


Evaluation of the Effect of Procedural Simulation on Improving Knowledge and Clinical Performance in Neonatal Resuscitation among Midwifery Students



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Abstract:

Introduction: Midwifery education combines theoretical learning with clinical practice to ensure high-quality maternal and neonatal care. However, the management of newborns with adaptation difficulties, particularly those at risk, remains a major challenge in initial training. This study aimed to evaluate the effect of procedural simulation on midwifery students' knowledge and clinical performance in neonatal resuscitation.

Methods: An experimental study was conducted from April 10 to 19, 2024, at the Higher Institute of Nursing Professions and Health Techniques in Casablanca. Forty midwifery students from semesters 4 and 6 were randomly assigned to a control group receiving traditional training (n = 20) or an experimental group receiving simulation-based training (n = 20). Data were collected using pre- and post-test knowledge assessments, a clinical performance checklist, a satisfaction questionnaire, and a confidence scale.

Results: Pre-test knowledge scores showed no significant difference between groups ($p = 0.662$). Post-test results revealed significantly higher knowledge scores and better clinical performance in the experimental group compared with the control group ($p < 0.001$). Students exposed to simulation reported high satisfaction (mean = 4.10 ± 0.55) and increased confidence.

Discussion: These findings underscore the educational value of procedural simulation in improving both cognitive and clinical outcomes. Nevertheless, the single-center design and limited sample size are potential limitations.

Conclusion: Procedural simulation significantly enhances knowledge, clinical performance, and confidence among midwifery students, supporting its integration as a complementary teaching strategy in initial midwifery education.

Keywords: Procedural simulation, Student midwives, Clinical performance, Level of knowledge, Confidence, Satisfaction.

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1. INTRODUCTION

The training of student midwives is traditionally based on a combination of theoretical and practical teaching approaches, with particular emphasis on maternal and neonatal care. However, the quality of newborn care, particularly for those experiencing difficulties adapting to extrauterine life or presenting complex neonatal situations, remains a major challenge in the clinical training of midwives [1-3].

The clinical practice of neonatal resuscitation in the delivery room is based on international guidelines and recommendations [4], including those of the International Liaison Committee on Resuscitation (ILCOR) [1, 5, 6].

These recommendations are largely aligned with clinical practices defined by the French Neonatal Society and other specialized professional organizations [1, 7].

Statistically, around 85% of full-term newborns breathe spontaneously within the first 10-30 seconds after birth, 10% require assistance, and only 1% of cases require neonatal resuscitation [8]. Although these neonatal resuscitation situations are rare, they require precise technical and decision-making skills [3, 4].

However, real neonatal resuscitation situations-particularly those in which newborns fail to initiate spontaneous breathing or require immediate ventilatory support-are unpredictable and occur rarely in clinical settings [9]. Consequently, student midwives have limited opportunities to observe or participate in such procedures during their clinical placements. This lack of exposure restricts the development of practical competencies and contributes to heightened anxiety or apprehension when students are faced with these critical events in real-life practice [10]. It is therefore vital that student midwives acquire sound theoretical knowledge and master the necessary technical gestures, in order to respond effectively to the demands of neonatal resuscitation [8, 11].

The diversity of clinical situations encountered when caring for newborns, such as "airway suctioning, resuscitation, or management of neonatal pathologies", also makes it difficult to simulate these practices optimally in a traditional teaching setting. In this context, procedural simulation appears to be an innovative and promising approach [12]. It enables realistic neonatal scenarios to be recreated in a controlled environment,

giving student midwives the opportunity to develop their technical skills while reinforcing their ability to make rapid and appropriate clinical decisions, without risk to patients or newborns.

This teaching method fosters the development of all the dimensions of competence: knowledge, know-how, and interpersonal skills, while consolidating clinical reasoning in an environment where error is permitted, thus contributing to students' confidence [12]. It is also based on the ethical principle of "never the first time on the patient" [13].

Simulation also offers the opportunity to develop essential cross-disciplinary skills, such as technical dexterity, leadership, teamwork, interdisciplinary communication, taking calls for help, risk management, and decision-making [13].

Studies have shown that simulation can enhance the acquisition of theoretical knowledge. For example, a study of final-year obstetrics students in Melbourne, Australia, found that simulation boosted students' confidence and improved their neonatal resuscitation skills, although gaps remain, particularly in handling emergency equipment and understanding the midwife's role [8, 14].

