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ORIGINAL RESEARCH

Blended learning using a crash cart and its effect on knowledge, skills, and clinical decision-making ability among nursing students

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Abstract
A crash cart serves as a mobile hospital station equipped with all the supplies needed to handle a life-threatening emergency. Just as healthcare professionals rely on these carts to respond quickly and effectively in critical situations, educators can leverage innovative approaches like blended learning to meet the needs of their students. Blended learning creates a flexible and dynamic environment that supports diverse learning styles and enhances knowledge retention. However, there are limited studies investigating the impact of different learning styles among nursing students. This study aimed to assess the effectiveness of blended learning on nursing students' knowledge, skills, and clinical decision-making ability related to crash cart utilization. A quasi-experimental with control group pretest-post-test design was used to reach the study's objective. This study was conducted at Maharishi Markandeshwar College of Nursing India from 23 April to 29 May 2024. The researcher determined the inclusion and exclusion criteria and then used convenience sampling to recruit participant. A total of 85 nursing students were included in the final analysis, divided into two groups: intervention and control. To avoid contamination, data from the control group was collected first then followed by the intervention group. Two blended learning models (Face-to-Face Driver Model and Rotational Model) were implemented throughout the study. The control group received a lecture and discussion covering theoretical elements, and educational videos for skill development were shared on Google Classroom. Meanwhile, the intervention group received a theoretical lecture followed by an online component accessed through a Learning Management System. Ethical clearance was obtained prior to the study commencement. The data was analyzed using descriptive statistics and independent t-test. The study found that the intervention group showed significantly better outcomes than the control group (p<0.05). Blended learning can be an effective approach for teaching emergency medications and operating emergency equipment. Therefore, nursing educators should incorporate practice sessions into their curriculum. This study suggests that blended learning, particularly the Face-to-Face Driver Model, is more effective than the Rotational Model.

Keywords: Blended learning, Face-To-Face Driver Model, learning in nursing, nursing education, Rotational Model

Introduction

India experiences a high frequency of emergencies and accidents across its various regions (Raghavan et al., 2024). Despite being a developing nation, the country faces a unique set of challenges due to its rapid economic expansion and urbanization (Vaz et al., 2021). This rapid growth has also led to an increase in vehicular traffic that resulting in a higher incidence of road accidents and related emergencies straining the country's emergency response systems (Pal et al., 2019; Giribabu et al., 2024). Furthermore, India confronts a dual burden of emergencies related to infectious and communicable diseases as well as chronic illnesses and traumatic incidents (Ram & Thakur, 2022; Bhattacharya et al., 2023). According to World Health Organization (WHO) projections, between 2015 and 2030, the percentage of mortality from non-communicable diseases is expected to escalate from 63.5% in 2015 to 72.5% in 2030 (World Health Organization, 2024). Given the projected rise in mortality from non-communicable diseases, robust emergency services are crucial. The amenities of emergency services are indeed sanctified in India's Constitution (Department of Emergency Medicine, JPNATC, AIIMS, 2019). According to Article 21 of India's Constitution, "right to life," if any hospital is not able to provide timely medical treatment to patients, then it is a violation of a patient's "right to life." (Department of Emergency

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Medicine, JPNATC, AIIMS, 2019). This constitutional mandate underscores the importance of accessible emergency care. India has made significant strides in this direction, with 17,000 ambulances across the union of 31 states and union territories, featuring helpline numbers 108 and 102 (Department of Emergency Medicine, JPNATC, AIIMS, 2019).

Given that condition, it is crucial that hospitals are equally prepared to handle emergencies, which is where crash carts play a vital role in providing immediate care for critical patients (Ahluwalia et al., 2023; Rungta et al., 2020). Crash cart configurations vary, but generally speaking, they consist of a wheeled cart with multiple compartments at waist or chest level **(Figure 1)**. Crash carts, also known as code carts or crash trolleys, are essential in hospital emergency protocols, equipped with life-saving medications, defibrillators and other critical care tools to respond quickly to cardiac arrests and other emergencies (Johnson et al., 2023). The trolley is a transportable unit that is furnished with necessary medical supplies and emergency gear (Jacquet et al., 2018). The phrase "crash cart" is commonly used to describe a mobile, self-contained unit that contains almost all of the supplies, drugs, and equipment needed to run a code (Møllekær et al., 2012; Barton & Crook, 2021). Furthermore, since defibrillators and heart monitors are essential in the majority of emergency scenarios, they are commonly kept stocked crash carts in medical facilities (Almulhis & Al-Moteri, 2024).

