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IMPACT OF HIGH-FIDELITY SIMULATION ON TRAINING OF NURSING STUDENTS IN ADULT CARDIOPULMONARY RESUSCITATION: EXPERIENCE OF A MOROCCAN CENTER

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Abstract

Introduction: Cardiac arrest is one of the most serious circumstances needing quick response. Nurses are the first to arrive at the patient's bedside in the event of cardiac arrest, starting cardiopulmonary resuscitation (CPR).As a method of teaching CPR, high-fidelity simulation has been demonstrated to have a substantial impact.Thus, the present study aims to evaluate the impact of adult CPR training based on high-fidelity simulation on anxiety and evolution in self-efficacy, satisfaction and self-confidence of undergraduate nursing students at the Higher Institute of Nursing Professions and Health Techniques in Fez, Morocco. **Methods:** An intervention study with a simulation group and a control group was carried out with 49 student nurses. The simulation group (n=25) received traditional training (theoretical lecture and procedural demonstration) and simulation-based CPR training, while the control group (n=24) received only traditional training. Data were obtained using the State-Trait Anxiety Inventory (STAI-Y1 and STAI-Y2), the Self-Efficacy Scale and the Student Learning Satisfaction and Confidence Scale. **Results:** Post-test results of the STAI-Y1 scale revealed a significant reduction in situational anxiety in the simulation group, with a mean score of 30.84 ± 1.84 out of 80, compared with the control group score (43.04± 1.36). Assessment of post-simulation self-efficacy showed a significant advantage for the simulation group (35.28±2.47) out of 40 over the control group (20.96±1.36). Mean CPR self-efficacy retention scores 30 days after training were significantly higher for the simulation group (34.80 ±2.19) than for the control group (20.88 ±1.36). Nevertheless, a significant decrease in mean self-efficacy scores was recorded for the simulation group between the post-test immediately after simulation training (35.28 ±2.47) and the post-test 30 days after training (34.80 ±2.19). Thus, the results revealed that mean satisfaction (23.16±0.68 out of 25) and self-confidence (36.08±0.99 out of 40) scale scores were high immediately after the simulation experience in the simulation group. Nevertheless, a significant increase in satisfaction (24.08±0.99) and a significant decrease (33.72±1.59) in self-confidence were recorded 30 days after simulation training. **Conclusion:** The outcomes demonstrated that adult CPR training using high-fidelity simulation was superior to the conventional approach in terms of decreasing anxiety and enhancing and maintaining undergraduate nursing students' self-efficacy, satisfaction, and confidence.

Keywords: Anxiety; Cardiopulmonary resuscitation; Morocco; Self-efficacy; Self-confidence; Nursing students; Satisfaction; Simulation.

Introduction

Cardiopulmonary arrest is one of the main causes of death worldwide [1]. Although progress has been made in the survival rates of adults with cardiopulmonary arrest over the last two decades, the figures remain alarming, with hospital survival rates of only 15% to 34% [2]. Cardiopulmonary resuscitation (CPR) is an essential topic that necessitates ongoing, concurrent instruction in theory and practice. There exists a correlation between inadequate survival results and the ability to conduct CPR effectively [3]. CPR's efficacy is significantly impacted by the competency of nurses, who are acknowledged as essential members of the resuscitation team [4]. For this reason, it's critical that nursing students who may experience cardiac arrest receive CPR training. Nevertheless, Kim and Roh found that nursing students' CPR knowledge was inadequate [5]. This lack of skill is often evident in undergraduate nursing students, who frequently express anxiety about performing cardiopulmonary resuscitation during their clinical placements [6].
As a result, many nursing students still lack the confidence to perform cardiopulmonary resuscitation despite receiving regular training and

practice. [7]. This lack of confidence is not only seen in students, but is also observed in graduate nurses, as confirmed by similar studies on the initiation of resuscitation procedures [8–10]. Confidence is defined as the ability to take knowledge and skills and transform them into actions and behaviours [11], and is often compromised by fear of harming patients, fear of making mistakes, and fear of litigation [12]. With regard to this, some nurses are reluctant to start CPR, which indicates a a low level of self-efficacy in their ability to start and carry out this resuscitation [13].