More recently, the study by Watelet (2017) showed that simulation improved teamwork, communication, emotional management, and the speed of decision-making in newborn resuscitation in the birth room of midwives several months after graduation [15].

As a corollary, another study carried out in Nancy by Lambert (2017) demonstrated that high-fidelity simulation promoted significant improvement in several skills, such as assimilation of the neonatal resuscitation algorithm, dexterity in care, technical and medical skills, as well as communication and teamwork, in almost half of the participating midwives [8].

Although research has highlighted the benefits of simulation across various healthcare fields, few studies have specifically examined its impact on midwifery training, particularly in neonatal care, where skills must be acquired in a realistic and repetitive context.

In Morocco, no study has yet examined the impact of simulation-based learning on the initial training of midwifery students, particularly in neonatal resuscitation. This research aims to evaluate the effectiveness of

procedural simulation on improving students' theoretical knowledge and clinical performance, and to provide evidence supporting its integration into midwifery education programs. Simulation is increasingly recognized internationally as a complementary pedagogical approach that enhances clinical preparedness, particularly in the management of at-risk newborns during the first minutes of life [16].

1.1. Research Question

To what extent does the integration of procedural simulation into the initial training of midwifery students at the Higher Institute of Nursing Professions and Health Techniques (ISPITS) in Casablanca? Can it help improve students' theoretical knowledge and clinical performance in neonatal care?

The study also pursues the following specific objectives:

- [1] Assess the effect of procedural simulation on the development of theoretical knowledge and clinical performance in neonatal resuscitation.
- [2] Evaluate student satisfaction following the procedural simulation session.
- [3] Measure students' confidence in their neonatal resuscitation skills after the simulation.

Based on the literature and the study design, the following hypothesis was formulated:

"Students who participate in the procedural simulation session will demonstrate significantly higher levels of knowledge and clinical performance in neonatal resuscitation compared with students in the control group".

2. MATERIALS AND METHODS

2.1. Type of Research

This experimental study was conducted from April 10 to April 19, 2024, at the Higher Institute of Nursing Professions and Health Techniques in Casablanca (ISPITSC). Its objective was to evaluate the impact of procedural simulation on midwifery students' theoretical knowledge and clinical performance in managing neonatal cardiopulmonary arrest.

2.2. Study Setting

The study was conducted at ISPITS Casablanca, a higher education institution that trains health professionals at the national level. The site was selected because it regularly hosts midwifery students during their initial training and offers the facilities required for simulation-based learning.

2.3. Participants

The initial sample consisted of 46 midwifery students enrolled in semesters 4 and 6 at ISPITSC. Due to absences during data collection, the final sample included 40 participants. Students were randomly assigned to two equal groups:

- **Control group (A):** 20 students who did not participate in the procedural simulation.
- **Experimental group (B):** 20 students who took part in the simulation session.

The slight reduction in the sample size did not affect the validity of the study, as the final number remained adequate to achieve the research objectives.

2.4. Sample Size Calculation

An a priori sample size calculation was performed using G*Power 3.1 for a two-tailed t-test for independent samples, with the following parameters: effect size (Cohen's d) = 0.83, α = 0.05, power = 0.80, and an allocation ratio of 1:1. The final sample of 40 students (20 per group) exceeded the minimum requirement and was considered sufficient to ensure reliable statistical analyses.

2.5. Participant Selection Criteria

• Inclusion criteria:

Participants must meet the following conditions:

- [1] Be enrolled in the midwifery option.
- [2] Have completed and validated theoretical courses on neonatal resuscitation.
- [3] Have never participated in clinical simulation training in neonatal resuscitation.
- [4] Participate voluntarily in the study.

A total of 40 student midwives will be involved, 24 in semester 4 (S4) and 16 in semester 6 (S6).

• Exclusion criteria:

Students who are absent during the procedural simulation session are excluded from the study.

2.6. Data Collection Methodology

2.6.1. Methodological Approach

The study adopts a randomized experimental method, with two groups: an experimental group (benefiting from procedural simulation) and a control group.

