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Effectiveness of Peer Teaching Among Undergraduate Nursing Students at the Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar, Pakistan. (An Evidence Based project)

Farooq Aziz*
Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar, Pakistan & Hayatabad Medical Complex, Peshawar, Pakistan
Email: farooqaziz511@gmail.com

Shaheen Ghani
Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar, Pakistan

Nasreen Ghani
Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar, Pakistan

Author Details

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Corresponding E-mail & Author*:

Farooq Aziz*
Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar, Pakistan & Hayatabad Medical Complex, Peshawar, Pakistan Email: farooqaziz511@gmail.com

Abstract

Background: Mechanical ventilation is a complex and critical skill in intensive care nursing that requires strong cognitive and clinical competence. Traditional lecture-based teaching often fails to adequately prepare nursing students for its practical application. Peer teaching has emerged as an evidence-based educational strategy that promotes active learning and collaboration.

Aim: To evaluate the effectiveness of peer teaching in improving knowledge retention, skill acquisition, and confidence in ventilator management among undergraduate nursing students.

Methods: A quasi-experimental pre-test and post-test study was conducted over four weeks at Sarhad University, Peshawar. Fifteen Semester 7 nursing students were selected using convenience sampling. Students who were enrolled and willing to participate were included, while those absent during testing were excluded. Data was collected using a structured questionnaire and analyzed using SPSS version 23. Descriptive statistics (mean, standard deviation, frequency, and percentage) and a pre–post comparison test were used. A p-value < 0.05 was considered statistically significant.

Results: The mean pre-test score was 45% (SD ± 52.9), which increased to 74% (SD ± 47.1) after the intervention. Improvements were observed across all domains, including ventilator settings, clinical indications, alarm management, and patient safety concepts. The findings demonstrated a statistically significant improvement in post-intervention scores ($p < 0.05$), indicating the effectiveness of the peer teaching intervention.

Conclusion: Peer teaching significantly improved knowledge and understanding of ventilator management among undergraduate nursing students. It is an effective instructional strategy that can enhance clinical competence, critical thinking, and confidence in critical care nursing education**.**

Introduction

Evidence-based practice (EBP) is widely considered an essential component of high-quality nursing care and a support of clinical decision-making based on the integration of the best available research evidence, clinical expertise, and patient preferences (Lee & Han, 2022; Lehane et al., 2018; Li et al., 2023; McLean, 2016; Melnyk & Fineout-Overholt, 2022). In this aspect, its application has increased beyond clinical practice to include nursing education, whereby it informs the adoption of effective teaching and learning practices (Zellefrow et al., 2023). With the ever-increasing complexity of healthcare systems, nursing students need to be prepared not just with theoretical knowledge but also with the capability to apply evidence in clinical practice scenarios. Unlike this expectation, teaching through traditional lecture-based remains the most common form of teaching in most institutions of nursing. Nevertheless, an increasing body of evidence is showing that passive learning methods are inadequate to attain higher-order thinking skills including critical thinking and clinical reasoning (Styers et al., 2018). Active learning strategies in comparison to traditional lectures, on the other hand, have been shown to significantly enhance student engagement and retention of knowledge (Theobald et al., 2020; Tokash et al., 2026). All these findings bring to light the necessity of new methods of teaching that encourage more meaningful learning and active involvement of students.

In response to these educational challenges, peer teaching, also known as peer-assisted learning, has emerged as an effective learner-centered strategy. It facilitates active learning, knowledge retention, and professional growth in nursing students (Palander et al., 2026). Likewise, peer teaching methods in health professions education have been demonstrated to enhance student engagement, understanding, and clinical learning outcomes(Tokash et al., 2026). In addition, learners may feel more at ease interacting with peers, which can alleviate anxiety and provide a supportive learning environment (Li et al., 2023).

Theoretically, peer teaching is underpinned by up-to-date constructivist principles of learning that stipulate that knowledge is constructed through social interaction, collaboration, and guided learning in educational settings (Burgess et al., 2020a). In this context, peer teaching can enable students to learn through slightly more knowledgeable peers, which can facilitate cognitive development through scaffolding and shared experiences (Burgess et al., 2020b). The approach given is especially applicable to nursing education, as both theoretical knowledge and practical skills are needed to provide safe clinical care.

