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Research

The Effect of Virtual Reality Airway Management as a Learning Strategy on Performance, Self-Efficacy, and Emotional Intelligence Among Nursing Students in the West Bank/Palestine

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ABSTRACT

Background: Management of the airway is a fundamental competency that nursing students should have. There is a lack of studies examining the effect of virtual reality airway management in Arab countries including Palestine. Thus, this study aimed to evaluate the effect of virtual reality airway management as a learning strategy on emotional intelligence, self-efficacy, and performance among nursing students in the West Bank/Palestine.

Methods: A pre–post-test control group design was used and 190 participants were randomly selected from (Arab American University) and categorized into experimental group (n = 95) and control group (n = 95). The experimental group received virtual reality airway management and the control group received traditional learning. The study was achieved during the time from October 2023 to December 2023.

Results: There were differences between the 2 groups after intervention in performance, self-efficacy, and emotional intelligence ($p < 0.01$), indicating the experimental group had higher mean scores in the aforementioned variables compared to the control group.

Conclusions: Virtual reality experiences could be a supplement to traditional learning and integrated as a teaching strategy in nursing curricula.

Introduction

Airway management is a critical aspect of patient care and an essential skill that nursing students must learn (Miranda et al., 2021). The prevalence of airway disorders like asthma and chronic obstructive pulmonary disease (COPD) varies by country and region (Adeloye et al., 2022). World Health Organization (WHO) estimated that asthma affected 262 million people globally and resulted in 455,000 deaths and COPD affected an estimated 65 million people globally and resulted in 3.23 million deaths in 2019 (WHO, 2020). The prevalence of these conditions is higher in low- and middle-income countries (WHO, 2020). Other airway disorders such as bronchiectasis, cystic fibrosis, and interstitial lung disease also have varying prevalence rates. The prevalence rates of airway disorders are constantly changing due to factors such as environmental pollution and lifestyle changes (Chatkin et al., 2022).

Nursing schools provide students with the necessary knowledge, skills, and comprehensive clinical training in airway management and airway emergencies, including intubation, suctioning, and oxygen administration (Miranda et al., 2021; Rushton et al., 2020). These schools prepare students to work under the supervision of experienced nurses and physicians to manage airway emergencies in real-life situations (Salameh et al., 2021) and provide safe and effective care to patients who require airway management (Miranda et al., 2021).

Nursing students need to have skills that enhance their performance and competencies including self-efficacy and emotional intelligence. The performance can be measured by the accuracy and speed of the participant's actions (Lochmannová et al., 2022). Also, self-efficacy has been described as the motivational effect that enables a person to set goals and create a plan of action (Hsiao, 2021). Self-efficacy can influence the participant's willingness to engage in

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the task and their ability to overcome challenges (Ding et al., 2020). High self-efficacy is correlated with effective clinical decision-making and problem-solving processes (Hwang & Oh, 2021). Self-efficacy is a strong requirement for work commitment and performance (Barbaranelli et al., 2018).

Emotional intelligence is basic to the nursing profession and education programs. It could be a significant element for success among nursing students (Budler et al., 2022). Emotional intelligence refers to the ability to recognize, understand, and manage one's own emotions and those of others (Mayer, 2004). Utilizing emotional intelligence is highly necessary because it assists nurses in dealing with stressful situations, emotions, and relationships with the healthcare team, patients, and families (Aghajani Inche Kikanloo et al., 2019). Several studies have shown that emotional intelligence improved learning through improved self-efficacy (ALmegewly et al., 2022; Budler et al., 2022; Benington et al., 2020; Halimi et al., 2021). High emotional intelligence improves job well-being (Li et al., 2021) and helps students successfully interact and respond to the learning environment (Aparicio-Flores et al., 2021). Also, there was a relationship between emotional intelligence and clinical competencies such as clinical-decision making (Azizi et al., 2020; Mahni et al., 2015).