Figure 1. Illustration of crash cart in the emergency care unit (Generated by AI).

Nonetheless, there is a general perception that this technology is not being utilized to its full potential in many hospitals (Alinier et al., 2006). It is crucial for nursing students to develop competence in setting up, using, and maintaining hospital crash carts (Nair et al., 2022). Key competencies for nursing undergraduates include critical thinking and clinical decision-making, which are essential for delivering safe and effective nursing care in the 21st century (Purabdollah et al., 2023). Inadequate understanding of the crash trolley's function, application, and maintenance can impact patient care standards that jeopardizing patients' lives in emergency situations (Kaushik & Mancheri, 2019). The nursing profession is vital to healthcare services such as responding to cardiac arrests, injuries, and other life-threatening situations (Trisyani et al., 2023; Göransson et al., 2024). Nursing students should master crash cart setup, use, and maintenance to prepare for their future roles. The knowledge, skills and clinical decision-making ability is important in this context. In more practical terms in the Emergency Department, nurses must restock crash carts after each shift verifying that all items are available and not expired. To achieve this level of competence, innovative educational approaches are being adopted, and one such approach is gaining traction in nursing education. The integration of blended learning is an evolving strategy aimed at enhancing the learning experience and competence of nursing students (Grønlien et al., 2021). A quasi-experimental study highlighted that educational program was useful on improvement of nurse's performance regarding emergency cart (Khaliefa et al., 2018). The study has examined knowledge and practice or skills, but has not comprehensively explored clinical decision-making skills. Other study reported that knowledge and skills in using crash carts were fairly good, but the study did not examine the aspect of clinical decision making (Dhudum & Mathew, 2023). One of the models widely used in blended learning is the Face-to-Face Driver Model and the Rotational Model (Ashipala et al., 2024; Haftador et al., 2023). Both models of blended learning offer significant advantages over traditional methods by incorporating flexibility, personalized learning, and multimedia resources that cater to diverse learning styles.

Although blended learning is an established and promising approach in nursing education, there is a clear absence of comparative research on specific blended models (Face-to-Face Driver Model vs Rotational Model) for crash-cart training and associated clinical decision-making in emergency nursing. As such, the present study represents an important and novel contribution to the literature by comparing these two models on the parameters of knowledge, skills and clinical decision-making ability with respect to crash-cart use. Over the past few decades, the field of emergency

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medicine has grown exponentially, with crash carts or emergency trolleys becoming essential medical equipment. Delays in receiving care or an incomplete crash cart can be life-threatening for patients. During emergencies, nurses often experience confusion and urgency when trying to access vital drugs and supplies, and limited exposure to emergency situations can erode their ability and confidence in performing critical tasks (Nair et al., 2022). As primary users of crash carts, healthcare professionals, including nurses and nursing students, require a thorough understanding of their function, application, and maintenance. Insufficient knowledge can compromise patient care and potentially endanger lives in emergency situations (Kaushik & Mancheri, 2019).

This study aims to assess the effectiveness of blended learning in crash cart utilization, exploring its impact on nursing students' knowledge, skills, and clinical decision-making abilities. Blended learning is justified in this context because it seamlessly integrates traditional Face-to-Face instruction with online learning opportunities (Abusabeib, 2025). This integration creates a flexible and engaging environment that provides diverse learning styles, promote active learning, and boosts information retention (Sáiz-Manzanares et al., 2020). In the Face-to-Face Driver Model, in-person instruction takes center stage, supplemented by digital resources that enrich the classroom experience (Asghar et al., 2022). This approach allows educators to maintain control over the learning environment, guiding students through real-time interactions, discussions, and hands-on activities (Mali & Lim, 2021). With instructors present to clarify doubts and provide additional explanations, students can better understand and retain the material (Tong et al., 2022). Conversely, the Rotational Model divides learning time between different modes of instruction. In this model, learners alternate between traditional classroom instruction, online learning modules, and sometimes independent study or group work (Kömür et al., 2023). The model offers more flexibility that allowing for personalized learning paths as students engage with the material at their own pace during online sessions without immediate access to an instructor for questions or clarifications. These two models combine online nursing education with student autonomy (at times without educator oversight), yet in the context of crash cart learning in emergency services, the effectiveness of the models remained questionable. Crash cart learning requires knowledge, practical skills, and decision-making processes among nursing students. The study's findings are expected to improve nursing students' knowledge, skills, and attitudes, ensuring they are well-prepared to provide immediate emergency care services in hospital settings.

