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Theoretical Models Integration in Development, Validation and Evaluation of Simulation in Basic Life Support Training: A Randomised Control Trial

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ABSTRACT

The current study addresses the persistent challenge of cardiopulmonary arrest and the critical need for prompt responses by healthcare providers (HCPs). Basic Life Support (BLS) training is vital for equipping HCPs with the skills necessary for cardiopulmonary resuscitation (CPR). Simulation training, an increasingly integral element of nursing education, offers an effective means of enhancing participants' confidence. This study aims to develop and validate a simulation training module in BLS and evaluate its effectiveness in improving confidence levels among newly employed nurses (NEN) in Jordanian government hospitals. This study introduces the Simulation in Basic Life Support Training (SBLST) module, which was developed in alignment with current BLS guidelines and educational theories. Through content and face validity, this study validates the efficacy of the module. In a randomised controlled trial involving 102 NEN, the intervention group underwent a full day of SBLST, while the control group received standard brochure-based training. Statistical analysis revealed a significant increase in confidence levels among the intervention group following the training (F-statistic = 37.969, $p < 0.001$). The findings underscore the effectiveness of the SBLST module in enhancing nurses' confidence in performing CPR. By integrating simulation and theoretical frameworks, this study advances the goal of enhancing BLS training in nursing education.

Keywords: *Simulation training, Cardiopulmonary resuscitation, Basic cardiac life support, Education, Nursing*

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INTRODUCTION

Cardiopulmonary arrest has become a major global health problem facing healthcare providers (HCPs), especially given the increased mortality it causes (1). Research shows that 36% of cardiopulmonary resuscitation (CPR) did not meet the Basic Life Support (BLS) standard; the findings included instances of forgetting to ask for help from the advanced team, checking rhythm for more than 10 seconds, inaccurate chest compression, and forgetting to open the airway during ventilation (2). Effective resuscitation needs a rapid recognition of the situation and rapid defibrillation. Additionally, cardiopulmonary arrest requires immediate action within minutes from the HCPs nearest the event (3). The early activation of the BLS chain of survival is crucial for saving the lives of victims (4). BLS training is crucial for developing health professionals (5, 6). The American Heart Association (AHA) mentions that HCPs should always be qualified to perform effective CPR (6).

Simulation training has become an essential learning method in the medical field (7). Simulation is a powerful tool for improving confidence among participants after BLS training (1, 3, 8). Simulation has become a primary teaching methodology in nursing education (6). Simulation training broadens nursing education by developing nurses into specialists in various fields and establishing higher degrees of study, such as master's degrees in critical care nursing, emergency care, maternity, and paediatric nursing care (9). The use of simulation in education has risen worldwide over the last 20 years (10, 11). Simulation is an alternative teaching method in the nursing curriculum (12). It's effective training method represents reality, maintains patient safety, and assists nurses in acquiring BLS knowledge and skills (13, 14).

Nursing education requires a specific learning theory to integrate simulation into the curriculum effectively (15). To maximise nurses' knowledge and practice levels, the WHO recommends using Miller's Pyramid and Kolb's Cycle as the theoretical models in nursing and midwifery training associated with simulation (16). A high level of confidence is important for nurses, particularly during their first year of employment, in establishing a strong professional foundation and enabling them to protect patients from unsafe care (10). Nurses' levels of confidence in BLS will fall without frequent training (1). Therefore, effective CPR needs competent nurses who are highly confident about performing BLS quickly and correctly (17).

Nurses are the primary target of BLS training (18). By profession, they face cardiopulmonary arrest victims daily, and they should be ready to face these situations (19), so they are vital members of a resuscitation team (20). Nurses are often the first witnesses to cardiopulmonary arrest (21) and the first responders to undertake CPR (1, 22). Therefore, they need effective BLS training, given their crucial role as first responders in situations requiring CPR.

This study aims to develop and validate a BLS simulation training module and evaluate its effectiveness in improving confidence levels among newly employed nurses (NEN) personnel in Jordanian government hospitals. It also aims to determine if there was any significant difference in the pre-test mean scores and post-test scores between intervention and control groups of NEN in terms of their confidence levels after the Simulation in Basic Life Support Training (SBLST) intervention.

METHODS

Simulation Training Module Development

The development of the SBLST module was a comprehensive process based on three sources. Firstly, the current study used the latest BLS guidelines from AHA 2020 (23). Secondly, the researchers conducted literature reviews that supported simulation as a unique strategy in BLS. Finally, the researchers strengthened the SBLST module with theoretical frameworks. The AHA guidelines are the global standard for official resuscitation guidelines, being exported to healthcare institutions, healthcare professionals, and laypeople. The latest AHA-BLS-2020 guidelines include new updates and modifications, and they are available in English as a provider manual. The selection of English for these interventions was based on the fact that nursing curricula and training for HCPs are conducted in English. The provider manual was simplified into two parts: knowledge and practice.