The approach is quantitative and includes data collection on:

- Assessment of general knowledge *via* pre-test and post-test.
- Assessment of clinical performance *via* a practical test.
- Levels of satisfaction and confidence in learning.

2.6.2. Measurement Instruments

The instruments used to collect data are as follows:

- Assessment of knowledge of Cardiopulmonary Resuscitation (CPR Knowledge Evaluation):

A pre/post-test in Multiple-Choice Questionnaire (MCQ) format, comprising 20 questions validated by the teaching team and neonatology experts. The aim is to measure the development of students' theoretical knowledge.

■ Clinical Performance Evaluation Grid:

This grid, used for the practical assessment of neonatal resuscitation, was developed and validated by the teaching team in collaboration with a group of neonatology experts. It evaluates students' technical skills in performing cardiopulmonary resuscitation on a critically ill newborn.

■ Student Satisfaction with Learning Scale (SSLS)

Measures students' satisfaction with their training, covering aspects such as the quality of teaching, teaching materials, and teaching methods. It is a French-validated version of the Student Satisfaction with Learning Scale (SSLS) [17].

The SSLS was developed by a group of researchers in the field of clinical simulation at the National League for Nursing [17, 18].

It is a 5-item questionnaire scored on a five-point Likert scale. The SSLS was designed to measure students' sense of satisfaction with their learning during a clinical simulation activity. More specifically, it examines teaching strategies, the variety of teaching materials, and the teaching style adopted by the teacher. A maximum total score of 25 points was obtained by adding the results of the 5 items.

The content validity of the SSLS was confirmed by a committee of nine experts in the field of clinical nursing simulation. The internal consistency coefficient (Cronbach's) of the SSLS was 0.94 [17-21].

■ Student Confidence in Learning Scale (SCLS):

This scale measures students' confidence in their ability to manage neonatal resuscitation situations. It is derived from the *Confidence in Learning Using Simulation Scale* (CLUSS) and has been widely used in simulation-based nursing education [17, 19].

The questionnaire consists of 8 items rated on a five-point Likert scale, with a total score ranging from 8 to 40, where higher scores indicate greater levels of confidence. The scale was initially developed within the context of research on simulation-based learning in nursing education [17, 18].

The content validity of the scale was confirmed by a panel of experts in clinical simulation, and its reliability has been well established in the literature, with good internal consistency (Cronbach's alpha of approximately 0.87) [17, 20, 21].

Reviews of simulation-based assessment instruments, as well as studies on the integration of simulation in nursing education, further support the methodological robustness and pedagogical relevance of these tools [20, 21].

2.7. Experimental Procedure

The experiment was divided into six distinct stages:

2.7.1. Stage 1: Pre-test

A Multiple-Choice Questionnaire (MCQ) was administered to all students to assess their knowledge prior to the intervention. The test was scored out of 20.

The purpose of this stage was to provide a diagnostic assessment of the student midwives' knowledge level. Students were not informed in advance about the pre-test, and no prerequisites were required.

2.7.2. Stage 2: Theoretical and Practical Training

The 40 student midwives participated in a 6-hour training program consisting of both theoretical and practical sessions. The training covered the following topics:

The physiology and pathology of neonatal adaptation to extrauterine life, principles of resuscitation in the delivery room, introduction to Cardiopulmonary Resuscitation (CPR¹), and principles of stabilization in the delivery room, including neonatal ventilation techniques and cardiac massage, based on the steps outlined in the revised ILCOR² 2010 recommendations.

2.7.3. Stage 3: Group Formation

To form the two groups, we randomly selected a group of 40 midwifery students.

To divide the large group into two groups, each with 20 students from different semesters (S4 and S6), each student was randomly assigned a piece of paper and placed in a basket:

- If they selected the paper from the experimental group, they would be placed in the group that would benefit from the procedural simulation (B).
- If they selected the paper with the control group, they would be assigned to the group that would not benefit from the procedural simulation (A).

The purpose of this step was to split the initial group into two groups [group (B) and group (A)] in order to study the impact of simulation on the development of knowledge and clinical performance in one group compared to the other.

2.7.4. Stage 4: Clinical Procedural Simulation

Initially, the teaching sequence was spread over one day at ISPITS according to a pre-established schedule. The students were introduced to the mannequin and equipment and had the opportunity to familiarize themselves with the teaching environment and practice on the simulator, which lasted approximately 30 minutes, guided by the facilitator.