Method

The study employed a quasi-experimental design with pre- and post-tests to achieve its objectives. The design evaluates the effectiveness of an intervention by measuring participants before and after implementation (Capili & Anastasi, 2024). The pre-test establishes a baseline and the post-test assesses changes that allowing researchers to determine the intervention's impact (Miller et al., 2020). Although this design has limitations, it is useful for real-world settings where randomization is not feasible (Andrade, 2021). This makes it suitable for studies like evaluating blended learning's effect on nursing students' crash cart skills. The population of this study consisted of undergraduate nursing students. The inclusion criteria were students enrolled in a 4-year degree program, specifically second-year students, who were willing to participate and available during data collection. In contrast, the exclusion criteria were participants who were absent on the day of intervention and post-test. The sample size was calculated based on an earlier study using Cohen's d formula (Cohen's $d=(\mu 1- \mu 2)/\sigma$. Considering effect size was 1.35 at the power of 0.80 according to which recommended sample size for each group was 25. Therefore, the required sample size in each group was 25. Keeping attrition in mind, the researcher took 50 nursing students in each group. Thus, a total of 100 nursing students were included in the study. However, during the course of the study, 8 participants dropped out in the intervention group and 7 participants in the control group **(Figure 2)**. Convenience sampling was used to recruit the sample for this study. Participants were non-randomly assigned to either an intervention group or a comparison group.

The data collection period for this study spanned from 23 April to 29 May 2024. The study employed two instruments: data collection tools and an intervention tool. The data collection tools included the demographic questionnaire that assess the following participants' profile such as sex, age, sex, previous experience in using crash cart, and previous sessional marks. Additionally, the study utilized three structured tools: a 30-item Knowledge Questionnaire, a 72-item Observational Checklist, and a 12-item Clinical Decision-Making Questionnaire. All the tools were developed by the authors, and their validity and reliability were subsequently tested and measured by nine experts from Maharishi Markandeshwar College of Nursing, India. The scale content validity index (S-CVI) was calculated using the averaging approach. The Structured Knowledge Questionnaire had an internal consistency reliability of 0.8, as measured by KR-20 (Kuder-Richardson Formula 20), indicating acceptable consistency among items. The Structured Observational Checklist for skills demonstrated high inter-rater reliability with a Pearson correlation of 0.9, confirming

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strong agreement between raters. The Structured Clinical Decision-Making Ability Questionnaire also showed high internal consistency with a Cronbach's alpha of 0.9, indicating reliable measurement of clinical decision-making skills.

