARDS pre and post theoretical lecture **table (2)** shows that, there were

statistically significant difference in all items of knowledge about (disease process, investigations-diagnostic procedures, medications and nursing care of patients with ARDS) among students included in the study post theoretical lecture compared to pre theoretical lecture, with p -value equal (<0.001).

Figure 1 reveals that, the total satisfactory level of knowledge among the students included in the study were 85.3% posttest after theoretical lecture compared to pretests before theoretical lecture which was 14.7%.

Comparison between total mean score of competent level of nursing students' skills regarding care of patients with ARDS post virtual lab training through three times observations. The results in **table 3** shows that, there were statistically significant differences in all items of nursing skills included immediate care (ABCDE), care of mechanical ventilator, care of endotracheal tube, central venous catheter care, urinary catheterization care and following infection control measures", with p -value equal (0.000*).

Figure 2 reveals that, the total competent level of students' skills through three times of observation was improved gradually, whereas 52.7 % of them had competent level of skills at first observation, 79.3% of them had had competent level of skills at second observation and 92.7% had competent level of skills at third observation

Figure 3 shows that, the total nursing students' satisfaction regarding achievement competency basic skills post virtual lab through third observation was 90.7%, 91.3% and 89.3% regarding clinical learning, clinical reasoning and debriefing and reflection respectively.

Table 4 shows a positive correlation between total satisfactory level of knowledge and total competent level of skills among students included in the study during third observations with P value = (0.001*).

Table (1): Demographic characteristics of critical care nursing students included in the study (n=150)

Students' demographic characteristics	No.	%
Age (years)		
Less than or equal 20 years	137	91.3
More than 20 years	13	8.7
Range	25-20	
Mean \pmSD	21.3 \pm 1.1	
Gender		
Male	17	11.3
Female	133	88.7
Overall grade of previous year		
Accepted	48	32
Good	56	37.3
Very good	33	22
Excellent	13	8.7
Having experience about virtual lab		
Yes	150	100
No	0.00	0.00
Getting knowledge regarding caring of patients with ARDS		
Yes	29	19.3
No	121	80.7

Table (2): Comparison between total mean score of correct nursing students' knowledge regarding care of patients with ARDS pre and post theoretical lecture (n. =150).

Total correct knowledge	Pre	Post	Pre vs. post	
	Mean \pm SD	Mean \pm SD	t-test	p-value
knowledge regarding disease process of ARDS	25.03 \pm 0.36	88.57 \pm 21.37	5.012	0.001*
knowledge regarding lab investigations & diagnostic procedures	20.03 \pm 0.23	86.31 \pm 21.43	4.708	0.001*
knowledge regarding Medications of ARDS	21.3 \pm 0.24	87.53 \pm 21.40	4.667	0.001*
knowledge regarding Nursing care for patients with ARDS	28.3 \pm 0.32	88.52 \pm 21.38	5.017	0.001*

p-value>0.05 NS; ***p-value* <0.001 HS

Figure (1): Students' total satisfactory and unsatisfactory level of knowledge regarding care of patients with ARDS pre and post theoretical lecture

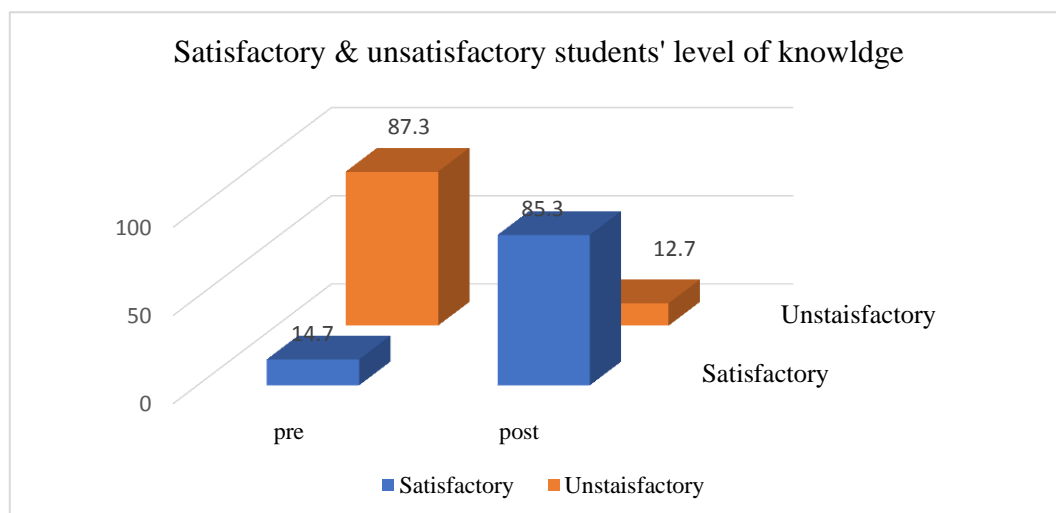


Table (3): Comparison between total mean score of competent level nursing students' skills regarding care of patients with ARDS post virtual lab training through three times observations (n.=150).