2.7.5. Stage 5: Post-test

Finally, a post-test was designed at this step, consisting of a theoretical assessment of all participants (40 students). The questions were identical to those in the pre-test. The post-test was also scored with a score of 20. The goal of this step was to assess the participants' development of theoretical knowledge in cardiopulmonary resuscitation, with or without simulation.

¹CPR: Cardiopulmonary Resuscitation

²ILCOR: International Liaison Committee for Resuscitation.

2.7.6. Satisfaction and Confidence Assessment

Students in the experimental group completed the Evaluation of Satisfaction with Simulation (SSLS) and the Evaluation of Confidence in Simulation (SCLS) to measure their feelings about the simulation training.

2.8. Practical Assessment

All participants, regardless of their group, completed a practical assessment in which they had to manage a neonatal resuscitation scenario on a low-fidelity mannequin.

“The chosen scenario was as follows: A newborn is born apneic and cyanotic with an Apgar score of 04/10. The infant’s airway is cleared and stimulated. After 10 seconds, positive pressure ventilation is initiated. At 40 seconds of age, the infant’s heart rate is 60 beats per minute. Specify your Action”.

For this evaluation, we used a clinical performance assessment grid for the group, composed of items concerning the different aspects of Cardiopulmonary Resuscitation.

2.9. Data Processing

The quantitative data collected using the various measurement instruments (CPR Knowledge Evaluation, SSLS, and SCLS) and EPCPR were processed and analyzed using SPSS software (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp.).

The sociodemographic characteristics of the participants in the experimental and control groups were analyzed using the chi-square test.

The means and standard deviations of the scores obtained on the various assessments (pre-test and post-test) were calculated for each group to describe the changes in theoretical knowledge (CPR Knowledge Evaluation) and clinical performance (EPCPR) before and after the training.

The gain scores (difference between post-test and pre-test) were compared between the two groups using a Student’s t-test for independent samples to determine the effect of the procedural simulation.

The statistical significance threshold was set at 0.05 ($p < 0.05$).

Finally, the scores on the Student Satisfaction Scale and the Student (SSLS) Confidence Scale (SCLS) were analyzed using descriptive statistics (mean and standard deviation).

2.10. Ethical Principles in Research

The study was conducted with the approval of the Board of Directors of the Higher Institute of Nursing and Health Techniques professions (ISPITS) of Casablanca, Morocco, under approval number 603/2025, stamped, signed, and authorized on September 26, 2025, by the Acting Director and the Acting Deputy Director in charge of academic affairs. Free and informed consent was obtained from all participants, and they were fully informed of the confidential nature of their responses.

Anonymity was strictly maintained, ensuring that the identities of the students were not revealed in any results, reports, or publications. Data collection and analysis were conducted in accordance with international scientific and ethical standards.

3. RESULTS

3.1. Sociodemographic Characteristics

The study sample consisted of 40 midwifery students (N = 40) (Table 1).

All participants were midwifery students, and all were female (100%), which is consistent with the predominantly female enrolment in midwifery programs in Morocco. The largest age group was students under 18 years (47.5%). Regarding academic level, 60% were enrolled in the fourth semester (S4) and 40% in the sixth semester (S6).

Statistical comparison was performed only for age, as this was the only variable with sufficient variability for testing. The analysis showed no significant difference in age distribution between the experimental and control groups ($p = 0.240$).

No statistical tests were conducted for sex or academic level because these variables were identical across groups or lacked the variability required for comparison.

Table 1. Sociodemographic characteristics of participants.

-		Experimental Group vs. Control							
		Control (A, n =20)		Expérimental (B, n = 20)		Total Number	Frequency %	Chi-square	p
		n	%	n	%				
Age	Under 18 years	9	47.4	10	52.6	19	47.5	2.853	0.240
	Between 18and 20years	1	20.0	4	80.0	5	12.5		
	Between 20and 24years	10	62.5	6	37.5	16	40.0		
Sex	Female	20	50	20	50	40	100	0,000	1,000
Semester	S4	13	54.2	11	45.8	24	60	0.417	0.519
	S6	7	43.8	9	56.2	16	40		
Option	Midwifery	20	50.0	20	50.0	40	100	0.000a	1.000

Note: NB. *Chi-Square statistics are significant at the 0.05 level.