Mechanical ventilation is regarded as one of the most complicated and vital clinical skills, especially in critical care nursing. To manage ventilators effectively, a good comprehension of physiological principles, clinical judgment and technical proficiency is necessary (Zhang et al., 2022). Although it is important, some studies have reported that nursing students are often not able to properly comprehend the concepts of ventilators when they are taught using the traditional lecture-based methods alone (Lee & Han, 2022). Such knowledge gap can result in a lack of confidence and difficulties with clinical decision-making.

Expanding on above issue, recent studies have shown that incorporation of peer teaching within clinical training can enhance the knowledge of the students on complex issues like ventilator management. An example is that peer teaching is a key strategy that facilitates knowledge retention and learning engagement in nursing and health professions education (Zhang et al., 2022). Likewise, peer-assisted learning has been associated with positive outcomes in academic performance and self-efficacy among

students (Li et al., 2023). Collectively, these findings indicate that peer teaching can serve as an effective alternative or supplement to conventional instructional practices. Nevertheless, although an increasing body of evidence supports peer teaching, limited research has specifically examined its effectiveness in ventilator education among undergraduate nursing students, particularly in low- and middle-income countries such as Pakistan. This highlights an important gap in nursing education research, as effective preparation of graduates for critical care practice remains essential for patient safety and quality care (Li et al., 2023; McLean, 2016; Stacciarini et al., 2026). It is therefore necessary to address this gap to ensure nursing graduates are adequately prepared to manage critically ill patients in clinical settings. In this context, the present study will also assess the effectiveness of peer teaching in enhancing knowledge retention, engagement, and competence among undergraduate nursing students regarding ventilator management at Sarhad University, Peshawar

Framework

This study was guided by the principles of evidence-based practice (EBP), integrating best research evidence, teaching expertise, and student learning needs to inform the educational intervention. Peer teaching was selected as an evidence-informed strategy supported by literature highlighting its effectiveness in enhancing engagement, knowledge retention, and clinical competence. The approach aligns with active learning principles that promote collaboration, participation, and deeper cognitive processing. To ensure a structured and outcome-focused investigation, the PICOT framework was applied to clearly define the study components and guide the research process.

Problem

During the clinical practicum, several challenges were identified in relation to the teaching and learning of ventilator management among undergraduate nursing students, particularly a gap between theoretical instruction and clinical application. Students were observed to have difficulty understanding ventilator settings, limited engagement in traditional lecture-based sessions, and poor retention of critical concepts required for safe clinical practice. Based on these observations, key questions emerged regarding the most effective teaching strategy for ventilator education, the impact of peer teaching on student engagement and knowledge retention, its comparative effectiveness against traditional lectures, students' perceptions of peer teaching in complex clinical topics, and the role of expert supervision in enhancing peer-assisted learning. To ensure a systematic and unbiased decision, a structured prioritization process was conducted involving faculty members, clinical instructors, and MSN scholars through a formal consensus and voting procedure. After careful evaluation of clinical relevance, educational impact, and feasibility, the group reached consensus to prioritize the investigation of peer teaching effectiveness in ventilator education among Semester 7 nursing students at Sarhad University, Peshawar. This decision was based on the critical importance of ventilator management in clinical practice, where inadequate knowledge may compromise patient safety, and the need to adopt innovative, evidence-based teaching strategies that enhance student engagement, clinical competence, and long-term knowledge retention.

Justification

As a clinical instructor, it has been observed that undergraduate nursing students face considerable difficulty in understanding ventilator management when taught through traditional lecture-based methods. Despite receiving adequate theoretical instruction, students often struggle to comprehend complex aspects such as ventilator settings, troubleshooting alarms, and effective patient management in critical care situations. This gap between theory and practice is further intensified by limited hands-on exposure, which contributes to poor skill retention, increased anxiety during clinical

placement, and potential risks to patient safety. Recognizing this educational challenge, peer teaching was identified as a potential instructional strategy to bridge the gap between theoretical knowledge and clinical application. In peer teaching, students actively engage in explaining concepts and demonstrating skills to their peers under the guidance of faculty supervision, thereby promoting active learning, collaboration, and confidence building. Therefore, this study was designed to evaluate the effectiveness of peer teaching in improving knowledge retention, skill acquisition, and confidence in ventilator management among undergraduate nursing students.

