Study Protocol for a Randomized Controlled Trial Comparing Instructor-led versus Blended Cardiopulmonary Resuscitation Training among Nursing Students

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29/4/2025

Introduction

Cardiopulmonary resuscitation (CPR) is a critical life-saving intervention essential for healthcare professionals, particularly nursing students, who frequently act as first responders in emergencies. Further, resuscitation knowledge is crucial for nursing students' learning and professional capability, as emphasized in undergraduate nursing programs. Traditional face-to-face lectures, hands-on skills practice, and practice sessions are typically used for teaching resuscitation content. Given the importance of resuscitation education to enhance resuscitation skills, many previous studies have focused on significant CPR skills and knowledge improvement, both traditional and HeartCode CPR training sessions have unique training features and provide different learning experiences and knowledge accumulation.

Traditional CPR training typically involves in-person, instructor-led sessions that emphasize both theoretical knowledge and practical skills. Studies have shown that such hands-on training significantly enhances the ability of newly employed nurses to perform CPR effectively, which is crucial for improving patient outcomes during cardiac emergencies (Yang, 2024; Parikh et al., 2022; Abdulwahhab, 2017). The American Heart Association (AHA) guidelines advocate for simulation training as a vital part of CPR education, reinforcing the importance of experiential learning in developing competency (Abdulwahhab, 2017; Jeong et al., 2022).

In contrast, HeartCode CPR represents a shift towards online, self-paced learning, which offers flexibility and accessibility for nursing students with diverse schedules. This method combines online modules with practical skills testing, allowing learners to acquire knowledge at their own pace before demonstrating their skills in a workshop setting (Kim & Cho, 2023; Andérson et al., 2012). The integration of technology in CPR training, such as gamification and interactive simulations, has been shown to enhance engagement and retention of skills (Wibowo, 2023; Blewer et al., 2012). However, while HeartCode CPR is gaining popularity, empirical evidence comparing its effectiveness to traditional methods in terms of knowledge retention, skill acquisition, and confidence among nursing students remains limited (Gebremedhn et al., 2014).

Recent literature highlights the efficacy of simulation-based training in improving CPR knowledge and practical skills among healthcare providers. For instance, studies indicate that simulation training can lead to better retention of skills and knowledge compared to traditional methods (Weiss et al., 2023; Fukushima et al., 2020). However, the comparative effectiveness of traditional versus online training methods like HeartCode CPR specifically for nursing students has not been thoroughly investigated, particularly in regions where healthcare education is rapidly evolving (Fukushima et al., 2020).

The need for more comprehensive studies that directly compare these training modalities is evident, as current research primarily focuses on

simulation-based training without adequately addressing the differences between traditional and online approaches (Hassan & Elsaman, 2022). In conclusion, while both traditional CPR training and HeartCode CPR have their unique advantages, the lack of empirical evidence directly comparing their effectiveness underscores the necessity for further research. As nursing education continues to adapt to technological advancements, understanding the most effective methods for teaching CPR will be crucial for preparing nursing students to respond effectively in emergency situations.

Objectives of the Study

The current study aimed to investigate how individual and team personality traits, academic motivation, and academic procrastination predict CPR training outcomes at individual and team levels, and to what extent these associations vary across different CPR training modalities (instructor-led versus blended).

Material and methods

Design

This study employed a randomized trial, experimental, posttest-only control group design.

Subjects

The target population comprised undergraduate nursing students enrolled in the BSN program. The inclusion criteria were determined as follows: (1) third- and fourth-year students, (2) they had already completed foundational coursework. On the other hand, the exclusion criteria were: (1) students enrolled in the program through bridging tracks, and (2) students who had completed the comprehensive clinical course.

Potential participants were randomly selected from eligible nursing students listed in academic records, screened for inclusion criteria, and invited via email. A total of 133 nursing students were enrolled and randomly assigned to one of two study groups. They were then divided into groups of 6 using block randomization to balance group sizes. Because the interventions differed in content and delivery, blinding of students and instructors was not possible.

The required sample size was calculated through an independent samples t-test aimed at detecting a moderate effect size (Cohen's d = 0.5) between the two training groups, with a statistical power of 0.80 and a significance level of 0.05. Based on that, a minimum of 63 students per group was required to ensure adequate power to detect statistically significant differences in the measured outcomes.