The ability to plan and execute the resuscitation pro cedure well is known as self-efficacy in cardiopulmonary resuscitation [13] ; due to insufficient CPR training, nurses may lack the necessary skills for practicing resuscitation because self-efficacy is reinforced by knowledge and experience [14]. According to Khoshnoodifar et al. (2019), students express discontent with the conventional teacher-centered method of teaching CPR. Likewise, a different study discovered that graduate nurses had lower satisfaction with this training approach [15]. In fact, educator-centered classroom learning has been the foundation of traditional nursing paedagogies for decades. [16]. This puts patient safety at serious risk since it makes it more difficult to learn clinical knowledge and practice skills in a real-world setting. [17].

In order to enhance student confidence and prepare them for this crucial skill in clinical practice, it is advised that the nursing curriculum include resuscitation components early in the student's education [18]. Because properly performed cardiopulmonary resuscitation (CPR) can save lives and enhance hospital discharge results, but it needs to be done so skillfully and efficiently [19].

Several approaches to CPR training and skill mastery have been used by nursing educators. One promising method is the use of a simulated mannequin [20], and especially high-fidelity simulation [21]. Thus, the use of high-fidelity simulation in undergraduate nursing programs has proven effective in promoting self-efficacy, increasing self-confidence and improving performance-related learning satisfaction, while reducing anxiety in students preparing for professional practice [22]. Indeed, high-fidelity simulation teaching is a powerful tool that contributes significantly to reducing nursing students' anxiety. This reduction in anxiety is essential to enable them to develop the skills required for successful and accurate cardiopulmonary resuscitation (CPR) [23]. Furthermore, simulation is an innovative teaching technique that contributes to the development of students' self-efficacy [24]. In this respect, nursing students participating in a simulation program are more likely to perform CPR safely and demonstrate greater self-confidence when faced with a real patient [25].

A number of studies have demonstrated that simulation significantly increases nursing students' sense of self-efficacy and confidence [26]. It has been demonstrated that simulation is more successful than traditional teaching methods at reinforcing these important concepts [27] .

Moreover, the research conducted by Fry and McGregor (2014) emphasizes the significance of self-confidence in nurses' clinical decision-making. This ability is developed by frequent exposure to particular scenarios, which promotes critical thinking and problem-solving. Consequently, integrating simulation into training reinforces this confidence and prepares students for effective decision-making in clinical settings, even before they begin their professional practice [29].

High-fidelity simulation-based CPR training has been noted to improve nurses' self-efficacy and satisfaction [30]. Studies also show that nursing students express a high level of satisfaction with the use of simulation.Indeed, this satisfaction is essential for improving student engagement, and fostering their motivation to learn [31]. Choi and al.(2020) studie assessed the self-confidence retention, showing that simulation was superior to traditional training methods in this regard.Moreover, the study, conducted by Gldsworthy and al. (2019), indicated that self-efficacy levels remained sustainable over time, as indicated by the results achieved after the simulation intervention.

To our knowledge, no prior research has examined the impact of high-fidelity simulation training in adult CPR on nursing students' anxiety, self-efficacy, satisfaction and self-confidence. Therefore, this study aims to evaluate the impact of high-fidelity simulation on anxiety, and evolution in self-efficacy, satisfaction and self-confidence of adult cardiopulmonary resuscitation nursing students.

Materials & Methods

Study population

The study population is composed of all students enrolled at the Higher Institute of Nursing Professions and Health Techniques (HINPHT) in Fez in the fourth semester of the professional license cycle; Option: Nurse in Emergency and Intensive Care (NEIC) and Nurse in Anesthesia and Reanimation (NAR) of the 2021-2024 class, who have not yet received the course on cardiopulmonary arrest in adults. A total of 58 students were concerned. The participants in this study have the same educational objectives regarding the resuscitation module in the fourth semester. The course on cardiopulmonary resuscitation for adults in an intra-hospital setting is part of this module. The selection criteria for study participants were

established in such a way as to exclude all students who have already received the course on CPR in adults or who have practiced CPR as part of a clinical internship or simulation. Of the 58 eligible students (meeting these criteria), 49 students were available and included in this study.