The literature review aimed to identify the most effective learning strategies for BLS training among nurses based on evidence-based practice. It guided the researchers in formalising key features of the SBLST module, including timing, area, participant number, and facilitator attributes. The study followed the search strategy suggested by the Joanna Briggs Institute to find relevant information in electronic bibliographic databases and grey literature. This strategy involved three levels: Level 1 included CINAHL and MEDLINE via Ovid; Level 2 comprised the Cochrane Central Register of Controlled Trials, Scopus, PubMed, and Web of Science; and Level 3 was the Airiti Library.

The search strategy required an accurate PICO framework, defining the Population, Intervention, Comparison or control group availability, and Outcomes (24). For the present study, to search for literature reviews, the researchers selected the population from among NEN, while the intervention involved providing them with BLS training and AHA guidelines. The researchers also ensured that a control group or multiple time-test measurements were available to compare the results. The primary objective of the research was to examine the effect of a simulation intervention on outcomes related to knowledge, practice, and confidence. The National League of Nursing (NLN) determined the six essential components of simulation training (25, 26). These components included context, background, designs, educational material, simulation experience, and focused outcomes. The context element outlined the training's goals, key features, and outcome measurement methods, as well as the pre-training and post-training evaluation procedures.

The research utilised a comprehensive searching strategy that incorporated Boolean operators such as "AND" and "OR" alongside a combination of relevant terms, including "Basic Life Support" (BLS), "Simulation", "Manikin", "Education", "Training", "Knowledge", "Skills", "Practice", "Performance", and "Confidence", as well as variants of the latter like "Self-confidence" and "Confidence Level". Specific focus was placed on literature related to nursing, employing the term "Nurs*" and including affiliations with the AHA. The search timeframe was set from 2014 to 2021. Duplicated articles retrieved from the electronic bibliographic databases were removed, retaining only one instance of each. The inclusion criteria were strictly limited to studies involving nurses as the population, excluding any research that involved nursing students or other non-nurse HCPs.

Additionally, only interventions that employed BLS training simulations were considered, with all unrelated interventions being excluded based on a title and abstract review. The selection process focused on experimental and quasi-experimental studies, with non-

experimental and review articles excluded. Furthermore, the primary variables for inclusion were knowledge, practice, and confidence, with any other variables being disregarded. Furthermore, any articles not published in English were excluded, resulting in the deletion of one article categorised as "not retrieved". The third method of developing the SBLST module involved integrating theoretical frameworks by incorporating theories into the simulation training module (27). In this study, two theoretical models, Miller's Pyramid and Kolb's Cycle, were identified as suitable and are explained in the results section regarding their integration into the SBLST module.

Simulation Training Module Validation

Content and face validity are necessary for developing educational material (28–31). The study was validated through content validity and face validity. In nursing, validating educational material enhances learning and future career preparation (32). Content validity was a crucial process that ensured the SBLST module was aligned with the AHA-BLS-2020 guidelines.

This process involved several steps. Firstly, a content validation form was prepared. The form was used to rate the relevancy of the module items using a four-level rating system as follows: (a) not relevant, (b) somewhat relevant, (c) quite appropriate, and (d) highly suitable. Secondly, a review panel of experts was selected, including English language specialists, BLS faculty members, and clinical instructors. Nine BLS experts participated in this study to ensure the validity of the content. According to previous studies, education experts are selected based on their experience in the field, which helps them evaluate educational material effectively (28–30, 33–36). For content validity, the recommended number of experts is six to ten from the same field (30). Thirdly, we prepared for face-to-face meetings with experts, who provided feedback to refine the module's relevance. Fourthly, experts independently completed the content validation evaluation form. Lastly, the content validity index (CVI) calculation was performed (30). An acceptable CVI value is 0.78 or more, with 0.90 being the standard for excellent content validity (29, 37).

The face validity assessment followed the content validity assessment. Twenty nurses from intensive care unit (ICU) and emergency unit (ER) were invited for this purpose. This assessment involved pilot testing the SBLST to refine its content and assess practical aspects, such as the time required and the course flow. Nurses evaluated whether the SBLST module appeared appropriate in terms of the content's readability, clarity, and understanding for learners, based on its surface appearance (31, 36, 38). Furthermore, face validity was assessed through pilot testing the instruments by calculating Cronbach's alpha.

Simulation Training Module Evaluation

Study design

The study was a single-anonymised, randomised, controlled trial with repeated measurement tests. It was registered with ClinicalTrial.gov (ID: NCT06001879).

Eligibility criteria

The control and intervention groups were homogeneous. The study included nurses with less than two years of experience in non-critical care departments, minimal exposure to cardiopulmonary arrest, and no recent BLS training. Nurses with ICU capabilities were excluded.

Sample size estimation

The sample size calculation using G*POWER initially determined that 72 participants should be involved, considering a potential 30% dropout over three months. Hence, the final sample size consisted of 102 participants, who were evenly distributed between the control and intervention groups.