Innovative technologies such as Virtual Reality (VR) has faced a remarkable development in education, especially nursing education (Hamad & Jia, 2022; Kamińska et al., 2019). VR utilizes computer technology to plan a 3-dimensional virtual environment, where user interaction is conducted by senses such as vision, touch, smell, and hearing. The users can enter a virtual world utilizing a headset with a hand-held controller or desktop (Hamad & Jia, 2022). VR makes students perceive themselves in realistic world situations (Salah et al., 2023). Also, they can learn in a safe environment, which provides them with feedback and self-correction till they become competent in performing skills through coordinated experiences (Aebersold, 2018; Alsswey et al., 2024). VR simulation allows timeless practices of procedures and gives immediate opportunities to critically analyze patients' conditions and experience their emotions in a controlled environment without any danger to patients (Guan et al., 2022). VR simulation allows students to exceed their abilities by using other methods rather than a manikin, minimizes the differences in clinical areas, and trains on various skills (Plotzky et al., 2023). VR training can help reduce the risk of complications associated with airway management procedures (Karamchandani et al., 2021) and enhance patient safety and quality of care (Putnam et al., 2021). VR airway management training can provide opportunities for participants to improve their performance, self-efficacy, and emotional intelligence (Chiang et al., 2022; Ding et al., 2020; Lee et al., 2023; Rushton et al., 2020).

VR application has been integrated into education on international levels and the effectiveness of using VR was proposed to enhance skills and clinical competencies in nursing education (Chen et al., 2020; Fealy et al., 2019; Foronda et al., 2017; Padilha et al., 2019). Few studies were conducted in Arab countries that examined the effect of VR on nursing students (Bani Salameh et al., 2024). Unfortunately, there is a lack of research about VR simulation experiences in educational institutions in Palestine. This study is one of the first studies to examine the effect of VR on performance, self-efficacy, and emotional intelligence. Therefore, this study could provide baseline data and literature on VR simulation practices. Identification of this technology could allow nursing instructors to apply as a learning method that provides nontraditional learning strategies for nursing education to improve students' outcomes and their performance. Also, VR simulation could be necessary for healthcare professionals, instructors, and policymakers to increase awareness of this technology among students, instructors, nurses, and the public.

Purpose and Hypotheses of the Study

This study purposed to evaluate the effect of VR airway management as a learning strategy on performance, self-efficacy, and emotional intelligence among nursing students in the West Bank/Palestine. Also, these hypotheses are developed based on previous studies and include:

H1- The nursing students who will engage in VR airway management as a learning strategy will have better performance in airway management than those who will participate in traditional learning.

H2- The nursing students who will engage in VR airway management as a learning strategy will have more self-efficacy than those who will participate in traditional learning.

H3- The nursing students who will engage in VR airway management as a learning strategy will have higher emotional intelligence than those who will participate in traditional learning.

Methodology

Study Design

This study adopted a pre–post-test control group design and included 2 groups (control and experimental) who were selected randomly. The experimental group received VR training sessions on airway management, while, the control group received traditional learning methods. This study was achieved during the time from October 2023 to December 2023.

Setting

This study was conducted at Arab American University in Palestine, an academic institution located in the northern area of the West Bank. The study was applied in the VR lab which was recently built inside the university.

Population, Sampling, and Sample

The target population of this study included all nursing students in the third year. There were an estimated 650 nursing students registered in the third year of the fall semester during the academic year 2022/2023. A simple random sampling technique was used to recruit the desired number of students. The G*power program was adopted to calculate sample size with an alpha of 0.05, moderate effect size of 0.5, and a power of 0.90 with an independent t-test. A sample of 172 students was required to carry out this study; an additional 18 participants were added to avoid withdrawal and dropout. Those participants were randomly distributed into experimental or control groups.

The participants in the present study were recruited by employing third-year students' institutional data, where a list of candidates was compiled, followed by even numbers were selected. Then, the investigator proceeded to allocate each eligible student in a randomized manner to either the experimental or control arm, where each student was asked to pull a number containing the type of group from the basket. This approach ensured the prevention of any potential selection bias. The sample frame of this study is explained in Fig. 1.

The inclusion criteria of the participants involved nursing students who were: a) registered in the third university year, b) not experiencing severe mental or cognitive problems (because VR may cause dizziness and drowsiness), and c) willing to engage in the study. The students who participated in any training programs such as advanced cardiac life support (ACLS) were excluded.