Data Collection

This study relied on four data collection instruments. The sociodemographic data questionnaire of the students included the characteristics of sex, age, nationality of the students, the option, previous knowledge of CPR and practical experience in CPR in the context of clinical internships or a simulation session. The French-Canadian version of the State-Trait Anxiety Inventory (STAI-Y), used in this study, was originally developed by Spielberger, Gorsch, Lushene, Vagg, and Jacob in 1983 [34]. The STAI-Y has undergone a process of translation and validation in French [35]. The STAI-Y is presented in the form of a self-administered questionnaire composed of two distinct parts, each comprising 20 statements. The first part, called the Y-1 form (STAI-Y1), assesses situational anxiety, that is, how a person feels at a specific moment, using a four-point Likert scale, ranging from “Not at all” to “A lot.” The second part, called the Y-2 form (STAI-Y2), measures trait anxiety, that is, how a person generally feels, also using a four- point Likert scale, with "Almost never" and "Almost always" as the extremes.” The scores for each part (ranging from 20 to 80) are obtained by adding the points assigned to each statement. A high score indicates high anxiety. The study conducted by Gauthier and Bouchard in 1993 validated the quality of the translation as well as the relevance of the STAI-Y as a tool for measuring anxiety [35].

The self-efficacy scale based on the general model of self-efficacy proposed by Bandura (1997) [36]. The General Self-Efficacy Scale (GSES), originally developed in

German by Matthias Jerusalem and Ralf Schwarzer in 1979, originally consisted of 20 items, but was reduced to 10 items in 1981 [37]. It has since been adapted into 32 other languages [38]. Including French in 2000 [39]. The self-efficacy scale consisted of 10 questions on a 4-point Likert scale, in which one was considered “Not at all true”, two “Barely true”, three “Somewhat true” and four “Completely true” [39].Scores ranged from 10 to 40, with higher scores corresponding to greater self-efficacy [40]. The self-efficacy instrument is known for its high reliability, stability, and construct validity, as confirmed by previous studies (Schwarzer & Jerusalem, 1995) [41].

The Student Satisfaction and Self-Confidence in Learning Scale was developed and published by the National Nursing Association[42]. The French and validated version of this scale was used in this study. So this assessment tool includes 13 items divided into two distinct subscales. The first subscale, the Student Satisfaction with Learning Scale (SSLS)[43–45]. This subscale is composed of five items measured using a five-point Likert scale. A maximum total score of 25 points is obtained by adding the scores of the five items. The internal consistency coefficient of the SSLS is 0.83 [45].The second subscale, the Student Confidence in Learning Scale (SCLS)[43–45], includes eight items also rated on a five-point Likert scale. A maximum total score of 40 points is obtained by adding the scores of the eight items. The internal consistency coefficient (Cronbach's) of the SCLS is 0.74. Thus, each subscale required a response (1 = totally disagree, 2 = disagree, 3 = undecided, 4 = agree and 5 = totally agree), added to a total score, with higher scores representing higher levels of learning satisfaction and self-confidence [45].

Thus, all questionnaires were completed under the same code name that each student had chosen during training in order to allow comparison of results. In addition, the validated French version of the three data collection instruments (The State-Trait Anxiety Inventory, the self-efficacy scale, the Student Satisfaction and Self-Confidence in Learning Scale) was used.

Study design and Setting

This is an interventional study with an equivalent control group, before and after simulation training, to compare the differences in anxiety and the evolution of self-efficacy, satisfaction and self-confidence of nursing students in adult CPR between the simulation and control groups. After receiving traditional theoretical training in adult CPR in an intra-hospital setting (theoretical course, demonstration and practice on procedural simulators of external cardiac massage, clearance of the upper airways, mask ventilation and use of an automatic external defibrillator under the direction and feedback of the teachers) The simulation group was trained by high-fidelity simulation in this area, while the control group received only traditional theoretical training. The training was conducted for both groups over a period of three days at the simulation laboratory of the (HINPHT) in Fez, Morocco. The teaching team consisted of a professor of higher education specialized in anesthesia-resuscitation from the Faculty of Medicine, Pharmacy and Dentistry of Fez, as well as the principal investigator.

The study was conducted in four distinct phases: Phase One (Theoretical Training), Phase Two (Simulation Training), Phase Three (Evaluation by Simulation), and Phase Four (Retention Phase).