Population and sampling method

The study focused on NEN at five hospitals in Jordan; the hospitals were randomly allocated into two groups using computer-generated randomisation. Specifically, random allocation software was used to assign three hospitals to the control group and two hospitals to the intervention group. Additionally, the participating nurses from these hospitals were randomly assigned using the randomiser function in Microsoft Excel. This randomisation of participants started with a visit to the nursing directors and continuing education offices in the selected hospitals to create a comprehensive list of nurses eligible for the study. The nursing directors were responsible for compiling the lists of eligible participants. To ensure equal representation from each hospital, the researcher allocated the sample size proportionally across the groups, depending on the number of participants meeting the eligibility criteria in each hospital. In the control group, 33.33% of the 51 NEN were distributed evenly among three hospitals. In the intervention group, 50% of the participants were allocated across two hospitals. This approach guaranteed a balanced representation within the study (Table 1). To avoid data contamination, the researchers ensured that the participants in the control and intervention groups were not selected from the same hospitals (39).

Table 1: Sample size for the selected hospitals

Total sample size: 102 NENs			
Control group sample size (n = 51)			
Hospitals name	**Total number of NENs**	**Sample size calculation using proportionate allocation**	**Estimated sample size**
Prince Hamza Hospital	60	(33/100) * 60 = 19.8	20
AL-Basheer Hospital	66	(33/100) * 66 = 21.78	22
Dr Jameel AL-Totanji Hospital	27	(33/100) * 27 = 8.91	9
Intervention group sample size (n = 51)			
Prince Faisal Hospital	64	(50/100) * 64 = 32	32
Al-Zarqa Governmental Hospital	37	(50/100) * 37 = 18.5	19

The research with the nursing directors in each hospital began with randomisation based on the participant lists. Excel features were utilised to prepare the final list. This final list for both groups was stored with the nursing directors to help schedule a suitable day and time for conducting the study. Several studies in Jordan have highlighted that nurses who graduated in 2021 and 2022, during the COVID-19 pandemic, completed their clinical training online. Due to nursing shortages, they started working directly in emergency departments, intensive care units, and respiratory triage centres without any in-person clinical training or specific orientation (40–42). Nursing students who graduated in Jordan during COVID-19 were recommended to participate in a specific nursing orientation programme so they could fulfil the clinical learning outcomes that were missed during the pandemic period (42).

The current study outlined its goals and potential risks before the participants voluntarily signed a physical consent form. The data collected from the participants was stored in a secure and confidential location. This study posed no hazards to the participants and involved no use of any medications that might have affected their health.

Research instruments overview

The research instruments consisted of two sections: demographic data and a self-evaluation questionnaire of confidence. The demographic section was used to gather information about age, gender, education, area of expertise, and work experience, along with questions about prior BLS training involvement. The self-evaluation questionnaire, adapted from Bissenbayeva's work (17), was used to assess nurses' confidence in BLS performance through seven statements. Participants were required to rate statements via a drop-down menu scale. In a study by Bissenbayeva (17), a self-evaluation questionnaire was validated for assessing nurses' confidence in CPR and the effect of In Situ Simulation (ISS) on their competence, achieving a high Cronbach's alpha of 0.865. In this study, we conducted a pilot test of this confidence tool, which resulted in a Cronbach's alpha of 0.73, confirming its suitability for our research context. The questionnaire compromised seven statements: (a) I have the knowledge to identify a person suffering from a sudden cardiac arrest; (b) I would perform chest compression on a person in need of it; (c) I would perform mouth-to-mouth ventilation for a person in need; (d) I would risk causing harm to the person I perform CPR on; (e) I would use a defibrillator if I had access to one during a cardiac arrest; (f) I have the knowledge to give first aid to a person suffering from a traumatic event; (g) I would give first aid to a person suffering from a traumatic event.

Data collection

The study consisted of three main phases: pre-test, intervention, and post-test, as shown in the flowchart (Figure 1).