Randomization

Participants were selected using a random sampling technique following the acquisition of a complete list of eligible nursing students from official academic records. Based on the predefined inclusion and exclusion criteria, a filtered list of potential participants was generated. From this list, students were randomly selected and invited to participate through a recruitment link sent to their email addresses. Those who filled out the link were screened again for eligibility, and then the researchers contacted those who met the criteria to notify them of their enrollment. Recruited participants were then assigned to one of the two study

groups, ensuring an unbiased and systematic approach to participant recruitment. Randomization utilized stratified randomization (to ensure that the distribution of both nursing schools is similar across treatment groups) and block randomization (to ensure that the number of participants assigned to each treatment group remains roughly equal throughout the trial). Due to the varying educational materials and delivery methods, it was not possible to blind or conceal the allocation to either students or instructors.

Interventions

All CPR training sessions were conducted over nine weeks (May - July 2025) at the Life Support Center at the private university, which is accredited by the American Heart Association (AHA) and equipped with high-fidelity manikins and advanced audiovisual technology. Following participant selection, students were randomly assigned to one of two intervention groups, each receiving a different CPR training modality. Both training methods were based on the most recent guidelines from the AHA and delivered by certified instructors to ensure consistency and quality of instruction (American Heart Association [AHA], 2020).

Each participant received an official invitation via email, which included a cover letter, details of the training schedule, course materials, and an informed consent form. To reduce potential external influences, both groups received their respective training at the same time. Upon completion of the training, participants were immediately asked to complete the postest self-reported questionnaires through Google Forms, with all items set as mandatory. Students were instructed to complete the surveys independently and were assured of the confidentiality and anonymity of their responses.

Intervention and Data Collection

All CPR training sessions were conducted over nine weeks (May - July 2025) at the Life Support Center at the private university, which is accredited by the American Heart Association (AHA) and equipped with high-fidelity manikins and advanced audiovisual

technology, providing a realistic and interactive environment to support hands-on, experiential learning under standardized conditions. Following participant selection, students were randomly assigned to one of two intervention groups, each receiving a different CPR training modality. Both training methods were based on the most recent AHA guidelines and delivered by certified instructors to ensure consistency and quality of instruction.

Each participant received an official invitation via email, which included a cover letter, details of the training schedule, course materials, and an informed consent form. To reduce potential external influences, both groups received their training simultaneously. Upon completion of the training, participants were immediately asked to complete the post-test self-reported questionnaires via Google Forms, with all items set to be mandatory. Students were instructed to complete the surveys independently and assured that their responses would be kept confidential and anonymous.

The participants were randomly assigned to groups of 6 to attend courses.

Training Method A: Instructor-Led Training

Students in this group received a traditional, face-to-face BLS course in a classroom and simulation lab setting. The training consisted of a 4-5-hour interactive session featuring theoretical videos, demonstrations, guided discussions, and hands-on practice with high-fidelity manikins. Emphasis was placed on immediate feedback, real-time technique correction, and active engagement through instructor supervision.

Training Method B: Blended Learning

Students in this group participated in a blended learning approach combining online and in-person instruction (HeartCode Course). The online component consisted of a 2-hour self-paced module featuring multimedia content on CPR principles, procedures, and updated AHA guidelines. This was followed by a 2-3-hour in-person practical session conducted in the simulation lab, where students practiced CPR skills using AHA videos and under the

guidance of trained instructors. The practical session focused on applying theoretical knowledge in realistic clinical scenarios.

Training Method A: Instructor-Led Training

Students in this group received a traditional, instructor-led BLS course in a classroom and simulation lab setting. The training consisted of a 4-5-hour interactive session that included theoretical videos, demonstrations, guided discussions, and hands-on practice using high-fidelity manikins.

Training Method B: Blended Learning

Students in this group participated in a blended learning approach combining online (consisting of a 2-hour session) followed by a 2-3 hour instructor-led instruction (HeartCode Course) conducted in the simulation lab, where students practiced CPR skills following AHA videos and under the guidance of trained instructors.

Assessments (Outcomes)

Students were assessed directly

Primary outcomes

CPR training outcomes (written exam and competency checklists)

The written exam for BLS, developed by the AHA, consists of 25 multiple-choice questions with four answer options. The exam covers critical areas of CPR, including response and activation, high-quality CPR, AED use, and team dynamics. The passing score is 84%, with a remedial attempt available for those who fail. Skills were assessed using an AHA-developed adult and infant checklist. Students have to complete all tasks to pass the checklist. If they fail, they have one extra chance to practice and then retake the exam.