3.2. Descriptive and Inferential Statistics of CPR Knowledge Evaluation Scores

3.2.1. Pretest Scores

The following table presents the descriptive and inferential statistics of the CPR Knowledge Evaluation scores obtained at the pretest by participants in the control group and those in the experimental group (Table 2).

The mean pretest score on the CPR Knowledge Evaluation was 7.45 ± 2.64 for the control group and 6.95 ± 4.12 for the experimental group. Both groups obtained comparable minimum and maximum scores (0-12 for the control group and 0-13 for the experimental group). An independent-samples Student's t-test showed no statistically significant difference between the two groups at baseline ($p = 0.662$).

3.2.2. Post-test Scores

The following table presents descriptive and inferential statistics for the post-test scores obtained on the CPR Knowledge Evaluation of participants in the control group and those in the experimental group (Table 3).

The mean post-test score on the CPR Knowledge Assessment was 14.15 ± 1.49 for the control group and 17.40 ± 0.59 for the experimental group. The difference in means between the two groups was statistically significant ($p < 0.001$). The median scores were 14.33 for the control group and 17.42 for the experimental group.

This improvement in students' neonatal resuscitation (CPR) knowledge in the experimental group is statistically significant, which supports the hypothesis that procedural simulation has a positive effect on students' theoretical knowledge.

3.2.3. Atest Gain Scores

The following table presents the descriptive and inferential statistics of the gain scores on the CPR Knowledge Assessment generated by the participants in the control group and those in the experimental group. The gain scores are calculated by subtracting the scores obtained by the subjects in the post-test from those they obtained in the pre-test (Table 4).

The mean gain score on the CPR Knowledge Assessment for participants in the control group is 06.70 ± 03.130 , while it is 10.45 ± 04.19 for participants in the experimental group. The minimum and maximum gain scores of the control group are 02.00 and 15.00, respectively, while they are 04.00 and 18.00 for the experimental group.

This difference is statistically significant with a p -value of 0.003, indicating that the increase in the level of knowledge in the experimental group is due to the procedural simulation intervention.

Finally, the median gain score in the experimental group (10.25) is also higher than that of the control group (6.14), indicating that the majority of participants in the experimental group showed a significant improvement in their knowledge.

Table 2. Descriptive and inferential statistics of CPR knowledge assessment pretest scores among midwifery students.

Group	n	M.	SD	Min	Max.	Med	p
Control (A)	20	7.45	2.94	0.00	12.00	7.57	0.662
Expérimental (B)	20	6.95	4.12	0.00	13.00	7.00	

Note: M = Mean, SD = Standard, deviation, min = score minimal, Méd = médiane, Max = maximum score.

Table 3. Descriptive and inferential statistics of CPR knowledge assessment post-test scores.

Group	n	Mean	SD	Min	Max	Median	p-value
Control (A)	20	14.15	1.49	11.00	17.00	14.33	$p < 0,001$
Experimental (B)	20	17.40	0.59	16.00	18.00	17.42	

Note: M = Mean, SD = standard deviation, min = minimum score, Med = median, max = maximum score.

Table 4. Descriptive and inferential statistics of the gain score.

Group	n	M.	SD.	Min.	Max.	Group Median	p
Control (A)	20	06.70	03.13	02.00	15.00	6.14	0.003
Expérimental (B)	20	10.45	04.19	04.00	18.00	10.25	

Note: M = Mean, SD = Standard Deviation, Min = Score minimal, Méd = médiane, Max = Maximum score.

Table 5. Clinical performance in cardiopulmonary resuscitation.

Expérimental / Control Group	n	M.	SD.	Min	Max	Méd	p
Control (A)	20	10.60	1.53	8.00	13.00	10.62	< 0.001
Expérimental (B)	20	15.55	1.90	11.00	19.00	15.62	

Overall, the gain scores on the CPR Knowledge Assessment confirm that students who participated in the procedural simulation significantly improved their knowledge of neonatal resuscitation compared to those in the control group. This improvement is statistically significant and reflects the positive impact of procedural simulation on the theoretical knowledge of midwifery students.

In summary, procedural simulation appears to be an effective educational tool for improving the theoretical knowledge of midwifery students in neonatal resuscitation, which supports the research hypothesis.