Current Practice

In the current practice of teaching ventilator concepts to undergraduate nursing students, the traditional lecture-based approach remains the predominant method of instruction. This approach is primarily instructor-centered, where educators deliver theoretical content through PowerPoint presentations, structured lectures, and textbook references (Billings & Halstead, 2021). In this model, students are largely passive recipients of information, with limited opportunities for hands-on practice, interaction, or collaborative learning.

Contemporary evidence indicates that although lecture-based teaching ensures standardized content delivery, it is less effective in promoting active learning, critical thinking, and long-term knowledge retention in nursing education (McLean, 2020; Theobald et al., 2020). Furthermore, reduced student engagement in traditional instructional methods has been associated with weaker clinical reasoning skills and lower confidence in performing complex clinical tasks such as ventilator management (O'Flaherty & Phillips, 2015; Freeman et al., 2020).

As a result, there is a growing shift in nursing education toward active and student-centered learning strategies. Among these, peer teaching is increasingly being explored as an alternative pedagogical approach to enhance student participation, improve self-directed learning, and strengthen practical competency in critical care topics such as mechanical ventilation (Tai et al., 2016).

PICOT Question

P (Population): Undergraduate nursing students (7th semester) at Sarhad University, Peshawar

I (Intervention): Peer teaching method for ventilator education

C (Comparison): Traditional lecture-based teaching (pre-intervention baseline comparison)

O (Outcome): Improvement in knowledge retention, skill acquisition, and confidence in learning.

T (Time): Four weeks

PICOT Question:

Among undergraduate nursing students, how does peer teaching compared to traditional lecture-based instruction affect knowledge retention, skill acquisition, and confidence in ventilator management over four weeks?

Purpose

The purpose of this study is to evaluate the effectiveness of peer teaching as an instructional strategy for enhancing nursing students' understanding of ventilator management. Specifically, the study aims to determine whether peer teaching improves knowledge retention, student engagement, and practical application skills when compared with traditional lecture-based instruction. This will be assessed through a comparison of pre-test and post-test scores following the intervention. In addition, the study incorporates expert-guided facilitation during peer teaching sessions to ensure accuracy of content delivery and to examine the impact of structured supervision on

learning outcomes. The findings of this study are expected to contribute to the development of evidence-based teaching strategies in nursing education and to support the integration of active learning approaches in critical care training.

Integration with Theory

This study is grounded in social constructivist learning theory, which posits that knowledge is actively constructed through interaction, collaboration, and shared meaning-making within social contexts (Vygotsky, 1978). In contemporary nursing education, this theory is increasingly applied to peer teaching, where students develop understanding by explaining and discussing complex clinical concepts such as ventilator management with their peers. Faculty members function as facilitators who scaffold learning and gradually reduce support as learners gain independence and confidence. Recent literature highlights that social constructivist approaches enhance engagement, deeper learning, and clinical competence by promoting dialogue, reflection, and active participation in learning processes (Burgess et al., 2020b). Moreover, evidence from nursing education demonstrates that peer-assisted and collaborative learning strategies improve knowledge retention, self-efficacy, and readiness for clinical practice in complex healthcare environments (Nilsson & Lindberg, 2024; Wong et al., 2023).

Review of Evidence-Based Literature

Recent evidence strongly supports the effectiveness of peer teaching as an active learning strategy in health professions education. A systematic review by Palander et al. (2026), reported that peer-assisted learning significantly enhances students' clinical reasoning, engagement, and knowledge retention compared to traditional teaching methods. The authors emphasized that structured peer interaction improves both academic performance and confidence in clinical skill application.

Similarly, Ziwei et al. (2023)**,** highlighted that active learning approaches, including peer teaching, promote deeper cognitive processing and long-term knowledge retention by engaging students in meaningful learning activities rather than passive information reception. This supports the shift from traditional lecture-based instruction toward student-centered learning models in nursing education.

In nursing and medical education contexts, Burgess et al. (2020a), found that peer teaching improves communication skills, collaborative learning, and self-directed learning abilities. The review further indicated that students often feel more comfortable learning from peers, which enhances engagement and reduces learning anxiety in complex clinical topics.

Furthermore, Ziwei et al. (2023), demonstrated that peer-assisted learning contributes to improved academic outcomes, confidence, and professional development among health sciences students. Their findings suggest that peer teaching is particularly effective when supported by structured faculty facilitation and clear learning objectives.