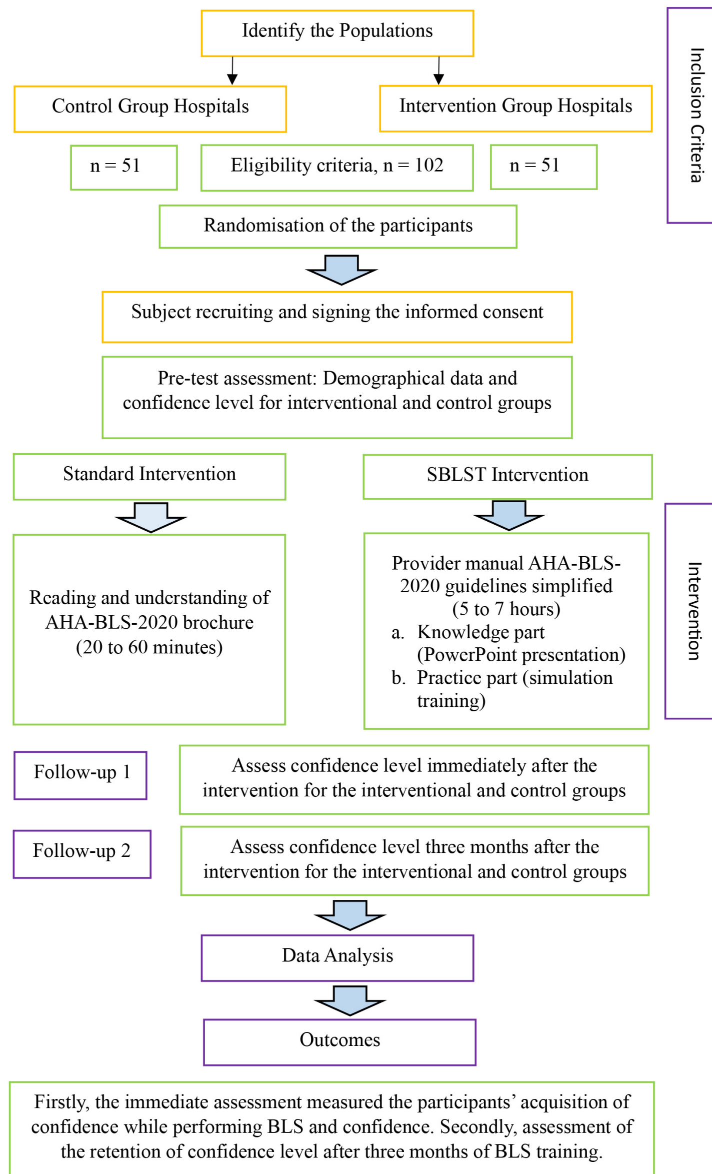

Figure 1: Consort flowchart.

Pre-test

Potential participants who met the eligibility criteria in both the control and intervention groups were invited to participate in this study. After signing the consent forms, participants completed the demographic data and pre-test questionnaires, which took approximately 30 minutes to complete.

Intervention

The intervention phase involved two separate approaches: the control group intervention and the experimental group intervention.

Control group intervention

The BLS-2020 informational brochure guidelines used with the control group were designed in accordance with AHA-BLS guidelines, which outline the theoretical knowledge and basic principles of BLS. The guidelines provide a foundational approach to life-saving intervention, ensuring that information in the brochure is evidence-based and consistent with established best practices. The AHA BLS 2020 brochure was selected as the control intervention to ensure participants had access to standardised BLS knowledge while avoiding the hands-on practice integral to the experimental group's simulation training. This brochure is a comprehensive guide designed to provide essential information and training for healthcare professionals and others who need to perform CPR and other basic cardiovascular life support skills. The brochure typically includes an introduction to BLS; an overview of the AHA guidelines on CPR; the steps to perform high-quality CPR for adults, children, and infants and the chest compression technique; the use of Automated External Defibrillators (AED); the relief of choking; team dynamics; and BLS in special emergency circumstances such as pregnancy, cardiac arrest, opioid overdose, and drowning. The brochure is designed to be a concise, easy-to-reference tool for both initial training and ongoing review. It ensures that all relevant information is covered to maintain the highest standards of care in life-threatening situations. The participants read and understood this brochure for 30 to 60 minutes. Then, they moved to the post-test. However, control group participants were wait-listed and subsequently exposed to the training intervention (29).

Experimental group intervention

The study was conducted in each hospital classroom, and the training was divided into multiple sessions. The researchers invited approximately ten nurses to participate in each session to maintain an optimal learning environment until the desired sample size was achieved. Secondly, the intervention group underwent five to seven hours of SBLST, which consisted of both knowledge and practice training. Previous studies have recommended that HCPs spend six to eight hours completing the BLS training (43–45). Another study mentioned that acquiring the knowledge requires two hours of lectures and group discussion (6). Another study by Knipe mentioned that nurses need at least three hours to acquire BLS skills (46).

The intervention for the experimental group was simplified into two parts: the first part, the knowledge component, was delivered using PowerPoint presentations and illustrative pictures, while the second part, the practice component, was facilitated by clinical simulation training. To conduct the practice, the researchers needed to prepare an adult half-body manikin and a paediatric full-body manikin. Adult and paediatric simulation manikins both have chest inflation and deflation characteristics during respiration, a palpable carotid pulse, a Charlie simulator to relieve choking, bag-valve-mask ventilation, and a chest compression board. Some topics are explained as knowledge-only, such as recognising life-threatening conditions, including the signs and symptoms of stroke and myocardial infarction. The five essential topics are the adult and child chains of survival; BLS for adults and pregnant women (including AED use); BLS for infants and children (including AED use); alternative breathing

techniques; and choking relief for adults, pregnant women, and infants. The session began with knowledge, reinforced through hands-on practice using simulation manikins. All the nurses in the intervention group received hands-on training. The researchers used a list of the nurses' names to ensure that each completed the full training session, while direct individual observation and supervision of each participant was maintained.

Post-test

Post-test-1 was performed immediately after the interventions for both groups; of the 102 participants, 51 were in the intervention group and 51 were in the control group. They all completed the immediate post-test, resulting in a 100% response rate post-test 2 (three months after the interventions). The researchers contacted the participants via cell phones and email addresses to complete post-test 2, which was conducted three months after the intervention. They sent a link to a Google Forms platform for people to complete the survey. The intervention group consisted of 48 participants who completed post-test 2, yielding a response rate of 94%. Meanwhile, the control group consisted of 45 participants who completed the survey, giving a response rate of 88%. Surprisingly, the actual dropout rate for both groups was only 0.096%, which was lower than had been expected.