During the first phase of the study that took place on the first day, 49 students were present while 9 students were absent. At the beginning, the students’

sociodemographic data questionnaire, the self-efficacy questionnaire (pre-test), and the State-Trait Anxiety Inventory-Y2 (STAI-Y2) questionnaire on trait anxiety were administered to all students present. The questionnaires were completed under the same code name that each student chose to use throughout the training to protect confidentiality.

Subsequently, a one-day theoretical and practical course on adult CPR in an intra-hospital setting was provided for 49 students covering all aspects of the chain of survival (diagnosis, alert, external cardiac massage, clearance of the upper airways, ventilation, as well as the use of the automatic external defibrillator, etc.).

At the end of this course, all participants (N = 49) answered the same questionnaire (post-test) on self-efficacy. The students were randomly assigned to either the simulation group or the control group. Following randomization by drawing lots within the student group, dividing it into 2 groups (1 and 2) comparable in terms of level of study (4th semester), option (NEIC, NAR), previous knowledge and practical experience in adult CPR in an intra-hospital setting. Thus, each group included both options with equal proportions for both the simulation and control groups.

The fourty nine students formed two groups [25 in the simulation group: (14 NAR and 11 NEIC) and 24 in the control group: (14 NAR and 10 NEIC)] and 12 subgroups including six in the simulation group with five students in one subgroup and four in each of the other five subgroups and six in the control group with four students in each subgroup.

The second phase began on the second day immediately following the first day and involved simulation training. Students in the simulation group (n=25) received high-fidelity simulation training in adult CPR in the hospital setting, using a cardiopulmonary arrest scenario in a patient presenting to the emergency department with chest pain. During patient assessment and treatment, the patient (the dummy) goes into cardiac arrest, and the students must recognize cardiac arrest, call for help, start basic cardiopulmonary resuscitation, use an automated external defibrillator and follow international recommendations for cardiopulmonary resuscitation.

The session began with a preliminary briefing, and an in-depth debriefing followed the scenario after each sub-group had passed through. Before the session began, all students in the simulation group (n=25) were asked to complete the State-Trait Anxiety Inventory-Y1 (STAI-Y1) questionnaire to assess their level of situational anxiety related to cardiopulmonary resuscitation.Each subgroup performed the scenario of a cardiopulmonary arrest on a high-fidelity simulator. They were accompanied by a nurse facilitator, who moved the scenario forward when necessary. The scenario involved recovery from cardiopulmonary arrest after the third defibrillation. Immediately after the debriefing, all participants in the simulation group completed questionnaires: the STAI-Y1, the self-efficacy questionnaire and the student satisfaction and confidence in learning questionnaire.

In the third phase (Evaluation by Simulation), all participants (N=49) were summoned and each subgroup, either from the simulation group or the control group, was asked to complete the STAI-Y1 questionnaire to assess their level of anxiety just before performing the scenario. Students in both groups then performed the same adult in-hospital cardiopulmonary arrest scenario used in the previous phase. After completing the scenario, each subgroup immediately repeated the STAI-Y1 questionnaire.

In the fourth phase (retention) of the study 30 days later, all students (N=49) returned for the retention assessment of self-efficacy, satisfaction and self-confidence for students in the simulation group and the retention assessment of self-efficacy for the control group with the same questionnaires and codes used previously.

Data analysis methods

Version 26.0 of the Statistical Package for the Social Sciences (SPSS) was used to analyse the statistical data. Number and percentage were used to represent qualitative data, whereas mean and standard deviation were used to express quantitative data. The paired series t-test was utilised to look at how the simulation group and the control group's levels of anxiety, self-efficacy, satisfaction, and self-confidence changed over the course of the various study sessions. The mean scores of anxiety, self-efficacy, satisfaction, and self-confidence were compared between the simulation group and the control group using the independent series t-test; a p-value of less than 0.05 was deemed significant.