Total competent level nursing students' skills	1 st Observation	2 nd Observation	3 rd Observation	test & p- value	
	Mean ±SD	Mean ±SD	Mean ±SD	t-test	p-value
Immediate care (ABCDE)	78.33± 3.40	117.6± 6.73	138.7 ±10.2	3.081	0.000*
Care of mechanical ventilator	76.41 ±3.36	118.9 ±7.49	141.3± 9.6	4.031	0.000*
Care of endotracheal tube	78.31± 3.37	118.4 ±7.81	140.1 ±11.4	4.072	0.000*
Care of Central venous catheter	78.32± 3.38	119.7± 7.88	145.0 ±12.8	5.071	0.000*
Care of urinary catheter	78.33 ±4.73	118.6 ±7.71	144.4 11.7	3.056	0.000*
Infection control measures	79.60 ±4.33	117. 4± 6.71	146.1 ±10.6	5.022	0.000*

*p-value <0.001 S

Figure (2): Total competent and incompetent level of students' skills regarding care of patient with ARDS through three times observations (n.=150).

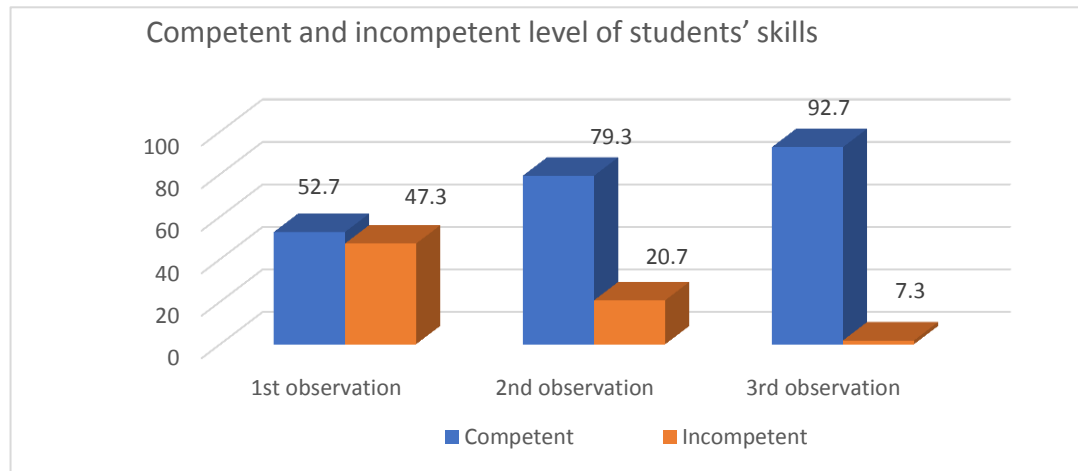


Figure (3): Percentage distribution of total nursing students' satisfaction regarding achievement competency basic skills post virtual lab through third observation (N=150).

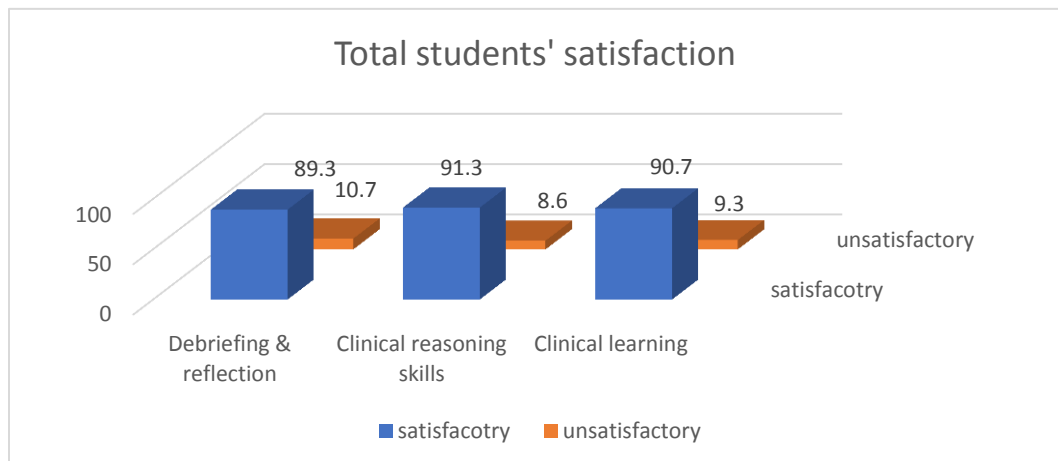


Table (4): Correlation between total satisfactory level of knowledge and total competent level of skills through third observation among students included in the study