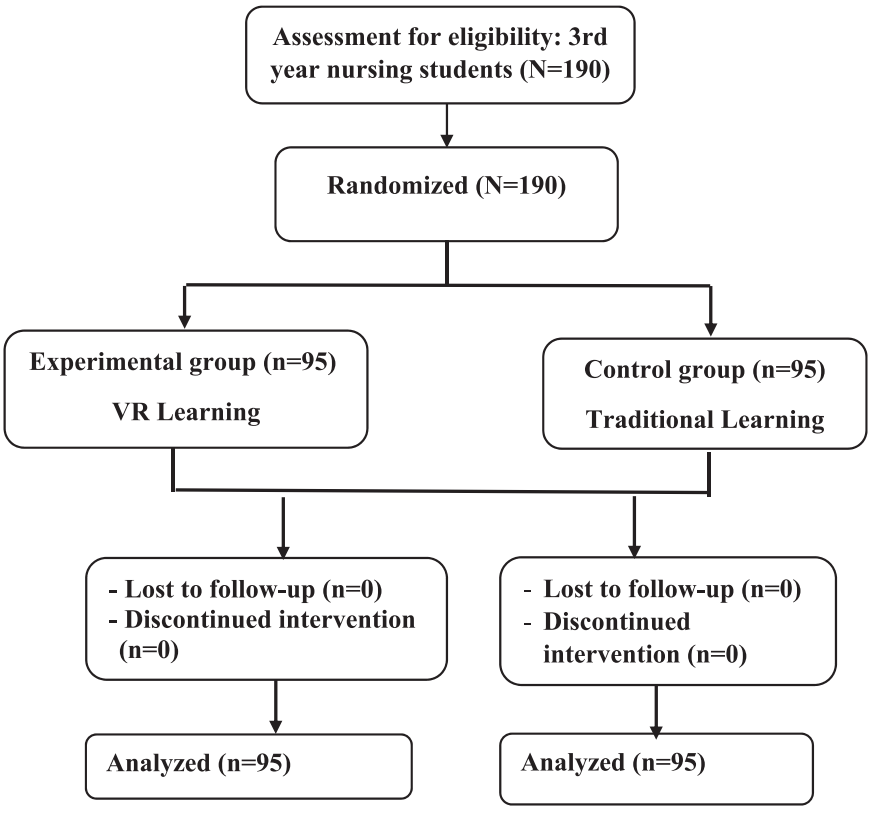

Fig. 1. Sample frame of the study.

Study Measurements

A structured self-reported questionnaire and observation were used to collect data. The questionnaire included the following parts; demographic data included age, gender, grade point average (GPA), experience in healthcare settings, and duration of the experience.

The New General Self-Efficacy Scale (NGSE) was developed by Chen et al. (2001) and consists of 8 elements, each element was assessed on a Likert scale ranging from 1 (low agreement) to 5 (great agreement). The scoring was based on the mean as follows: ≤ 3 reflected a low self-efficacy level and > 3 indicated a high self-efficacy level. This scale has acceptable validity and reliability with a Cronbach's alpha of 0.86 (Scherbaum et al., 2006). The Arabic version of this scale, which had good validity and reliability with Cronbach's alpha ranging from 0.91 to 0.95 was adopted in this study (Amer et al., 2023). The Cronbach's alpha of NGSE in this study was 0.942.

Wong Law Emotional Intelligence Scale was created by Wong and Law (2002) and consists of 16 items, and each item is scored using a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The mean was used for scoring as follows: $4 \leq$ reflected low emotional intelligence and > 4 indicated high emotional intelligence. The original tool is valid and reliable, where Cronbach's alpha was 0.94 (Pacheco et al., 2019). The Arabic version of this tool, which is valid (El Ghoudani et al., 2018) and reliable with Cronbach's alpha of 0.67 (Naeem & Muijtjens, 2015) was used to conduct this study. The Cronbach's alpha of WLEIS in this study was 0.827.

The Airway Management Skills Checklist developed by the American Heart Association (AHA) was used to assess performance. It consists of 7 items measuring airway management performance by assessing these skills: checking responsiveness, activating the emergency response system, checking breathing, checking pulse, inserting oropharyngeal or nasopharyngeal airway, administering oxygen, and performing effective bag-mask ventilation for 1 minute. The scoring result was pass or fail; if all procedure steps were successfully achieved, the student achieved a passing score. If all steps were not followed, the student received a failing score and should receive remediation.

Intervention and Data Collection Procedures

At the beginning, the study announcement was posted on the third-year students' board in addition to electronic contact links in collaboration with the nursing faculty administrator to facilitate students' recruitment. Then, the investigator provided students who agreed to engage in the study with the required information and criteria.