3.3. Clinical Performance

The following table presents the descriptive statistics of the scores obtained on the Clinical CPR Performance Assessment in the practical assessment for participants in the control group and those in the experimental group (Table 5).

The results of the practical assessment of cardiopulmonary resuscitation reveal a statistically significant difference between the two groups (experimental and control), with a significantly higher clinical performance for the experimental group.

The mean score obtained by the control group in the clinical performance of CPR during the practical assessment was 10.60 ± 1.53 , whereas the experimental group achieved a significantly higher mean of 15.55 ± 1.90 .

In the control group, minimum and maximum scores ranged from 8.00 to 13.00, while in the experimental group, they ranged from 11.00 to 19.00. The median score was 10.62 for the control group and 15.62 for the experimental group.

An independent-samples Student's t-test revealed that the clinical performance in CPR of the experimental group 15.55 ± 1.90 was statistically higher than that of the control group 10.60 ± 1.53 , $p < 0.001$.

These findings demonstrate that participants in the experimental group showed a significant improvement in their practical cardiopulmonary resuscitation skills. The statistically significant difference observed in the practical assessment reinforces the effectiveness of procedural simulation-assisted teaching in improving the clinical performance of midwifery students in neonatal resuscitation.

3.4. Satisfaction and Confidence of Midwifery Students with their Learning

3.4.1. Results of the Scale Student Satisfaction with Learning (SSLS)

The analysis of the results of the Student Satisfaction Scale with their learning (SSLS) reveals an overall high level of satisfaction with teaching assisted by procedural simulation in cardiopulmonary resuscitation.

The means and standard deviations of the five (SSLS) items are presented below, showing participants' satisfaction with different facets of teaching (Table 6).

Overall satisfaction with learning (Item 1): Almost all participants had a mean of 4.10 ± 0.55 , indicating high overall satisfaction of students with their learning in cardiopulmonary resuscitation through the procedural simulation. Students generally felt satisfied with their learning experience.

Appreciation of educational tools and activities (Item 2): The majority of participants, with a mean of 4.55 ± 0.51 , found that the educational tools and activities of the procedural simulation were very effective in improving their knowledge in External Cardiac Massage (ECM) of the newborn. This shows a strong educational impact of the tools and activities used in the simulation.

Usefulness and Effectiveness of Teaching Methods (Item 3): With a mean of 4.45 ± 0.51 , students found the teaching methods used in the simulation, such as hands-on approaches and feedback, useful and effective in improving their understanding of neonatal resuscitation.

Table 6. Satisfaction of midwifery students about cardiopulmonary resuscitation training.

Items	n	Min	Max	Som.	Mean	SD.
Item 1: The teaching/learning methods used in the procedural simulation in NNE CPR were useful and effective.	20	3	5	82	4.10	0.553
Item 2: The procedural simulation included various tools and different teaching activities aimed at improving my knowledge of NNE CPR.	20	4	5	91	4.55	0.510
Item 3: I liked the method by which my teacher conducted the teachings of NNE CPR in the procedural simulation.	20	4	5	89	4.45	0.510
Item 4: The way my teacher conducted the teachings in procedural simulation suited my way of learning NNE CPR knowledge.	20	4	5	93	4.65	0.489
Item 5: The tools and learning activities used in the procedural simulation are motivating and helped me acquire NNE CPR knowledge.	20	4	5	89	4.45	0.510

Table 7. Descriptive statistics of the results obtained from the items on the SLCS.

The Items	M.	SD.
Item 1: I am confident that I have mastered the knowledge of neonatal resuscitation in CPR that the professor presented in the procedural simulation lessons	4.30	0.470
Item 2: I am convinced that the procedural simulation lessons focused on knowledge of neonatal care in terms of CPR that are essential to my basic nursing training	4.60	0.503
Item 3: Thanks to the clinical simulation lessons, I have acquired essential knowledge and skills in terms of CPR to perform the tasks required in healthcare settings	4.30	0.733
Item 4: My professor relied on relevant knowledge to lead the nne procedural simulation lessons in CPR	4.55	0.510
Item 5: I have the responsibility, as a student, to learn the essential knowledge of CPR during the procedural simulation lessons	4.20	0.410
Item 6: I know how to get help when I do not understand the knowledge of the MCE of the nne presented in the procedural simulation lessons	4.75	0.444
Item 7: I know how to use the simulation lessons procedural to learn the knowledge and skills necessary for the practice of nursing	4.35	0.489
Item 8: It is entirely the responsibility of my teacher to indicate to me the knowledge that must be learned during clinical simulation teachings	4.45	0.510

Note: M = mean, SD. = Standard deviation. 5 = Very confident; 1 = not at all confident.