Ethical considerations

This work is part of a larger research that received approval from the University Hospital Ethics Committee of Fez, Anatomy, Surgery and Anesthesiology Laboratory, Faculty of Medicine, Pharmacy and Dentistry of Fez, Hassan II University Hospital Center Fez (date: 12/15/2022, No. 32/22), and written authorization from the regional directorate of health and social protection of Fez Meknes (Date: 10/26/2022, No. 5997). Before any data was collected, written consent was provided by every student who consented to participate in the study. The assurances that participation was completely optional and replies would be kept private were given to the students. The ability to leave the study at any moment was granted to participants.

Results

Fourty nine nursing students participated in the study. 37 (75.5%) females and 12 (24.5%) males participated in the study. The students' average age was 19.92 years (SD = 0.99). The majority of the participants were Moroccans n = 46 (93.90%) and 3 students were foreigners (6.10%) (**Table I**).

Table I. Sociodemographic characteristics of participants

Variables	Total (N=49) n (%)
Sex	
Female	37 (75,5%)
Male	12 (24,5%)
Nationality	
Moroccan	46 (93,9%)
Foreigner	3 (6,1%)
Option	
NAR	28 (57,14%)
NEIC	21 (42,85%)
Average age M (ET)	19,92 (0,99)

M: Mean; SD: Standard Deviation; NAR: Nurse in Anesthesia and Reanimation; NEIC: Nurse in Emergency and Intensive Care.

Table II. Evolution of situational anxiety scores (STAI-Y1) in the simulation group

Group	Pre-simulation Test (score out of 80) (M ± SD)	Post-simulation Test (score out of 80) (M ± SD)	Pre-test Evaluation by Simulation (score out of 80) (M ± SD)	Post-test Evaluation by Simulation (score out of 80) (M ± SD)	p
Simulation	41,40 ± 1,78	36,04 ± 1,39 [a]	35,68 ± 1,57 [a,b]	30,84 ± 1,84 [a,b,c]	<0,001

M: Mean; SD: Standard deviation; STAI- Y1: Situational Anxiety and Trait Anxiety Inventory Y-1 form, measures situational anxiety.
[a]: Compared to the Pre-simulation Test ($p < 0.001$), [b]: Compared to the Post-simulation Test ($p < 0.001$), [c]: Compared to the Pre-test Evaluation by Simulation ($p < 0.001$).

For the simulation group, a significant decrease in mean anxiety scores was observed between the different assessment periods. (**Tableau II**).

Table III. Evolution of Situational Anxiety Scores (STAI-Y1) in the Control Group

Group	Pre-test Evaluation by Simulation (score out of 80) (M ± SD)	Post-test Evaluation by Simulation (score out of 80) (M ± SD)	P
Control	41,42±1,50	43,04± 1,36	<0,001

M: Mean; SD: Standard Deviation; STAI- Y1: Situational Anxiety and Trait Anxiety Inventory Y-1 form, measures situational anxiety.

For the control group and during the simulation evaluation phase, a substantial increase in mean anxiety levels appeared comparing the pre-test and the post-test. (**Table III**).

Table IV. Comparison of Anxiety Scores Related to CPR between the Simulation Group and the Control Group (Pre- and Post-Intervention)

Simulation Group	Control Group	P
Anxiety Trait (STAI-Y2) (Score out of 80) (M ± SD)		
38,80±2,14	38,92±1,55	0,829
State Anxiety (STAI-Y1) (Score out of 80) (M ± SD)		
Pre-test Simulation	Pre-test Evaluation by Simulation	0,972
41,40 ± 1,78	41,42±1,50	
Post-test Simulation	Post-test Evaluation by Simulation	<0,00
36,04 ± 1,39	43,04± 1,36	1
Pre-test Evaluation by Simulation	Pre-test Evaluation by Simulation	<0,00
35,68 ± 1,57	41,42±1,50	1
Post-test Evaluation by Simulation	Post-test Evaluation by Simulation	<0,00
30,84 ± 1,84	43,04± 1,36	1

M: Mean; SD: Standard Deviation; STAI-Y2 form, measures trait anxiety; STAI- Y1: Situational Anxiety and Trait Anxiety Inventory Y-1 form, measures situational anxiety.

Trait anxiety (STAI-Y2) scores were comparable before the intervention, and no noticeable statistically significant differences were found (P = 0.829). When comparing situational anxiety (STAI-Y1) scores with respect to CPR, students in the simulation group had significantly lower scores (P < 0.001), as measured by the post-test evaluation by simulation, than students in the control group, who received only theoretical CPR training (**Table IV**).