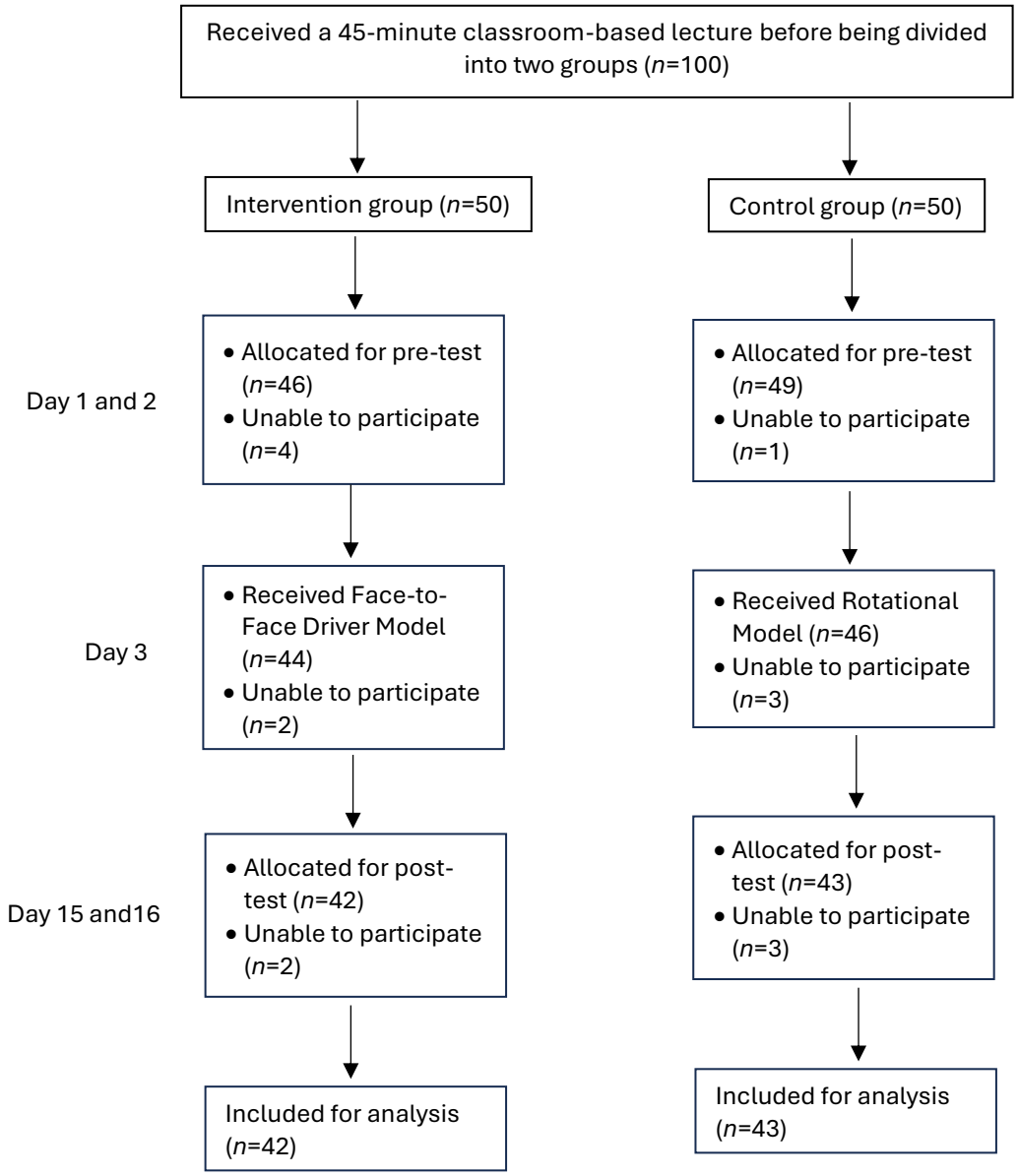

Figure 2. Study process.

The intervention tools included a protocol for the intervention group and a standard protocol for the control group. Prior to group assignment and intervention, all participants attended a 45-minute classroom-based lecture using the lecture-discussion method, covering key theoretical areas including crash cart purpose and importance, maintenance protocols, nurses' responsibilities, component identification and organization, drug storage and pharmacology, instrument and equipment use, and documentation procedures. This standardized lecture ensured both groups received the same foundational knowledge. After that, the researcher divided the participants into two groups, and data collection began with the control group. Following the lecture, students independently accessed educational videos on several skills, including crash cart setup, defibrillator parts and operational check, Ambu bag parts and operational check, and laryngoscope parts and operational check, via Google Classroom. They studied the materials asynchronously for 30 minutes without real-time support. To avoid contamination, data collection began with the control group on days 1 and 2, which included a pre-test assessing nursing students' knowledge, skills, and clinical decision-making ability regarding

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Crash Cart utilization. On day 3, the group received the Rotational model of blended learning intervention. The post-test was administered on day 15. The total duration of the intervention was 1.25 hours. The control group could watch the videos only once, whereas the experimental group could access and watch the content as many times as needed during the intervention period.

After completing the control group, the researcher proceeded to the intervention group. Besides attending lectures, participants accessed six instructional videos via the Crash Cart Companions mobile app (developed using Appy Pie). During the 30-minute session, the researcher was present to address questions and provide real-time guidance that promoting engagement and understanding. On days 15 and 16, post-tests of knowledge, skills, and clinical decision-making ability regarding crash cart utilization were conducted among nursing students in the experimental group. The assessments used were: a structured knowledge questionnaire via LMS (Learning Management System), a structured observational checklist through Objective Structured Clinical Examination (OSCE), and structured clinical decision-making ability questionnaires using a paper-and-pencil technique. No research assistants were involved during data collection process.