Assessment of the simulation facilitators' leadership in teaching (Item 4): Item 4 had the highest mean of 4.65 ± 0.48 , indicating that the simulation facilitators conducted the sessions well in a positive and engaging manner. Participants particularly appreciated the way the instructors structured and conducted the simulation sessions.

Motivation and impact of teaching tools on improving knowledge in External Cardiac Massage (ECM) (Item 5): With a mean of 4.45 ± 0.50 , this item shows that the majority of students found the teaching tools (manikins, visual aids, *etc.*) motivating and effective in improving their knowledge in (ECM), thus reinforcing the idea that procedural simulation stimulates active learning.

Indeed, these results highlight the effectiveness of procedural simulation as a teaching method for neonatal resuscitation and suggest that it plays a key role in improving students' practical skills in newborn Cardiopulmonary Resuscitation (CPR).

3.4.2. Results of the Student Learning Confidence Scale (SLCS)

All participants in the experimental group (B) completed the Student Learning Confidence Scale (SLCS) at the time of the post-test.

The **SLCS** allows us to objectify the level of confidence that participants have in their knowledge of cardiopulmonary resuscitation acquired in simulation, to resolve a health problem (CPR). The means and standard deviations for each of the 8 items of the **SLCS** are presented in Table 7.

The item mean scores range from Item 5 (4.20 ± 0.41) to Item 6 (4.75 ± 0.44). These high averages indicate that students hold a positive perception of procedural simulation teaching and feel confident, ranging from "completely confident" to "confident" in their mastery of the knowledge and skills required for neonatal Cardiopulmonary Resuscitation (CPR). Overall, the results show that participants expressed strong confidence in their learning through simulation for the management of neonatal resuscitation.

Students reported increased confidence in the knowledge and skills gained during simulation, with Item 1 scoring 4.30 ± 0.47 . They also reported a very high level of confidence in their ability to seek help and make use of the simulation-based lessons (Item 6: 4.75 ± 0.44). Furthermore, they indicated that the CPR knowledge acquired through evolving procedural simulation scenarios would be useful in addressing cardiopulmonary arrest situations (Item 3: 4.30 ± 0.733).

Participants unanimously agreed that they were responsible for managing their learning during simulation sessions (Item 2: 4.60 ± 0.50). This suggests they take an active role in their learning process, which is essential for engagement and knowledge retention.

In addition, students strongly agreed that simulation facilitators provided relevant CPR knowledge (Item 4: 4.55 ± 0.55), and that knowledge is essential to their nursing education (Item 2: 4.60 ± 0.50).

4. DISCUSSION

This study is part of an effort to improve the initial training of midwifery students at ISPITS in Casablanca. The main objective was to evaluate the impact of a procedural simulation-assisted teaching sequence in neonatal care, specifically Cardiopulmonary Resuscitation (CPR). This research examined the effect of this method on the theoretical knowledge and practical skills of midwifery students.

The sample for this study consisted of 40 midwifery students ($N = 40$), all female, which reflects the predominantly female composition of midwifery training in Morocco. The majority of participants were under 18 years of age (47.5%) and in their fourth semester (60%).

The results show that students in the experimental group, who received procedural simulation training, demonstrated a significant improvement in their theoretical knowledge (17.40 ± 0.59) compared to the control group (14.15 ± 1.49). Moreover, their clinical performance during post-tests and practical assessments was higher in the experimental group (15.55 ± 1.90) than in the control group (10.60 ± 1.53).

These findings confirm the hypotheses formulated at the beginning of the study and provide new insights into the effectiveness of simulation in midwifery education.

This result is consistent with the findings of a comprehensive literature review conducted by Alalhareth and Howarth (2020), which analyzed research on resuscitation training for first-year nursing students. The review indicated that simulation training allows students to gain experience closely resembling real-life practice, thereby promoting the development of neonatal resuscitation skills. It also demonstrated that learner skills, confidence, and satisfaction are significantly enhanced through simulation [22].