Correlation (<i>r</i>)	Total satisfactory level of knowledge	
	<i>r</i> test	<i>p</i> value
Total competent level of skills during third observation	0.572	0.001

Discussion

The critical care environment is a constantly changing field with emerging technologies and therapies to aid patient recovery through the often-life-threatening illness. Critical care nursing student should be trained on some of these technologies in nursing practice such as virtual lab training that allow students to provide safe, high quality of care for patients who experience critical illness. Virtual lab training encourages nursing students to learn and achieve competence in a safe context through the provision of feedback and self-correction. Achievement competency basic skills is a fundamental concept in nursing which has a direct relationship with quality improvement of patient care and support improvements in the critical care environment through continuously enhancement in nursing practice. So that, the researchers conducted the current study to assess the effect of virtual lab training for critically care nursing students on achievement competency basic skills.

Concerning demographic characteristics of the critical care nursing students included in the current study, the result revealed that; the mean **age** of them was 21.3 ± 1.1 with majority age ranged between less than or equal 20 years. From the researchers' point of view, this age group is the most common among the studied students according to their studying consequence. This finding was in agreement with a study done by **Lee, & Han (2022)** who study "Development and evaluation of a virtual reality mechanical ventilation education program for nursing students" and found that the mean age of students was 22.8 ± 1.51 .

Regarding **gender**, the study result revealed that most of the studied students were females. The reason of this result may be due to females have the greater interest in studying nursing in Egypt. In addition to, the studying of nursing in Egypt were exclusive for females only till a few years ago. This result supported

by **Alfatih, et al., (2022)** who study "Knowledge, attitude and practice of medical students towards COVID19 in Sudan: A cross sectional study among 19 universities" who found that, most of the students was female.

In relation to **overall grade of previous year**, the study result revealed that near than two fifth of the studied students had a good degree. From the researchers' point of view, this finding may be due to the statistical analysis to calculate the sample size of students included on the current study based on their total number in each grade of previous year form the following grades accepted, good, very good and excellent. These results are inconsistent with **Komsan, & Dogham (2022)**. Who studied "Effect of Virtual Flipped Classroom on Critical Care Nursing Students' Knowledge regarding Acute Respiratory Disorders and Learning Approach" and found that near to three quarters of students had excellent degree.

In concern to students' **experience about virtual lab**, the study result revealed that all of students have experience about virtual lab. The reason for this result may be due to virtual lab training was applied for all students in the faculty of nursing -Ain shams university at different academic groups, from the first year until fourth years based on the nursing curriculum in each year. Furthermore, the interesting of the students to pass the training of virtual lab, because it considers a new technology in nursing education for acquiring basic knowledge and skills regrading caring for patients especially in critical care units. This finding is inconsistent with **Firoozjaie (2022)**. Who carried out study entitled " Knowledge, Attitude, and Practice toward Prevention of COVID-19 Among Nursing and Midwifery Students: A cross-sectional Study in Gorgan, Northern Iran " and found that near to two fifth of students had experience about virtual lab.

Comparison between total mean score of correct nursing students' knowledge regarding

care of patients with ARDS pre and post theoretical lecture, the results of the current study revealed that there were statistically significant differences in all items of knowledge about (disease process, investigations-diagnostic procedures, medications and nursing care of patients with ARDS) among students included in the study post theoretical lecture compared to pre theoretical lecture, with p -value equal (<0.000). This result may be due to the researchers have used theoretical lecture prior the virtual lab training, as it is one of the most widely used traditional teaching methods for students to acquire information, and to ensure the achievement of competency basic skills. These results are not matched with **Komsan, & Dogham (2022)** who done study about "Effect of Virtual Flipped Classroom on Critical Care Nursing Students' Knowledge regarding Acute Respiratory Disorders and Learning Approach" and found that three quarters of students had poor information about care of ARDS.