The data analysis was conducted using SPSS version 20. To summarize the demographic characteristics of the participants, descriptive statistics were employed that providing an overview of the sample's key features. Prior to analyzing the outcomes, the researcher performed a series of assumption tests to ensure the suitability of the data for independent t-tests. Specifically, tests for homogeneity and normality were conducted to verify that the data met the necessary assumptions. For hypothesis testing, a significance level of 0.05 was adopted that allowing for a 95% confidence interval in the results. This rigorous approach ensured the reliability and validity of the findings. Prior to initiating the study, the researchers obtained ethical approval from the Institutional Ethics Committee of the selected Institute in Haryana, India. The approval was granted on December 8, 2023, with reference number CTRI/2024/04/066037. Following the approval, written informed consent was diligently obtained from all participants. The researchers took the time to thoroughly explain the purpose, nature, and potential implications of the study. Emphasis was placed on assuring confidentiality, anonymity, and the voluntary of participation. By doing so, the researchers aimed to establish a foundation of trust and transparency that is essential for conducting ethical research.

Results

The table shows that the majority of nursing students in the intervention group (81%) and control group (51.2%) were between 18-20 years old. In terms of gender, the majority of nursing students in the intervention group (66.7%) were female, whereas in the control group, the majority (51.2%) were male. Regarding previous experience with using crash carts, most students in the intervention group (81%) had no prior experience, whereas in the control group, most (67.4%) had previous experience. However, both groups had a similar distribution of previous sessional marks, with 78.6% of students in the intervention group and 79.1% in the control group scoring above 50% **(Table 1)**. The table indicates that at baseline, the intervention and control groups were homogeneous and comparable in terms of pre-test knowledge (p>0.05) and skills (p>0.05) scores. However, the groups were heterogeneous in terms of pre-test clinical decision-making ability scores, with a significant difference observed (p<0.01). At baseline, the mean pre-test knowledge scores of nursing students in the intervention and control groups were 28.29±6.04 (56.58%) and 27.09±5.38 (54.18%), respectively. The mean pre-test skill scores were 26.05±6.74 (36.18%) in the intervention group and 26.58±6.93 (36.91%) in the control group, with a mean difference of 0.53. These results indicate that most nursing students had unsatisfactory levels of knowledge and skills regarding crash cart utilization. Additionally, the pre-test clinical decision-making ability scores were 11.62±2.90 (58.1%) in the intervention group and 9.93±3.13 (49.6%) in the control group, with a mean difference of 1.68. The baseline results indicate that the experimental and comparison groups of nursing students had similar levels of knowledge and skills regarding crash cart utilization before the intervention, as evidenced by the non-significant difference ($p > 0.05$). Before the intervention, both groups were equivalent in terms of knowledge and skills. However, there was a significant difference in clinical decision-making ability ($p < 0.01$), with the experimental group performing better than the comparison group **(Table 2)**.

The post-test results showed significant improvements in both groups. The mean post-test knowledge score was higher in the intervention group (41.81±2.96, 83.62%) compared to the control group (33.02±5.92, 66.04%), with a mean difference of 8.78. Notably, both groups demonstrated significant improvements in knowledge scores from pre-test to post-test (intervention group=28.29±6.04 to 41.81±2.96; control group=27.09±5.38 to 33.02±5.92). Similarly, the mean post-test skill score was higher in the intervention group (50.48±6.75, 70.1%) compared to the control group (39.23±9.24, 54.4%), with a mean difference of 11.24. Significant improvements were observed in skill scores from pre-test to post-test in both groups (intervention group=26.05±6.74 to 50.48±6.75; control group=26.58±6.93 to 39.23±9.24). The mean

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post-test clinical decision-making ability score was also higher in the intervention group (17.93±1.81, 89.6%) compared to the control group (13.23±3.07, 66.1%), with a mean difference of 4.69. Both groups showed significant improvements in clinical decision-making ability scores from pre-test to post-test (intervention group=11.62±2.90 to 17.93±1.81; control group=9.93±3.13 to 13.23±3.07) **(Table 2)**. Therefore, it can be concluded that both the Face-to-Face Driver Model and Rotational Model of blended learning were effective in enhancing nursing Face-to-Face Driver Model students' knowledge, skills, and clinical decision-making ability regarding crash cart utilization. However, the proved to be more effective than the Rotational Model.

Table 1. Comparison of demographic variables between study groups at baseline.