Table V. Evolution of Self-Efficacy in the Simulation Group

Group	Pre-test Theoretical Course (score out of 40) (M ± SD)	Post-test Theoretical Course (score out of 40) (M ± SD)	Post-test Simulation (score out of 40) (M ± SD)	Post-test 30 Days After Simulation (score out of 40) (M ± SD)	p
Simulation	15,92 ±1,52	21,08 ±1,47 [a]	35,28 ±2,47 [a,b]	34,80 ±2,19 [a,b,c]	<0,001

M: Mean; SD: Standard Deviation.
[a]: Compared to Pre-test Theoretical Course (p<0.001), [b]: Compared to Post-test Theoretical Course (p<0.001), [c]: Compared to Post-test Simulation (p<0.001).

Throughout the course of the various evaluation periods, the simulation group's mean self-efficacy scores significantly improved. However, there was a significant decrease in the mean self-efficacy scores between the post-test immediately after the simulation training and the post-test at 30 days post-training (**Table V**).

Table VI. Evolution of Self-Efficacy in the Control Group

Group	Pre-test Theoretical Course (score out of 40) (M ± SD)	Post-test Theoretical Course (score out of 40) (M ± SD)	Post-test 30 Days After Simulation (score out of 40) (M ± SD)	p
Control group	15,50 ±1,47	20,96 ±1,36 [a]	20,88 ±1,36 [a,b]	<0,001

M: Mean; SD: Standard Deviation.
[a]: Compared to Pre-test Theoretical Course (p<0.001), [b]: Compared to Post-test Theoretical Course (p<0.001).

There was a significant improvement in mean self-efficacy scores at the immediate and 30-day post-test compared to mean scores at the pre-test. However, there was a significant decrease in mean self-efficacy scores between the post-test immediately after the theoretical course and the 30-day post-test (**Table VI**).

Table VII. Comparison of Self-Efficacy Scores in CPR between the Simulation Group and the Control Group (Pre- and Post-Intervention)

Simulation Group (score out of 40) (M ± SD)	Control Group (score out of 40) (M ± SD)	P
Pre-test Score Before Theoretical Course		
15,92± 1,52	15,50 ±1,474	0,332
Post-test Score (Immediately After Theoretical Course)		
21,08 ±1,47	20,96 ±1,36	0,766
Post-test Score (Immediately After Simulation) 35,28 ±2,47	Post-test Score (Immediately After Theoretical Course) 20,96 ±1,36	<0,001
Post-test Score at 30 Days		
34,80 ±2,19	20,88 ±1,36	<0,001

M: Mean; SD: Standard Deviation.

The Pre-test Score Before Theoretical Course results for CPR self-efficacy indicated no statistically significant difference in mean scores between the simulation group and the control group (p = 0.332). In addition, the results of the Post-test Score (Immediately After Theoretical Course) for CPR self-efficacy indicated no statistically significant difference in mean scores between the simulation group and the control group (p = 0.766). When comparing the change in self-efficacy scores, students in the simulation group obtained significantly higher scores (P < 0.001), as measured by the second post-test of CPR self-efficacy, than students in the control group. The mean CPR self-efficacy score for the 25 participants in the simulation group for the retention phase of the study was 34.80 (2.19). Thus, the mean CPR self-efficacy score for the 24 participants in the control group was 20.88 (1.36). Mean CPR self-efficacy retention scores 30 days after training were significantly higher (p < 0.001) for the simulation group than for the control group (**Table VII**).

Table VIII. Student Satisfaction and Self-Confidence in Learning Scales (Simulation Group)

Instrument	Post-test (Immediately After Simulation) (M ± SD)	Post-test (30 Days After Simulation) (M ± SD)	P
Student Satisfaction with Learning Scale (SSLS) (Score out of 25)	23,16±0,68	24,08±0,99	<0,001
Student Confidence in Learning Scale (SCLS) (Score out of 40)	36,08±0,99	33,72±1,59	<0,001

M: Mean; SD: Standard Deviation.