Before their participation, the students were informed of the objectives and implementation of the procedure. The consent forms were signed by the participants who agreed to participate in this study and met the eligibility criteria. Students received printed information about the date and time of the study. Then, the students were randomly assigned to the experimental or control group. Once the students were divided into 2 groups, these 2 groups were assembled.

Intervention for the Control Group

On the first day, the participants in the control group were asked to fill out a questionnaire that included demographic data and self-efficacy and emotional intelligence scales. Then, the control group received traditional learning about airway management, which was conducted by the investigator. The traditional learning was conducted as follows: students were divided into groups, each group consisting of 9 to 10 students. Then, 2 sessions were provided for each group in 2 days, where the duration of each session ranged from 160 to 180 minutes. These sessions are illustrated in Table 1.

Table 1
Traditional learning program and virtual reality learning program.

Time and Duration	Session	Contents	Teaching strategies (methods and materials)
Traditional learning program			
First day 160-180 minutes	The first session	Airway management • Definition • Purposes of procedure • Methods • Steps of procedure	• Lecture • Videos • Discussion
Second day 160-180 minutes	The second session	Application on procedure	• Demonstration • Re-demonstration on mankind • Group work
Virtual reality learning program			
First day (3-3.5 hours)	The first session	Orientation sessions were provided to the students by a VR instructor about VR involving components, advantages, actions, and utilizing virtual reality technology, specifically VR glasses and a stick, within the confines of a VR laboratory	• VR simulation • Discussion
Second and third day (140-180 minutes)	Eight to 9 sessions for each student, each session (experience) was estimated 15-20 minutes	Application on procedure	• VR simulation

Subsequently, the students underwent training and proceeded to apply the procedure.

Intervention for the Experimental Group

Regarding the experimental group, the investigator met the VR instructor at the nursing faculty, whose role as a technician was restricted to preparing the laboratory, running and controlling the experiment, and training students to use the VR experience. Then, the students were given an illustration of the intervention (airway management experience), including its objectives, content, duration, and experience by the researchers.

VR airway management experience was developed according to the AHA's guidelines. This experience was designed by the investigator and structured by a VR technician who followed the investigator's experience steps. These steps were arranged as follows: initiating a series of checks to assess responsiveness, calling for immediate assistance from surrounding individuals, activating the emergency response system, and getting the automated external defibrillator. Then, perform a visual examination of the chest for any signs of movement and assess the pulse for 5-10 seconds, placing an oropharyngeal airway, and administering effective bag-mask ventilation for 1 minute. After that, provide appropriate oxygenation by delivering a ventilation rate of once every 6 seconds, ensuring the correct ventilation speed within 1 second, and delivering an adequate ventilation volume of approximately half a bag. Also, the experience was provided with written instructions before performing any steps, in addition to audio alarms that activate when a wrong step is taken and ask the student to go back from the beginning to repeat the steps.

Also, this experience was assessed for validity using the content validity index (CVI), in which the CVI was judged by 3 experts in advanced life support who were provided with a brief description of the study purposes and the experience, in addition to CVI form for scoring the questions related to experience. Experience software and a CVI form were sent to the experts by e-mail. After returning the responses, the CVI was calculated and was 1, which reflects the validity of airway management experience.

The students in the experimental group were categorized into ten groups, where every group consisted of 9 to 10 students. Approximately 3 to 3 half-hour orientation sessions were provided to the students by a VR instructor about VR involving components, advantages, actions, and utilizing virtual reality technology, specifically VR glasses and a stick, within the confines of a VR laboratory.

The intervention was achieved in the following steps: before the session, participants in this group were requested to fill out the same questionnaire that was administered to the control group. After that, students were required to wear the HMD and utilize the stick. Then, they enacted the VR intervention sessions as explained in Fig. 2. At the beginning of VR experience, there was a screen presenting the definition, purposes of procedure, and methods of airway management. Then the student engaged in airway management experience. The required duration of each session was estimated at 15 to 20 minutes, therefore, each nursing student in the experimental group was required between 8 and 9 sessions to be competent. Additionally, the students were divided into groups, each group accommodating between 9 and 10 students. Table 1 illustrates the VR learning program.

After that, the participants in both groups were asked to complete the same questionnaires at the end of all sessions. Additionally, the students' airway management performance was assessed while practicing on the Laerdal Airway Management Trainer. The performance was evaluated using the AHA checklist for airway management skills by the researcher.