Variables	Intervention group		Control group		*p*
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Sex					
Male	14	33.3	22	51.2	0.96
Female	28	66.7	21	48.8	
Age					
18-20	34	81	22	51.2	0.04
21-23	8	19	21	48.8	
Previous experience					
Yes	8	19	29	67.4	0.01
No	34	81	14	32.6	
Previous sessional marks					
<50%	9	21.4	9	20.9	0.95
>50%	33	78.6	34	79.1	

Table 2. Comparison of knowledge, skills and clinical decision-making ability score.

Variables	Evaluation	Intervention group	Control group	*p*
Knowledge (Max. score=50)	Pre test	28.29±6.04	27.09±5.38	0.33
	Post test	41.81±2.96	33.02±5.92	0.01
Skills (Max. score=72)	Pre test	26.05±6.74	26.58±6.93	0.72
	Post test	50.48±6.75	39.23±9.24	0.01
Clinical decision-making ability (Max. score=20)	Pre test	11.62±2.90	9.93±3.13	0.01
	Post test	17.93±1.81	13.23±3.07	0.01

Discussion

The study shows that experience using or understanding the concept of crash carts is important for nursing students. This is evident in that the participants already had such experience, although there were differences in the percentage between the two groups. Previous studies supported that proficiency with crash carts is essential for prompt emergency response, which can help minimize mortality and morbidity rates (Silva et al., 2021). Therefore, nursing schools should introduce crash carts early on so that students are prepared to learn and use them when needed, such as during clinical practice in emergency departments or intensive care units (Folliard et al., 2022). Hands-on experience is essential in nursing education that allowing students to apply theoretical knowledge in daily care (Mahasneh et al., 2021). Through direct involvement in patient care and clinical procedures, nursing students can develop the critical thinking, problem-solving, and decision-making skills essential for effective practice (Ahmady & Shahbazi, 2020). Experience helps bridge the gap between theory and practice that enabling students to refine their techniques, build confidence, and competency required to deliver high-quality care. Clinical experience helps nursing students combine theory with practice, making them better prepared to care for patients.

The finding documented that there is an improvement in knowledge about crash cart among nursing students after received learning method Face-to-Face Driver Model. There was a significant improvement in the knowledge scores for both groups from baseline to post-test, as both were exposed to different blended learning models. This finding aligns with a study that evaluated the effectiveness of a teaching program for critical care nurses on emergency cart performance in intensive care units (Khemnar et al., 2017). This instructional approach which likely involved direct instruction, demonstrations, and interactive elements proved effective in augmenting students' understanding of crash

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cart utilization (Albalushi et al., 2022). The observed improvement in knowledge suggests that the Face-to-Face Driver Model facilitated a deeper comprehension of the equipment, its functions, and its role in emergency situations. As a result, nursing students were better equipped to apply their knowledge in emergency contexts **(Figure 3)**. The success of this learning method emphasizes the importance of interactive and guided instruction in nursing education (Mirzaei et al., 2025), particularly when teaching complex or high-stakes topics like crash cart management in emergency care. In relation to this finding, then the school of nursing serves as the primary facilitator of learning, where instructors provide direct guidance, demonstrations, and training to students (Pivač et al., 2021). The school's faculty members are responsible for designing and delivering the curriculum, leading classroom sessions, and conducting practical exercises (Boso et al., 2023). Through this model, nursing educators can offer real-time feedback, address students' questions and concerns, and create an interactive learning environment regarding crash cart along with its implication in clinical settings. This study also shows that there is an improvement in skills in using crash carts after the intervention was given. The observed improvement in skills suggests that the school's intervention augmented students' technical abilities and instilled confidence in their capacity to respond effectively in emergency scenarios. The school of nursing is recommended in shaping the next generation of nursing professionals with skills including the use of crash cart in emergency unit.

Figure 3. Illustration of emergency context (Generated by AI).

The decision-making ability among nursing students was observed to improve throughout the study. This finding indicates that the Face-to-Face Driver Model of learning increases critical thinking and decision-making skills in emergency cases. The improvement occurred due to the model combined the best of both worlds: the structure of in-person instruction with the individualized support and practice that technology offers (Ladisla, 2018). In this model, most of the learning happens in a traditional classroom, where an instructor can lead simulations, role-playing, and group discussions (Buhl-Wiggers et al., 2022). In addition, the model provides a safe space for students to experience an urgency, make quick decisions in emergency case, and receive immediate, in-person feedback on their choices. The instructor can also model effective communication and problem-solving in real-time. Meanwhile, digital tools are used to supplement this learning that offering repetitive practice through scenario-based exercises and simulations (Dahri et al., 2024). This combination allows for collaborative learning that mimics the high-pressure environment of an emergency. This approach makes students more adaptable, resourceful, and confident, as they have both the conceptual understanding from in-person guidance and the muscle memory from repeated technology-aided practice.