In addition, a recent meta-analysis by Zhang et al. (2022), confirmed that peer teaching in nursing education significantly improves knowledge acquisition, critical thinking, and clinical competence, especially in high-complexity areas such as critical care and emergency nursing.

Collectively, contemporary literature provides strong and consistent evidence that peer teaching enhances learning outcomes, student engagement, and clinical competence. These findings support its application in ventilator education, where complex concepts require active participation and repeated cognitive reinforcement to ensure effective learning and clinical readiness.

Methodology

Study design

A quasi-experimental pre-test and post-test study design was used to assess the effectiveness of peer teaching on ventilator management among undergraduate nursing students.

Study setting
The study was conducted at the Department of Nursing, Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar, Pakistan.

Study population
The study population comprised undergraduate nursing students enrolled in Semester 7 of the critical care nursing course.

Inclusion Criteria
Undergraduate nursing students enrolled in Semester 7 at Sarhad University, Peshawar, who were registered in the critical care nursing course and willing to participate in the study were included.

Exclusion Criteria
Students who were absent during either the pre-test or post-test, or who did not participate in the peer teaching sessions, were excluded from study.

Sample size and sampling technique
A total of 15 students were recruited using a convenience sampling technique based on availability and willingness to participate.

Study instrument
Data was collected using a structured self-developed questionnaire consisting of 15 items, including 10 multiple-choice questions and 5 true/false questions related to ventilator management. The instrument was developed following an extensive literature review and was reviewed by subject experts, including senior faculty members in critical care nursing and nursing education, to ensure content validity, clarity, and relevance. Necessary revisions were incorporated based on expert feedback prior to data collection.

Intervention
A structured peer teaching intervention was implemented. Students participated in peer-led teaching sessions on ventilator management under the facilitation of the researcher and supervision of an expert faculty member to ensure accuracy and standardization of content delivery.

Data collection procedure
A pre-test was conducted to assess baseline knowledge of participants. Following this, peer teaching sessions were delivered. After completion of the intervention, a post-test using the same instrument was administered to evaluate changes in knowledge and learning outcomes.

Data analysis
Data was analyzed using SPSS version 26. Descriptive statistics were used to summarize participant characteristics. Pre-test and post-test scores were compared to assess the effectiveness of the intervention.

Ethical considerations
Ethical approval was obtained from the Institutional Review Board (IRB) of the Institute of Nursing Science, Sarhad University of Science and Information Technology, Peshawar. Informed consent was obtained from all participants prior to data collection.

Participants were informed about the study objectives, procedures, potential benefits, and their right to withdraw at any time without any academic consequences. Confidentiality and anonymity were strictly maintained throughout the study, and all data were used solely for research purposes.

Result

Table 1: Demographic Characteristics of Study Participants (n = 15)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20–22	6	40.0%
	23–25	7	46.7%
	>25	2	13.3%
Gender	Male	4	26.7%
	Female	11	73.3%
Residence	Urban	9	60.0%
	Rural	6	40.0%
Previous ICU Exposure	Yes	5	33.3%
	No	10	66.7%
Prior Ventilator Training	Yes	3	20.0%
	No	12	80.0%

Interpretation of Demographic Characteristics

The study included 15 undergraduate nursing students from Semester 7. Most participants were in the age group of 23–25 years (46.7%), followed by 20–22 years (40.0%), while only a small proportion (13.3%) were above 25 years. In terms of gender distribution, the majority were female students (73.3%), reflecting the typical gender pattern in nursing education, while males accounted for 26.7% of the sample.

Regarding residence, 60.0% of participants were from urban areas, whereas 40.0% belonged to rural backgrounds. More than half of the students (66.7%) reported no previous ICU exposure, while only 33.3% had prior clinical exposure in critical care settings. Similarly, the majority (80.0%) had not received any formal ventilator training before the study, indicating limited baseline exposure to ventilator management (Table 1).