Statistical analysis

SPSS version 27 was used for data analysis, with descriptive and inferential methods employed to evaluate the effectiveness of the training intervention. Group consistency in pre-tests and differences in post-tests were assessed using one-way ANOVA with a significance level of $p < 0.05$. Additionally, Cohen's d was calculated to demonstrate the training module's impact, with values below 0.2 indicating a small effect, those of 0.2 to 0.8 indicating a moderate effect, and those above 0.8 indicating a large effect (47). The issue of participant dropout in the pre-test and post-test was addressed by adjusting the timing of these assessments to ensure full participation in the study. Both the pre-test and post-test-1 were conducted on the same day, immediately before and after the intervention, which allowed the researchers to achieve 100% participation. Additionally, the researchers collected email addresses and cell phone numbers from the participants to facilitate responses to the follow-up questions after post-test 2, which were sent three months later.

RESULTS

Simulation Training Module Development Results

Based on the 2020 BLS guidelines from the AHA, the researchers developed the SBLST module, dividing it into two parts: knowledge and practice. The knowledge component was delivered through an interactive PowerPoint presentation, which blended text and visuals to engage learners effectively. The practice component involved hands-on simulation training using low-fidelity manikins.

The search produced seven intervention-based studies published between 2014 and 2021, as illustrated in the literature review flowchart (Figure 2). The eligible articles used various teaching methodologies for BLS training. Based on a reviewed article from a systematic search, the researchers decided to use a PowerPoint presentation to impart theoretical

knowledge and a low-fidelity simulation approach to help learners apply the SBLST module in practice. The researchers also selected a professional facilitator to conduct the training sessions, which involved ten learners per session. Moreover, nurses with ICU and ER capabilities were excluded. The training duration of SBLST is six to eight hours, including a pre-test, an immediate post-test, and a post-test three months after the intervention. Lastly, the researchers selected the learners' confidence levels as the evaluation criteria for this study. Each decision has a unique justification. Most studies used PowerPoint presentations for knowledge learning and simulation to practice skill acquisition (48–51). The researchers used a PowerPoint presentation to convey BLS concepts, enhanced by pictures and video understanding (52–54). Four studies emphasised the benefits of teamwork and focused on debriefing at the end of the training (48, 55, 56). Four studies utilised low-fidelity manikins for BLS training (20, 48, 50, 55). Meanwhile, one study employed a high-fidelity manikin (51). Furthermore, a single study used a Baby Anne simulation (56).

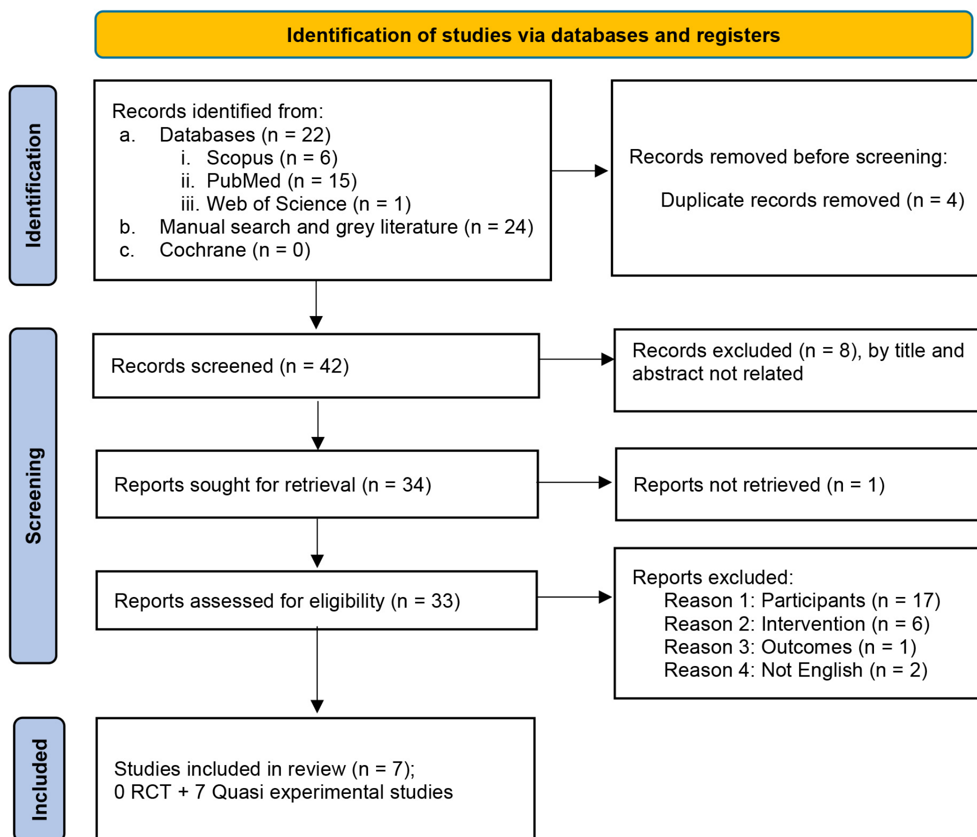

Figure 2: Literature review flowchart.