The study highlighted that the Face-to-Face Driver Model proved to be more effective than the Rotational Model. This is primarily because the Face-to-Face approach prioritizes the direct, real-time guidance of a qualified instructor, which is crucial for building the confidence and appropriate act decisively under pressure. In this model, the majority of the learning occurs in a classroom or simulation lab where a nurse educator can lead high-fidelity simulations of cardiac arrest or other emergencies. During these scenarios, the instructor can provide immediate, personalized feedback on a student's actions, such as their technique for chest compressions, the proper use of the defibrillator, or their communication with the rest of the code team. The instructor can also model critical thinking and team leadership in real-time. This immediate feedback loop is vital for correcting errors and reinforcing best practices before they become habits. In contrast, the Rotational Model provides exposure to different environments, the lack of a consistent and instructor availability can lead to gaps in learning and an inability to address specific student weaknesses. Although this study demonstrates the effectiveness of the blended learning method, there are several limitations. Among them are the relatively short duration of the study which may not capture the long-term effects of the blended learning method. Additionally, the study's limitations are the relatively small sample size and the fact that it was conducted in only one location. The small sample size may limit the generalizability of the findings that making it challenging to apply the results to a broader population. Furthermore, conducting the study in a single location may introduce biases specific to that

setting that influencing the outcomes. These limitations highlighted the need for future research with larger, more diverse samples and multiple locations to validate and expand upon these findings.

Conclusion

The study concluded that blended learning can be an effective pedagogical tool for training nursing students in crash cart management. However, the model was found to be more effective than the Rotational Model in enhancing knowledge, skills, and clinical decision-making ability among nursing students. This study has significant implications for holistic nursing education and emergency preparedness training. The substantial improvement in nursing students' knowledge, skills, and clinical decision-making ability due to the model of blended learning suggests the need for an integrated student-centered pedagogy in critical care teaching. Nursing interventions that incorporate blended learning can increase future nurses' preparedness for accurate and confident execution of real-time emergency situations. From a policy perspective, these results support the institutional adoption of structured blended learning frameworks in clinical skill development programs, particularly in areas critical to patient safety, such as crash cart management. This approach aligns with the nature of holistic nursing by integrating competence with caring. It is recommended that future studies apply the model to evaluate its effectiveness in other learning contexts outside of emergency nursing.

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AI statements

The authors declare that the manuscript was developed without any involvement from generative-text AI tools. However, some of the images used as illustrations were created using AI.

Author's declaration

All authors were involved throughout the study process, including conception, study design, data acquisition, data analysis, and manuscript preparation.

Availability of data and materials

The dataset and all materials are available upon reasonable request.

Competing interests

There are no conflicts of interest associated with the study.

Ethical clearance

Ethical approval was obtained from the Maharishi Markandeshwar Institute of Medical Sciences & Research, Institutional Ethics Committee (IEC), with clearance letter number IEC-2704, issued on December 8, 2023.

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Publishers and journal's note

The authors have presented excellent work in utilizing a Crash Cart in their study on blended learning. The design and findings can serve as a resource for developing further research in nursing education beyond India.

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Authors' insight

Key points

- Blended learning approaches incorporating theoretical and practical training on Crash Carts have shown to improve nursing students' knowledge and skills in emergency situations.
- Studies suggest that simulation-based learning and blended learning approaches can enhance nursing students' clinical decision-making abilities.
- Standardizing Crash Cart contents and providing regular training sessions improved nursing students' competency and accountability in effectively utilizing these critical care tools.

Emerging nursing avenues

- How does blended learning compare to traditional teaching methods in improving nursing students' knowledge and skills regarding Crash Cart usage?
- What specific components of blended learning (e.g., simulation-based training, video tutorials) are most effective in enhancing nursing students' clinical decision-making abilities in emergency situations?
- How can blended learning programs be tailored to address the unique needs and challenges of nursing education in India, particularly in terms of resource constraints and diverse student populations?

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