Structured debriefing was conducted for both groups, where students were instructed to reflect on their behaviors (Nascimento et al., 2020). This technique aids in providing feedback and rectifying inappropriate conduct (Coutinho et al., 2016). Therefore, once the students finished the experiences (Traditional and VR), a debriefing session was conducted by the researcher to obtain students' self-evaluation and reflection. This debriefing session was guided using the oral reflective ten-question from the NLN scenarios and lasted for sixty minutes. The students in the experimental group endorsed that

Fig. 2. Application of virtual reality experience.

Table 2
Comparison between study variables among control and experimental groups at preintervention (N = 190, Control = 95, Experimental = 95).

Characteristic	Categories	Control group n (%)	Experimental group n (%)	Chi-square	p-value
Gender	Male	38 (40.0)	40 (42. 1)	0.180	0.678
	Female	57 (60.0)	55 (57.9)		
GPA	Excellent	16 (16.8)	16 (16.8)	0.161	0.688
	Very good	40 (42.2)	41 (43.2)		
	Good	37 (38.9)	36 (37.9)		
	Medium	2 (2.1)	2 (2.1)		
Experience	Yes	61 (64.2)	63 (66.3)	0.491	0.483
	No	34 (35.8)	32 (33.7)		
		Mean (SD)	Mean (SD)	t-test	p-value
Age		20.70 (0.93)	20.64 (0.76)	0.513	0.609
Duration of experience		1.45 (0.50)	1.38 (0.52)	0.822	0.413
Self-efficacy		3.07 (0.10)	3.06 (0.11)	0.353	0.724
Emotional intelligence		3.65 (0.30)	3.64 (0.29)	0.138	0.890

M: Mean; SD: Standard Deviation; N/n: number; %: percentage; GPA: General Point Average.
*p: significant at the ≤0.05 level.

the experience was interesting and the instructions and alarms in the experience helped them to recognize and apply the procedure. Also, this technology helped them to deal with a patient in an unrealistic environment, which enhanced their self-confidence and controlled their emotions. Also, the students in the control group revealed that they needed to repeat the procedure many times to apply it correctly.

Ethical Considerations

Approval to carry out this study was attained from the Institutional Review Board (IRB) at Arab American University in Palestine. Written informed consent was obtained from the study participants. Study objectives and protocol were discussed with the eligible students. Participation was voluntary and the students could withdraw during any time of the study with no benefits or risks. Confidentiality was kept in all phases of the study. Also, the study's data were kept in a file on the computer which was not backed up.

Data Analysis

The SPSS version 26 software was adopted to enter and analyze the study data. Descriptive statistics were used to analyze the sociodemographic characteristics of the study participants, where mean (M) and standard deviation (SD) were used for continuous variables, and numbers and percentages (%) for categorical variables.

At pretest, the homogenous characteristics of the sample were evaluated between the control and experimental groups utilizing t-tests and chi-squares. Additionally, the equality of error variances test of Levene's test was applied. Concerning demographic characteristics, the results showed that the Chi-squares demonstrated no differences between the groups concerning gender and experience in healthcare settings. Also, the t-test showed no significant differences in the mean of age and duration of experience (Table 1).

The independent sample t-tests examined differences in self-efficacy and emotional intelligence between the 2 groups and a paired test was adopted to examine the differences in dependent variables in the same groups pre and postintervention. The normality assumptions were tested and found to be met. The homogeneity of variances between the 2 groups was tested using Levene's test to verify the second premise. There was no significant violation of the assumption of equal variance, and no significant group variances in self-efficacy and emotional intelligence. The third premise of mutual exclusivity was satisfied since there were no appreciable differences between the 2 groups (Table 2). Findings were considered significant at a p-value of ≤ 0.05.

Table 3
Comparison between the control and experimental groups in performance at postintervention: Chi-square test.

Phase and group	Performance			
	n	n (%) of pass	Test statistics	
			Chi-square	p-value
Postintervention:				
Control group	95	32 (33.7)	81.16	0.000**
Experimental group	95	84 (88.4)		

** p: significant at the <0.01 level.

Results

The current study involved 190 students registered in the third year. All students completed the study. Findings showed that the average age of the participants was 20.67 years (SD = 0.84). More than half of the participants were females (58.9%) and 43.7% of the students obtained a very good GPA. Furthermore, a majority of them (65.3%) had experience in healthcare settings. The average duration of their experience was a mean of 1.42 (SD = 0.50).