Many studies have highlighted the effectiveness of low-fidelity simulation training for BLS, which has become a vital strategy in nursing education over the last twenty years (11, 57, 58). This innovative teaching approach addresses the needs of a growing number of trainees and is considered convenient for BLS training due to its portability (5, 48). Four studies mentioned that an AHA-certified instructor facilitated the BLS training (50, 51, 55, 56). Clinical instructors facilitated BLS interventions in two studies (48, 50). Most of the studies included nurses from all hospital departments in the BLS training. However, one study excluded ICU and ER nurses because they frequently performed CPR and had sufficient knowledge and skills in BLS, which might have affected the study results (2, 49).

Based on a reviewed article from a systematic search (20, 48, 51, 56), the researchers agreed to select ten learners per session. This number is ideal for preventing learners from becoming overwhelmed and for minimising training duration. It also allows sufficient repetition of the training and helps reduce errors (59, 60). Moreover, four articles were reviewed from a systematic search that involved BLS training being conducted for six to eight hours (50, 51, 56, 57). Other previous studies have also recommended a duration of six to eight hours for BLS training for healthcare professionals (43, 44). The theoretical portion of the training typically requires two hours for lectures and group discussions (6).

Furthermore, nurses require at least three hours to acquire BLS skills effectively (46). Most reviewed articles from a systematic search employed pre-tests and immediate post-test assessments to measure participants' acquisition levels before and after the intervention (20, 50, 51, 55). Two studies assessed BLS competency retention levels among learners using a post-test administered three to six months after the initial training (49, 56). Two studies measured the learners' confidence levels using a Likert scale (48, 51). Post-test 2 would be conducted after three months, given that previous studies have indicated that retaining nurses' confidence and competence requires BLS refresher training every three months (1).

Simulation Training Module Validation Results

The CVI revealed that the SBLST module items achieved a score of approximately 0.88, indicating their relevance and appropriateness. Moreover, the researchers received feedback from BLS experts and language experts; based on this feedback, content validity was achieved. This finding ultimately resulted in the modification of the SBLST module. Eleven women and nine men with ICU and ER experience participated in the face validity assessment. The facilitator implemented the SBLST module over five hours. Most participants provided positive feedback, noting the clarity of the module and surveys, albeit with some suggestions for improvement in terms of appearance and duration. The comments were reviewed, and the face validity of the SBLST module was achieved.

Simulation Training Module Effectiveness Results

The control and intervention groups had similar demographic characteristics, according to the data presented in Table 2. All the participants held bachelor's degrees in nursing, with the majority having less than two years of experience in the field. None of the participants had received BLS training before the study. Most were between the ages of 20 and 24. The data showed a relatively even distribution of male and female participants, with 54 men and 48 women. The pairwise comparison shown in Table 3 indicates that both groups had similar confidence levels before the intervention, given that there was no significant difference in the pre-test results ($p = 0.26$).

Table 2: Demographical features of participants

Demographical data	Category	Control group	Experimental group	Total
		N (%)	N (%)	N (%)
Age (year)	20–24 25–29	45 (44.1) 6 (5.9)	47 (46.1) 4 (3.9)	92 (90.2) 10 (9.8)
Gender	Men Women	25 (24.5) 26 (25.5)	29 (28.4) 22 (21.6)	54 (52.9) 48 (47.1)
Education level	Bachelor's degree	51 (50)	51 (50)	102 (100)
Experience years in the nursing field	Less than one year from 1 to 2 years	46 (45.1) 5 (4.9)	45 (44.1) 6 (5.9)	91 (89.2) 11 (10.8)
Did you receive any basic life support training in your health institutions?	No	51 (50.0)	51 (50.0)	102 (100.0)

The confidence Mean ± SD presented in Table 3 is based on the groups and the times taken to perform the tests using one-way repeated measures ANOVA. The analysis determined that the confidence scores significantly differed across the three test points of pre-test, post-test-1, and post-test-2: F-Stat (df) = 37.969 (2,182) ($p < 0.001$). According to the alternative hypothesis, the pairwise comparison revealed a significant difference in the confidence levels across all assessments between the intervention and control groups. In post-test-1, the confidence M±SD of the intervention and control groups were 74.15 ± 13.768 and 65.60 ± 17.322, respectively, with $p = 0.010$. In post-test-2, they were 71.71 ± 16.374 and 52.86 ± 22.479, respectively, with $p < 0.001$. The confidence levels over time indicated that the training module was more beneficial compared to the standard intervention in all post-tests. Confidence levels decreased after three months. They remained high in the intervention group and returned to baseline in the control group.

Table 3: One-way repeated measures ANOVA

Confidence level: F-Stat (df) = 37.969 (2,182); (*p** = 0.000a)				
Test point	Mean ± SD		Pairwise comparison	
	Control group	Experimental group	Mean difference	*p*-value*
Confidence pre-test	49.60 ± 17.658	45.30 ± 18.856	4.305	0.260
Confidence post-test-1	65.60 ± 17.322	74.15 ± 13.768	8.552	0.010
Confidence post-test-2	52.86 ± 22.479	71.71 ± 16.374	18.848	< 0.001

Notes: *Significant at 0.05; a: One-way repeated measures ANOVA was applied. The multivariate normality assumption is fulfilled.