CPR team performance

Team performance was assessed during a 10-minute CPR scenario. Two approaches were used, including:

1. Direct observation and recording by two independent data collectors: duration of check pulse (from putting hands on the carotid to declare no pulse), time to start CPR (from declaring no pulse to start compression), time to start CPR (from finding the patient to start compression), time to first shock (from AED arrival), shock pause: time to start CPR after shock.
2. Feedback device attached to the manikins to measure: chest compression fraction (CCF), CPR score, compression score, total number of compressions, average rate, percentage of correct rate, average depth (mm), percentage of adequate depth, percentage of good release, ventilation total score, total ventilations, ventilations with good volume, compression time (minutes), pause time (minutes), longest pause (seconds).

Secondary outcomes

Ten-Item Personality Inventory (TIPI)

The TIPI (Gosling et al., 2003) assesses five essential personality traits: openness to experience, conscientiousness, extroversion, agreeableness, and emotional stability, measured on a 7-point Likert scale (1= disagree strongly and 7 = agree strongly). Cronbach's alpha in the current study was 0.752.

The Motivated Strategies for Learning Questionnaire (MSLQ)

The MSLQ is a self-report instrument designed to assess students' motivational orientations and their use of different learning strategies for a college course (Pintrich et al.,

1991). The questionnaire consists of 81 items, measured on a 7-point Likert scale (1 = Not at all true of me and 7 = Very true of me), and forms 15 subscales. Three subscales were chosen from the MSLQ:

1. Value Component: Task Value (6 items): Task value refers to students' perceptions of the course material in terms of interest, importance, and utility. High task value should lead to more involvement in one's learning. Cronbach's alpha in the current study was 0.934.
2. Expectancy Component/ Control of Learning Beliefs (4 items): Control of learning refers to students' beliefs that their efforts to learn will result in positive outcomes. If students believe that their study efforts make a difference in their knowledge, they should be more likely to examine more strategically and effectively. Cronbach's alpha in the current study was 0.817.
3. Expectancy Component/ Self-Efficacy for Learning and Performance (8 items): The items comprising this scale assess students' performance expectations in addition to their confidence in skills and ability to perform that task. Cronbach's alpha in the current study was 0.870.

The Academic Procrastination Scale–Short (APS-S)

The Academic Procrastination Scale–Short (APS-S) measured the severity of students' academic procrastination (Yockey, 2016). The APS-S comprises five items rated on a 5-point Likert scale (1 = totally agree, 5 = totally disagree). Higher scores indicated a greater tendency to procrastinate on academic tasks. Cronbach's alpha in the current study was 0.897.

Student Satisfaction and Self-Confidence in Learning

This instrument, developed by the National League for Nursing (NLN), comprises 13 items designed to assess students' satisfaction with the instructional process and their self-confidence in applying acquired skills. It consists of two subscales: Satisfaction with Current Learning (5 items), which evaluates the perceived effectiveness, clarity, and instructional support, and Self-Confidence in Learning (8 items), which measures students' confidence in their ability to apply and evaluate the learning outcomes. Responses are rated on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with higher scores indicating greater levels of satisfaction and self-confidence. The scale has demonstrated high internal consistency, with Cronbach's alpha values of 0.94 for satisfaction and 0.87 for self-confidence (NLN, 2020).

Basic Resuscitation Skills Self-Efficacy Scale (BRS-SES)

This 18-item scale was developed based on Bandura's self-efficacy theory and informed by the European Resuscitation Council guidelines and prior validated resuscitation instruments (Hernández-Padilla et al., 2016). It assesses nursing students' confidence in performing key resuscitation tasks. Participants rate their confidence on a 0–100 scale, where higher scores indicate greater perceived self-efficacy in performing basic resuscitation procedures. The BRS-SES has demonstrated excellent internal consistency (Cronbach's $\alpha = 0.96$).

Reassessment

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics, including means, standard deviations, and frequencies, were used to summarize the demographic characteristics and main study variables. Chi-square and t-test were used to determine whether there was a difference in socio-demographic characteristics

between the groups. The differences in satisfaction, confidence, and self-efficacy between the two training groups were assessed using Analysis of Covariance (ANCOVA), while controlling for confounding variables.

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