The findings indicated a statistically significant difference between the 2 groups in performance of airway management at postintervention (Chi-square = 81.16, $p < 0.001$) (Table 3). This finding proposed the effectiveness of VR learning methods compared with traditional learning methods in improving performance in airway management, which accepted hypothesis 1.

Table 4 explains a significant difference in self-efficacy between the control group before and after the intervention ($t_{(93)} = -58.952$, $p < 0.001$). This finding proposed the effectiveness of the traditional learning methods in improving self-efficacy among the control group. Also, there was a significant difference in self-efficacy between the experimental group before and after the intervention ($t_{(93)} = -38.456$, $p < 0.001$). This result suggested that the VR learning method was effective in improving self-efficacy.

As shown in Table 5, the findings revealed no statistically significant difference in self-efficacy between the control and experimental groups in preintervention ($t_{(188)} = 0.353$, $p > 0.05$). On the other hand, a statistically significant difference was found between the control and experimental groups in self-efficacy in postintervention ($t_{(188)} = -5.871$, $p < 0.001$). These findings indicated the VR learning

Table 4
Comparison between the control and experimental groups in self-efficacy at prepost intervention: paired t-test.

Group	Self-efficacy				
				Test statistics	
	n	M (SD)	95% CI	t-test	p-value
Control group	95	3.07 (0.10)	−1.01 to −0.952	−58.952	0.000*
Preintervention	95	4.05 (0.14)			
Postintervention					
Experimental group	95	3.06 (0.10)	−1.24 to −1.12	−38.456	0.000**
Preintervention	95	4.24 (0.28)			
Postintervention					
	Emotional intelligence				
Control group					
Preintervention	95	3.65 (0.30)	−0.619 to −0.467	−14.230	0.000**
Postintervention	95	4.19 (0.13)			
Experimental group					
Preintervention	95	3.64 (0.30)	−1.950 to −1.726	−32.540	0.000**
Postintervention	95	5.48 (0.39)			

M: Mean; SD: Standard Deviation.
P-value:
*Significant at ≤ 0.05;
**Significant at ≤ 0.01.
CI: Confidence Interval.

method was more effective in enhancing self-efficacy than the traditional learning methods, which accepted hypothesis 2.

The findings revealed that a significant difference was demonstrated in emotional intelligence between the control group before and after the intervention ($t_{(93)} = -14.230$, $p < 0.001$). This result suggested the effectiveness of the traditional learning methods in enhancing emotional intelligence in the control group. Also, there was a significant difference in emotional intelligence between the experimental group before and after the intervention ($t_{(93)} = -32.540$, $p < 0.001$). This finding proposed the effectiveness of the VR learning method in improving emotional intelligence among the experimental group (Table 4).

Additionally, Table 5 illustrates that no statistically significant difference in emotional intelligence between the 2 groups in preintervention ($t_{(188)} = 0.188$, $p > 0.05$). On the contrary, there was a significant difference between both groups in emotional intelligence in postintervention ($t_{(188)} = -30.253$, $p < 0.001$). These findings indicated the effectiveness of VR learning method in improving emotional intelligence than the traditional learning methods, which accepted hypothesis 3.

Table 5
Comparison between the control and experimental groups in self-efficacy and emotional at prepost intervention: independent t-test.

Phase	Self-efficacy				
				Test statistics	
	n	M (SD)	95% CI	t-test	p-value
Preintervention:					
Control group	95	3.07 (0.10)	−0.024 to −0.034	0.353	0.724
Experimental group	95	3.06 (0.11)			
Postintervention:					
Control group	95	4.05 (0.14)	−0.254 to −0.126	−5.871	0.000**
Experimental group	95	4.24 (0.28)			
	Emotional intelligence				
Preintervention:					
Control group	95	3.65 (0.30)	−0.078 to 0.090	0.188	0.890
Experimental group	95	3.64 (0.29)			
Postintervention:					
Control group	95	4.19 (0.13)	−1.373 to −1.204	−30.253	0.000**
Experimental group	95	5.48 (0.39)			

M: Mean; SD: Standard Deviation.
P-value:
*significant at ≤ 0.05.
** Significant at ≤ 0.01.
CI: Confidence Interval.