Cohen's d effect sizes were calculated between pre-test and post-test-1 and pre-test and post-test-2 for the intervention and control groups. According to Table 4, the values of Cohen's d indicates a "large effect" in the confidence levels among the intervention and control groups between pre-test and post-test-1, but the Cohen's d value of the control group (0.9) was twice as high as that in the intervention group (Cohen's d = 1.8), indicating the effectiveness of the SBLST. Furthermore, the effect size between pre-test and post-test-2 indicates that the training module had a "large effect" (Cohen's d = 1.5) on the confidence level of the intervention group, while it showed a "low effect" (Cohen's d = 0.2) on the confidence level of the control group. Thus, the results show that the training SBLST module was effective in retaining participants' levels of confidence in BLS.

Table 4: Effect size

Test time	Effect size – Cohen's formula (d)			
	Pre-test and post-test-1		Pre-test and post-test-2	
	Experimental group	Control group	Experimental group	Control group
Cohen's d	1.8	0.9	1.5	0.2
Effect level	Large effect	Large effect	Large effect	Low effect

DISCUSSION

Simulation Training Module Development Phase Discussion

The module was developed using a comprehensive approach to enhancing confidence levels among nurses. The integration of simulation and theoretical frameworks in BLS training serves the overarching goal of creating a comprehensive and effective learning experience (27). The AHA is the largest organisation that provides BLS, with updated information offered through evidence-based practice events (61). The current study utilised the 2020 AHA guidelines, which are based on the BLS guidelines.

Most reviewed articles from our systematic search used quasi-experimental designs, while some high-quality RCTs from previous studies (such as 11, 22) investigated simulation-based training in BLS. These studies predominantly focused on nursing students rather than practising nurses in clinical settings. These results highlight a gap in evidence specific to the professional nursing workforce, even though it is critical for translating findings into evidence-based practice in real-world healthcare environments. Therefore, the current study was conducted using RCT studies to evaluate the effectiveness of BLS simulation training for nurses in terms of raising their confidence levels. Reviewed articles from a systematic search helped formalise the key elements of the SBLST module. These include the educational approach, the type of simulation utilised in training, the time and location requirements, the eligibility criteria for participants, the number of participants in each session, the attributes of the facilitator, and the assessment method.

The intervention was divided into two parts: the first involved imparting knowledge, while the second involved practical training. Prior studies have shown that BLS training requires knowledge acquisition at the beginning and then the transfer of this knowledge into practice using simulation training (1, 8, 35, 51–53, 57). Previous studies suggested that a full day of BLS training can help learners complete the training with fewer mistakes and difficulties (11, 16, 17, 62). Moreover, the researchers found that BLS training is most effective when conducted in hospital classrooms, which is consistent with previous studies (63). One study conducted BLS training in an empty patient room (48). However, this option was excluded from the current study due to potential disruptions during training, consistent with a previous study that found overcrowded hospitals to be unsuitable for training (59). According to several earlier studies (1, 51, 64), BLS training facilitators must hold training certification from international organisations like the AHA. The higher education level of the facilitator is the easiest way to ensure the information is understood and to increase the knowledge levels among trainees (65). BLS instructor eligibility criteria include critical care unit experience, teaching expertise, and good communication skills (64). These facilitator characteristics are crucial because this person conducts the BLS training and corrects the participants' performance (66).

The current study integrated Miller's Pyramid and Kolb's Cycle to guide the SBLST module during training. These models boost learners' confidence and enhance the safety of the training because simulation training is conducted in a non-critical and non-threatening environment, rather than on actual patients, in a simulated setting. Moreover, these models ensure a comprehensive understanding of the material and improve learners' proficiency through repeated training involving simulation until they minimise errors and difficulties (27, 34). The WHO strongly recommends these models to ensure nurses receive adequate training and provide effective, safe care to patients (16). Miller's pyramid emphasises the importance of acquiring knowledge and understanding basic concepts before clinical practice training (16, 27). Furthermore, many studies have utilised Kolb's cycle during BLS training, and Kolb noted that this model maximises knowledge and practice levels among learners (46, 53, 67, 68).

Simulation Training Module Validation Phase Discussion

Experts were consulted to enhance the SBLST module, resulting in its improved effectiveness. Previous studies have shown that incorporating expert feedback can enhance students' learning experiences (30, 36). For the experts in this study to reach a consensus aligns with the approach of a previous study, which emphasised that the harmony and agreement of experts' validation are crucial to achieving the specific goals of educational materials (32). The CVI score of 0.88 indicated that the SBLST module was highly relevant and appropriate. It surpassed the acceptable threshold of 0.78 and approached the standard for excellence of 0.90 (29, 30). The module was modified to ensure clear language, based on feedback from the language reviewer. Clear language is important for inclusivity, usability, and minimising misunderstandings among learners, as previous studies have shown (31, 36).