The Student Satisfaction with Learning (SSLS) scale shows a high score immediately after the simulation (23.16±0.68) and a significant increase 30 days later (24.08±0.99). In addition, the Student Confidence in Learning (SCLS) scale also shows high self-confidence immediately after the simulation (36.08±0.99). However, a significant decrease in mean self-confidence scores was observed between the post-test conducted immediately after the simulation training and the one conducted 30 days later (**Table VIII**).

Discussion

The objective of this study was to evaluate the impact of high-fidelity simulation on anxiety, self-efficacy, satisfaction and self-confidence of adult cardiopulmonary resuscitation training programs on nursing students in the Moroccan context. The study's findings indicated that the mean situational anxiety (State and Trait Anxiety Inventory: STAI-Y1) levels had significantly decreased between the simulation training phase and the simulation assessment phase for the simulation group (**Table II**). In contrast, for the control group, which received only theoretical training, a notable increase in the average situational anxiety scores (STAI-Y1) was recorded between the pre-test and the post-test during the simulation assessment (**Table III**). In addition, the high-fidelity simulation method was significantly more effective than the traditional teaching method in decreasing the situational anxiety levels of nursing students (**Table IV**). Since anxiety can be a major obstacle to performing cardiopulmonary resuscitation (CPR) effectively, it is critical that nursing students learn how to control their anxiety in high-stress circumstances while also increasing their confidence [46]. This need is supported by Pontin and al. (2016) who stated that nursing students express various concerns about CPR justifying the application of varied educational strategies. In this sense, Fermandez-Ayuso and al.(2018) found that all nursing students had increased levels of stress and anxiety before simulations, but these levels decreased significantly at the end of the simulation sessions.

This notable decrease contrasts with the results observed in traditional teaching methods, where student anxiety tends to persist. Thus, simulation has been shown to be more successful in lowering student anxiety before, during, and especially before clinical practice. [49].

This translates into increased student confidence when intervening in real-world scenarios [50]. In a thorough mixed methods review, Labrague et al. (2019) also showed that high-fidelity simulations can help nursing students feel less anxious and more confident. It has been demonstrated that anxiety and performance are related,, with some moderate levels of anxiety even being conducive to optimal performance[52]. Nonetheless, lowering student anxiety enhances both the therapeutic relationship and the quality of care provided to patients by nurses [29].

By reproducing realistic clinical scenarios such as cardiopulmonary arrest, simulation aims to prepare students to effectively manage critical situations. However, these scenarios, particularly cardiopulmonary arrest, can induce considerable stress and anxiety in learners [51]. In this regard, McDermott et al. (2021) showed that pre-simulation briefing can have a significant impact on students' anxiety levels. Indeed, by emotionally preparing students and providing them with relevant information, the briefing allows them to organize their knowledge and better prepare for the learning objectives.

Thus, Jeong et al.(2022) showed that receiving encouraging feedback during debriefings can lessen anxiety connected to CPR. Consequently, to lessen clinical nurses' anxiety about performing CPR, it is recommended to develop simulation training programs that include debriefings and constructive feedback. Also in our study, the findings of the pre-test and post-test immediately after the theoretical course regarding the sense of self-efficacy in CPR showed no statistically significant difference between the mean scores of the simulation group and the control group. Thus indicating equivalent starting conditions for the study. In addition, the outcomes revealed that the self-efficacy of the simulation group significantly improved in comparison to the control group (**Table VII**). This result is in line with a study conducted by Al-Kalaldeh and Al-Olime (2022) who reported that high-fidelity simulation training significantly

improved self-efficacy in cardiopulmonary resuscitation. Indeed, healthcare provider self-efficacy is an essential component of clinical practice [56], as to succeed in their professions, nursing students need to have strong levels of self-efficacy and confidence in their clinical skills [57].

It is therefore essential to develop these skills from the early stages of training. Indeed, self-efficacy predicts not only clinical performance [56], but also the quality of care provided. In this perspective, simulation-based training has been shown to improve both students' self-efficacy and other fundamental clinical skills[58]. In this regard, a favourable link was demonstrated by Roh and Issenberg (2014) between high levels of self-efficacy and the execution of psychomotor abilities associated with resuscitation.