Table 2: Pre-Test and Post-Test Competencies of Participants (n = 15)

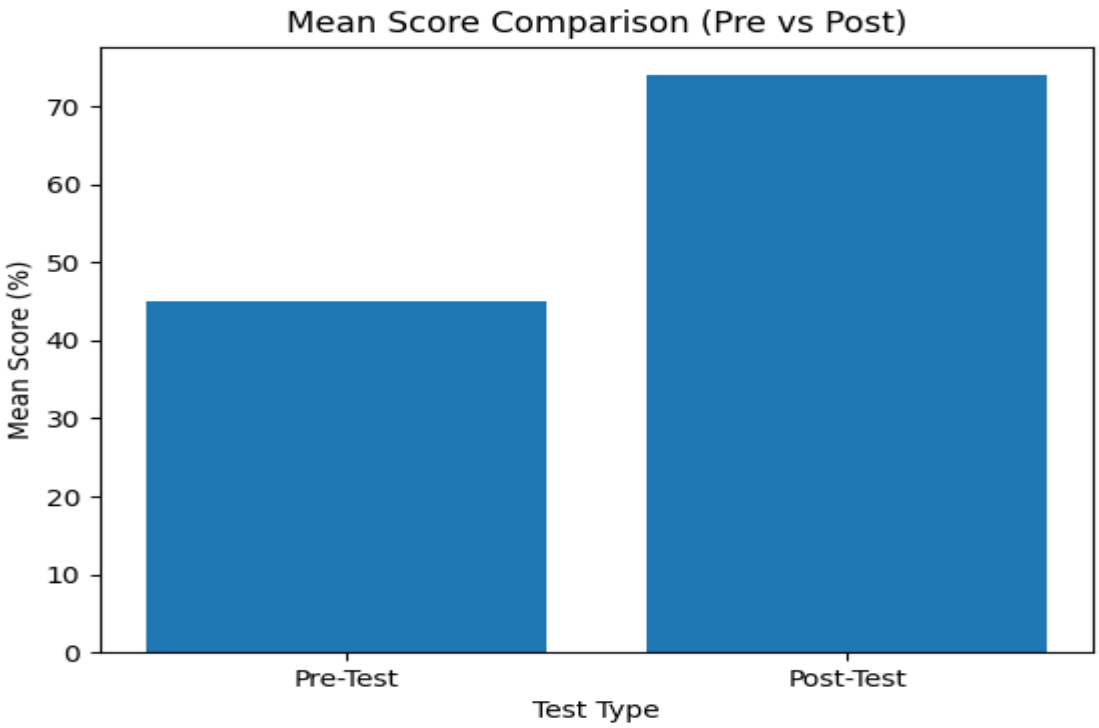
S. No	Questions	Pre-Test Correct (%)	Post-Test Correct (%)
1	Primary purpose of a mechanical ventilator	45	75
2	Key indication for mechanical ventilation	42	76
3	Meaning of PEEP in ventilator settings	38	74
4	Constant factor in volume-controlled ventilation	40	72

S. No	Questions	Pre-Test Correct (%)	Post-Test Correct (%)
5	Primary goal of adjusting tidal volume	44	76
6	Cause of high-pressure alarm on ventilator	35	70
7	Strategy to prevent ventilator-associated pneumonia (VAP)	50	80
8	Consideration for weaning a patient off ventilator	39	73
9	Most frequently used ventilator mode	41	74
10	Role of FiO_2 in ventilator settings	43	75
11	PEEP helps keep alveoli open (T/F)	55	85
12	Mechanical ventilation is used only in cardiac arrest (T/F)	60	84
13	High tidal volumes can cause lung injury (T/F)	52	82
14	A ventilator does not require humidification (T/F)	41	70
15	Weaning from mechanical ventilation should be monitored carefully (T/F)	57	83

Pre-Test and Post-Test Competencies of Participants

The results of the pre-test showed that the participants had a moderate baseline knowledge of ventilator management with a mean score of 45% and significant gaps in the areas of high-pressure alarm causes, PEEP interpretation, and weaning considerations. After the peer-teaching intervention, the post-test mean score rose to 74%, and it is evident that there is an improvement in knowledge and understanding. The notable improvements were in the key areas, such as high-pressure alarms (35%-70%), PEEP (38%-74%), weaning (39%-73%), and VAP prevention (50%-80%). In general, there was a consistent improvement in all 15 items, which indicated a positive learning outcome in both theoretical and clinical areas. The range of scores was improved in the pre-test (35%-60) to the post-test (70-85), which reflects an increase in competency and understanding. Additionally, the statistically significant value ($p < 0.05$) indicates that the teaching intervention was effective, and the improvement was not a coincidence (Table 2).