Besides content validation by experts, it is important to consider potential users' reviews of the SBLST module and questionnaires through the face validation procedure (36). In this study, face validity was established through the pilot testing of the SBLST module and associated instruments. The final SBLST module was modified based on learner feedback to ensure its appropriateness for the target population. Learners' feedback enhances face validity, as mentioned in previous studies (28, 29, 31, 36, 38). The achievement of face validity in this study can be attributed to the field of experience, the number of participants involved in the face validity process, the clarity of the module's language, and the teaching methodology used in the training. Participants in face validity studies must be from the same field of experience (36). Moreover, the minimum acceptable number of raters for face validity is 10 (31). According to previous studies (31, 38, 54, 69), effective visual aid illustrations, such as the use of PowerPoint presentations and simulation manikins, are critical in achieving face validity. Finally, the internal consistency of the Cronbach's alpha (α) was checked and found to be 0.73, reflecting the appropriateness of the instruments, in line with previous studies that suggest an acceptable α value of 0.7 (70).

Simulation Training Module Evaluation Phase Discussion

The effectiveness of the SBLST module intervention in raising confidence levels

Nurses must be knowledgeable and skilled in BLS (8). High-quality CPR enhances victim survival rates (2, 71, 72). However, nurses' practical training in BLS is considered a successful way to minimises mortality (1, 6). Moreover, a systematic review by González et al. (73)

urged that BLS training for laypeople is crucial in enhancing survival rates during out-of-hospital cardiac arrest. Confidence in nursing is defined as the ability to provide optimal patient care, which can be enhanced through simulation training (74). Higher confidence levels were associated with better patient outcomes and improved nurse satisfaction with equipment, policies, and procedures (75, 76). Conversely, poor confidence delays patient care (77).

Confidence in nursing arises from knowledge, practice, and critical thinking (78). Numerous studies have highlighted that simulation training is a powerful tool for enhancing self-confidence (1, 3, 8, 47, 79), particularly in resuscitation training, which fosters independent CPR performance (51). Conversely, confidence levels may decline without frequent training (1). The current study found that participants in the intervention group had significantly higher confidence levels than those in the control group, aligning with a previous study on the effectiveness of simulation-based training in improving confidence levels among nurses (1, 51, 80).

The study found that the SBLST module was more effective than brochures in increasing NEN confidence, and Cohen's d was calculated to confirm the intervention's impact. Previous research also used Cohen's d to confirm the impact of BLS training (76, 81–83). Similarly, a systematic review by Suárez et al. (84) found that simulation-based training significantly enhances skill retention compared to traditional methods, with the author advising its integration into health education. Another study suggested that theoretical knowledge may require supplementary hands-on practice to ensure skill mastery, enhance clinical decision-making, and improve team performance (85, 86).

Consistent with findings obtained by Dick-Smith et al. (22), this study reinforces the idea that structured, practical BLS training significantly boosts nursing confidence and sustains it over three months. These findings underscore the need to integrate simulation into nursing education curricula to ensure long-term competency and readiness.

The increase in confidence levels in the intervention group may be attributed to the acquisition of knowledge and skills, which enabled them to perform BLS independently. Prior studies have shown that maximising knowledge and skills positively influences decision-making, confidence, and patient safety (10, 13, 17, 80). Moreover, repetition training until errors are minimised during sessions contributes to confidence retention (6, 27). At the three-month follow-up, confidence levels had reduced in the intervention group, which nevertheless maintained a higher level of confidence than the control group. Confidence levels declined in the control group, which returned to the baseline. This decline aligned with previous studies that indicated a decline in confidence over time (1, 87). To address this, frequent short-term BLS training sessions (1, 45) or a renewal of BLS training every two years in international institutions (3, 86) are advisable.

The positive practical implications of simulation have become integral to nursing education over the past two decades (12, 56); simulation has expanded the nursing education curricula and led to the development of new nursing programmes in higher education, including master's degrees in emergency care, critical care, maternity care, and paediatric care (9).

Limitations

The study's findings are subject to several limitations. Firstly, the generalisability of the results may be limited due to the narrow scope of the research, with the data collected from

only five of Jordan's 121 hospitals. Additionally, the participants' performance was assessed solely based on their self-reported confidence. The researcher plans to conduct further research using in-situ simulation and high-fidelity manikins to evaluate knowledge and practice levels among critical care nurses.

CONCLUSION

The SBLST module was designed in accordance with the 2020 BLS Guidelines, utilising a low-fidelity simulation approach and integrating Miller's Pyramid and Kolb's Cycle. The study successfully developed and validated an SBLST module to enhance the confidence levels of NEN in Jordanian government hospitals when performing BLS. The SBLST module can serve as a valuable tool for hospitals and healthcare organisations to ensure that their employees possess the necessary skills and are prepared to provide effective CPR in emergencies.

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ETHICAL APPROVAL

All the procedures were performed in compliance with relevant laws and institutional guidelines, as well as being approved by the Human Research Ethics Committee at Universiti Sains Malaysia, which is compliant with the Helsinki Declaration (protocol code: USM/JEPeM/22110681). Furthermore, the researchers obtained approval from the Ministry of Health's IRB committee in Jordan to initiate this study in five Jordanian hospitals in Amman and Al Zarqa City (protocol code: MOH/REC/2022/340).

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