The current study's findings also indicated hat the retention scores of self-efficacy at 30 days were significantly higher in the simulation group than in the control group (**Table VII**). In this regard, Secheresse and al. (2016) demonstrated that the utilization of high-fidelity simulation allowed to maintain levels of self-efficacy higher than those observed in the control group. However, the simulation group's self-efficacy scores significantly decreased between the post-test immediately after simulation and the 30-day post-test (**Table V**). A similar trend was noted in the control group, which received only theoretical training (**Table VI**). These results suggest that nursing education, combined with repeated simulation experiences, is crucial to maintain and strengthen students' self-efficacy [60]. This improvement is crucial because, according to Cummings and Connelly (2016), nursing graduates with high levels of self-efficacy are better prepared to provide high-quality patient care in real clinical situations. Also, repeating simulation sessions not only helps to continually reinforce and update the skills and knowledge initially acquired, but also to maintain a high level of self-efficacy. Thus, regular retraining is essential to sustainably improve nursing students' self-efficacy and, consequently, their ability to provide quality care[62].

At the end of the simulation training, the present study showed that the simulation group had high scores on the Student Satisfaction with Learning Scale (SSL) and the Student Confidence in Learning Scale (SCLS) (**Table VIII**). These results are consistent with those reported by Demirtas and al. (2021), who stated that simulation-based training improves student satisfaction and self-confidence. Furthermore, nursing students participating in a simulation program are more likely to perform CPR safely and with greater confidence in the presence of real patients [25]. This increased confidence allows students to more effectively overcome future obstacles and develop a positive belief in achieving their goals [64]. Furthermore, students who underwent high-fidelity simulation training interpreted the experience positively and reported high levels of satisfaction and self-confidence after the simulation [65].

In fact, the substantial influence of high-fidelity simulation on satisfaction and confidence in providing critical care may be explained by the availability of a group of learners working together in an environment comparable to a real clinical situation. Hospital-grade equipment is also accessible in the simulation laboratory with simulated patients. Thus, in the present study, the simulation scenario was followed by debriefing, which may also contribute to improving the satisfaction and confidence of students in the simulation group [66]. So et al. (2019) indicated that debriefing is essential to ensure effective learning. After 30 days, the findings of this study revealed a significant increase in the mean scores of the Student Satisfaction Scale with their Learning (SSLS) of the simulation group between the post-test immediately after the simulation training and the post-test at 30 days of this training (**Table VIII**). This could indicate that students appreciated more the impact of the simulation on their learning as they saw its benefits over time. In support of this result, Alconero-Camarero and al. (2016) found that nursing students expressed great satisfaction with the usage of clinical simulation. This satisfaction was maintained in a positive way, as shown by the lasting impact of simulation on satisfaction scores both before and after graduation [68]. Nevertheless, the results of this study showed a significant decrease in the mean scores of the Student Confidence in Learning Scale (SCLS) of the simulation group between the post-test immediately after simulation training and the post-test at 30 days of training (**Table VIII**). In this regard, some investigations have shown a beneficial relationship between students' confidence and active learning and the frequency of simulation exposure. [61] . Al Gharibi and Arulappan (2020) reported that repeated simulation experience improves self-confidence of nursing students. These results show that repetitive simulation improves the overall clinical learning outcomes of nursing students.

Strengths & limitations

This study represents a first initiative to assess the impact of simulation as an innovative teaching method on anxiety, self-efficacy, satisfaction and self-confidence of nursing students at ISPITS in Fez and Morocco. The limitations of this study include the sample limited to nursing students. However, given the significant results, it is recommended to replicate this study on a larger scale to determine whether these results can be supported by a larger sample. Thus, it is suggested to conduct a study involving several Institutes in Morocco, which can

provide a more global view of learning outcomes in a more general sample.

Conclusion

High-fidelity simulation-based CPR training reduced nursing students' anxiety. Furthermore, high-fidelity simulation was shown to have a positive effect on improving and retaining nursing students' self-efficacy, satisfaction, and self-confidence. The results of this study support the implementation of simulation as a dynamic teaching strategy. It is suggested that training be repeated periodically to progress and update nursing students' CPR knowledge and skills to reduce their anxiety, and increase their self-efficacy, satisfaction, and self-confidence when faced with a real patient.

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