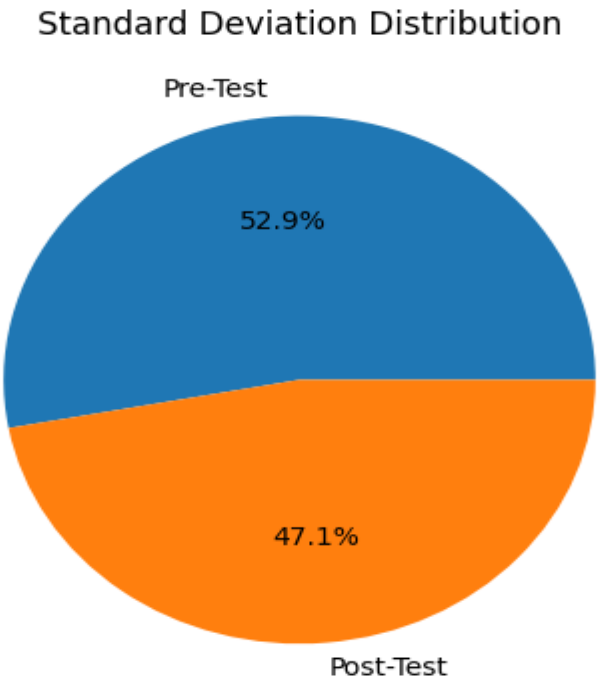
Mean score comparison pre vs post (figure1)



Mean score comparison pre vs post

The bar graph clearly shows that the mean scores of the participants who participated in pre-test and post-test had an increase of a significant percentage. The mean score of the pre-test is 45 percent, whereas the mean score of the post-test is 74 percent, which proves to be a significant improvement in the percentage of 29 (figure 1).

Mean score comparison pre vs post (figure 2)



Mean score comparison pre vs post

The pie chart indicates that there was a slight drop in standard deviation between pre-test (52.9%) and post-test (47.1%). This means a lower variability and more regular performance of the participants following the intervention (figure 2).

Overall, these results suggest that peer teaching can significantly aid nursing students in their understanding of how to operate a ventilator. The intervention also helped to retain better the knowledge and enhance the use of theoretical concepts in clinical practice.

This paper illustrates that peer teaching is a powerful educational tool in ventilator education, which greatly increases critical thinking, confidence and competency among nursing students. It is based on the Social Constructivist Theory developed by Vygotsky who contends that learning takes place during social interaction and mutual engagement (Vygotsky, 1978). Peer teaching helps in scaffolding whereby the students can gradually accumulate knowledge and clinical skills under the guidance of a peer teacher. Therefore, incorporating peer-led approaches within nursing education can enhance the readiness of the nursing students to clinical practice.

Recommendation

Peer teaching is suggested to be systematically integrated into the undergraduate nursing curricula as an evidence-based method of improving learning outcomes, especially in complex areas like ventilator management. The frameworks of structured peer teaching should be applied with ongoing supervision of the faculty to guarantee accuracy, consistency and academic rigour. It is also suggested to incorporate simulation-based learning and interactive debriefing sessions to enhance the confidence, critical thinking, and clinical decision-making skills of students. Moreover, it is necessary to actively encourage the use of peer-assisted learning in nursing education institutions to enhance conceptual understanding, clinical reasoning, and psychomotor skills. It is suggested that future studies should be done to determine the long-term effects of peer teaching on clinical competency, professional performance, and patient care outcomes in real-life situations.

Conclusion

This research offers empirical data that the peer teaching method is an effective pedagogical approach towards the better understanding of ventilator management by undergraduate nursing students. The significant increase in the post-test performance is an indicator that structured peer-assisted learning has a positive effect on the acquisition and processing of knowledge as well as the application of theoretical concepts in practice. The peer-led instructional model contributed to the creation of an interactive and intellectually supportive learning environment that enhanced the level of conceptual learning and better retention of complex critical care information. Taken together, these results highlight the pedagogical importance of peer teaching in developing active learning, enhancing clinical reasoning and fostering skill development in nursing education. In that regard, introducing structured peer teaching in nursing programs could significantly improve the level of clinical competence and readiness of the students to engage in professional practice in critical care environments.

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