As regards the total satisfactory level of knowledge among the students included in the study, most of them had satisfactory level of knowledge posttest after theoretical lecture compared to pretests before theoretical lecture level. This result is in the same line with a study done by **Li, et al., (2020)** who studied "Flipped classroom improves nursing students' theoretical learning in China: Ameta-analysis" found that there was a highly statistically significant difference between pre compared to post theoretical according to their total score of knowledge.

Regarding to nursing student skills, the result of this study shows that there was statistically significant difference between third observation post virtual lab training compared to first and second observation according to competent level of skills, with p -value equal (0.000^*). This is supporting the research hypothesis. From the researchers' point of view, the critical care nursing students self-assessed their competency regrading caring for patients with ARDS through the provision of feedback and focused technical supervision by the researchers that drive the clinical skills of the students in the critical care unit. This result is in the same line with a study done by **Baran, E., & Correia. (2018)** who studied "A professional

development framework for online teaching" and found that there was a highly statistically significant difference between pre compared to post theoretical according to their total score of skills.

Concerning to total competent level of students' skills regarding care of patient with ARDS through three times observations, the result of this study shows that majority of the students included in the study had competent level of skills after the third observation and more than three quarters of them had a competent level of skills in the second observation. While more than half of them had a competent level of skills regrading caring for patients with ARDS after first observation. From the researchers' point of view, to achieve basic skills efficiently depends on continuous observation of students' performance to ensure high quality of care provided to patients. This result is in the same line with a study done by **Mikkelsen (2020)** who studied "Nursing students' experiences, perceptions and behavior in a flipped-classroom anatomy and physiology course" found that most of them had improve their competent skills pre and post observation.

In concern to total level of nursing students' satisfaction regarding achievement competency basic skills post virtual lab through third observation, the result of this study shows that majority of the students included in the study had a satisfactory level regarding the clinical learning, clinical reasoning and debriefing and reflection. From the students' point of view, virtual lab training is effective for achieving basic skills with high competency, because most of them are accustomed to studying with the tablet system since high school. On other hand, virtual lab training is easy, safe and available at any time, because it depends on the use of mobile phones or computers connected to the Internet. This result is in agreement with a study done by **O'Flaherty, & Laws. (2022)** who studied "Nursing student's evaluation of a virtual classroom experience in support of their learning Bioscience" and found that most of them had improve their competent skills post virtual lab training. Also, this study is in the same line with a study done by **Whitlock (2019)** who studied "Nursing student's

evaluation of a virtual classroom experience in support of their learning Bioscience " and mentioned that most of them had improve their competent skills post virtual lab training.

Regarding to Correlation between total satisfactory level of knowledge and total competent level of skills through third observation, the result of this study shows a positive correlation between satisfactory level of knowledge and competent level of skills during third observation $r = 0.572$ with p value 0.001^* . This result is in agreement with a study done by **Joseph, et al., (2021)** who studied". Flipped classroom improves Omani nursing students' performance and satisfaction in anatomy and physiology " and mentioned there was a positive correlation between satisfactory level of knowledge and competent level of skills among nursing students. Also, this study is in the same line with a study done by **Colomo-Magaña, et al., (2020)** who studied". University students' perception of the usefulness of the flipped classroom methodology." And found that there was positive correlation between satisfactory level of knowledge and competent level of skills.

Finally, from the researchers' point of view, virtual lab training is an effective learning intervention that has a measurable impact on learning outcomes and achievement competency basic skills. Importantly, the current study also shows that competency basic skills improve most when virtual lab training and traditional teaching methods are combined.

Conclusion

Based on the findings of the current study. The implementation of virtual lab training had a significant positive improvement on achievement competency basic skills among critically care nursing students. This is evident through most of the critical care nursing students had satisfactory level of knowledge post theoretical lecture compared to pre. Also, majority of them had competent level of skills regrading caring for patients with ARDS during third observation compared to first observation level. In addition to majority of them had high level of satisfaction regrading clinical learning, clinical reasoning and debriefing and reflection

in achievement of competency basic skills post virtual lab training through third observation.

Recommendations

Studying factors affecting the achievement of competency basic skills among critical care nursing students, in addition to precautions should be followed during virtual lab experiment.

Designing more virtual reality simulation programs can expand the nursing students' skills experience in safe virtual spaces and enhance their performance, self-efficacy and learning satisfaction.

Further, the expanded use of virtual reality simulation programs the potential to assure the accurate assessment of trainee competence as they progressively acquire the essential milestones associated with their specific training

In curriculum nursing, one area of need is to develop virtual reality simulation programs and scenarios that build problem-solving skills by means of communication and cooperation between multiple learners in the same virtual space.

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