Discussion

Our study supported the effect of VR as an intervention in promoting students' performance in airway management. Our findings are consistent with the results of earlier studies (Bani Salameh et al., 2024; Lee & Baek, 2023; Lee & Son, 2023; Shujuan et al., 2022; Yu & Yang, 2022). This study proposes that learning and training using VR can enhance the performance of nursing students and equip them with the necessary skills to be proficient within healthcare environments. VR technology facilitates the demonstration of clinical experiences and practicing these experiences in a safe environment. Also, all guides and instructions are provided inside the experience, thus it is easy for students to re-demonstrate the experience many times until mastering it (Aebersold, 2018).

Our findings revealed that self-efficacy was higher in the experimental group compared to the control group postintervention. This study suggests that VR improved self-efficacy for nursing students more than traditional learning. The findings of the present study are supported by the results from previous studies (Al-Gharibi et al., 2021; Costa et al., 2020; Liaw et al., 2023; Shah et al., 2022; Song & Kim, 2023; Yu et al., 2021). However, Kim et al. (2023) demonstrated no statistically significant difference was observed in academic self-efficacy. Our result could be interpreted as the utilization of a VR simulation program has the potential to enhance the practical experience of nursing students in secure virtual environments, which can lead to improvements in their self-efficacy in task performance and overall satisfaction with the learning process (Yu et al., 2021). Exposure to VR as an

instructional approach and perceiving as a novel encounter may have contributed to a heightened sense of self-efficacy among students (Costa et al., 2020). Students with a high level of self-efficacy are more likely to be motivated in the learning process.

The study's intervention yielded a notable enhancement in emotional intelligence among nursing students, the participants in the experimental group exhibited higher levels of emotional intelligence in comparison to the control group. There is a lack of studies concerning the effects of VR experiences on emotional intelligence. The outcomes of the present investigation add evidence about the effect of using VR on enhancing emotional intelligence among nursing students. Previous studies demonstrated that VR improved perceived empathy (Gillespie et al., 2021; Quay & Ramakrishnan, 2023). VR fosters affective learning and attitudes among healthcare workers demonstrated by improving empathy (Gillespie et al., 2021). This study suggested that VR intervention provided students with the impression that they were in a realistic and safe environment, which affected their feelings and attitudes and resulted in high emotional intelligence. This experience provided students with real stimuli and sounds that reflect reality, therefore, students practiced experience in the absence of stress and fear till they performed the skill accurately (Carstens et al., 2021).

Strengths and Limitations of the Study

This study represents the first experimental investigation conducted in Palestine seeking to assess the effectiveness of VR on the performance, self-efficacy, and emotional intelligence of the airway. Our study exhibits significant findings and contributions to the existing body of literature by including Arab nursing students.

Regardless of the strengths of this study, it had several limitations. This study was executed at a single location and involved a similar group of participants at 1 private university.

Implications of the Study

This study provides evidence in favor of incorporating VR into nursing curriculum. The nursing educators need to integrate VR into their teaching. Implementing such a strategy will enhance the quality and outcomes of their courses. Integrating VR into nursing courses would enhance the clinical competencies of graduate nurses. VR learning provides students with the opportunity to engage in clinical situations that are infrequently experienced in real-world settings, which will enhance and broaden their experiences and preparedness to effectively handle different cases encountered in their professional activity.

Policymakers and nursing managers should enact VR simulations upon developing their strategies as much as possible. Future research should be replicated on other nursing students from different universities in the region. Additionally, a mixed methods study could be carried out to examine the experiences of the participants with VR experience.

Conclusion

This study established that VR simulation as a learning strategy enhanced students' performance, self-efficacy, and emotional intelligence in comparison with traditional learning. VR is a learning strategy that provides a nursing student with a safe and effective learning environment. VR experiences can be integrated as a supplement to traditional education, therefore, the study reinforces incorporating VR into nursing courses to minimize the requirement for clinical practice areas available for clinical training.

Declaration of Competing Interest

No potential conflict of interest was reported by the authors.

CRediT authorship contribution statement

Hisham Zahran: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Resources, Writing – original draft, Writing – review & editing. **Malakeh. Z. Malak:** Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Fuad El-Qirem:** Conceptualization, Methodology, Software, Supervision, Writing – original draft, Writing – review & editing. **Bara Asfour:** Methodology, Writing – original draft, Writing – review & editing.

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Ethics Approval

All procedures performed in studies involving human participants were by the ethical standards of the institutional and/or national research committee at Arab American University at Palestine with reference NO# 2023/A/88/N.

Consent to Participate (Include Appropriate Consent Statements)

Each participant provided informed consent before beginning the study.

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