On the other hand, Hakimi *et al.* (2021) revealed that knowledge, skills, and confidence scores increased significantly immediately after simulation training ($p < 0.001$). The changes were maintained 6 weeks after training. These changes were not observed in the control group [3].

Furthermore, a study conducted by Watelet (2017) showed that simulation improves skills such as teamwork, emotion management, and rapid decision-making [15].

The improvement in theoretical knowledge and clinical performance can be attributed to the immersive and interactive nature of procedural simulation. By reproducing realistic clinical situations, this method allows students to apply the theoretical knowledge they acquired, thus strengthening their clinical reasoning and critical thinking skills. Furthermore, this interactive environment promotes better retention of theoretical concepts by allowing students to contextualize and test them in practical situations [1, 15, 16, 23, 24].

Overall, our results suggest that a procedural simulation teaching sequence could replace a few hours of clinical internships, which could help compensate for the lack of internship availability in these settings. As demonstrated by Hayden *et al.* (2014), a traditional clinical experience in a clinical setting combined with an experience reproduced by clinical simulation would adequately train new graduates for clinical practice [23].

As a corollary, the French National Authority for Health (2024) highlighted the importance of clinical simulation in improving the knowledge of healthcare professionals. This approach allows for the recreation of realistic and interactive scenarios, contributing to a thorough understanding of concepts [16].

4.1. Improvement of Theoretical Knowledge

In terms of knowledge and clinical performance, the results of this study are consistent with those reported by KC *et al.* (2017) and Vadla *et al.* (2022), which demonstrated significant improvement in skills and clinical practice following training [25, 26].

In contrast, the results of Bang *et al.* (2016) differ from those obtained in our study. Indeed, although midwives' knowledge and skills increased by more than 90% immediately after training, the percentage of learners who passed the OSCE decreased to approximately 80% [27].

It is important to note that the participants in our study belonged to two different semesters and therefore to two distinct levels in terms of theoretical knowledge and practical skills. Despite this initial heterogeneity, the analysis showed a homogeneous and statistically significant progression in neonatal resuscitation knowledge and skills in both groups.

This improvement in participants' theoretical knowledge can be explained by the fact that procedural simulation, which recreates realistic clinical situations, allows for direct application of the knowledge acquired during training, regardless of their initial level [24].

The immersive environment created by simulation promotes active learning, complementing traditional teaching methods, and facilitating the acquisition of new skills. This teaching approach is particularly effective for the development of technical skills, as well as non-technical skills such as those related to Crisis Resource Management (CRM), which are essential in emergency situations [14, 28].

Indeed, by subscribing to socioconstructivist pedagogy, Jeffries describes simulation as a learner-centered teaching method [19].

New teaching strategies, such as Simulation Teaching, can enhance student learning and creativity; Therefore, they provide the learning process with a solid foundation for lifelong learning. Furthermore, this method can simulate learners' sense of self-confidence and reinforce learning through activities/learning labs [3].

4.2. Improved Clinical Performance

The results of the practical assessments also showed a significant improvement in the clinical skills of the students in the experimental group (15.55 ± 1.90). In comparison, the participants in the control group achieved lower scores (10.60 ± 1.53).

The students in the experimental group showed significant progress in terms of technical accuracy, time management, and clinical decision-making. This improvement can be attributed to the gradual repetition of clinical scenarios, which allows the students to become familiar with the procedures and build their confidence.

By providing a safe and risk-free environment for patients, simulation also allows students to make mistakes and learn from them, helping reduce anxiety related to real-life clinical practice.

Our results corroborate those of previous studies, which observed a significant improvement in students' clinical skills after simulation sessions. Using a simulation-based teaching method for neonatal resuscitation can help healthcare providers become sufficiently proficient in this skill [1, 3].

This approach has proven particularly beneficial for midwifery students, especially in terms of autonomy and satisfaction, with benefits that are maintained even several months after training [1, 22].

In addition, Audiberti *et al.* (2023) observed improvements across all self-assessment domains among midwives following simulation-based training. Moreover, participant support for implementing a continuing education program in neonatal resuscitation was unanimous, highlighting the acceptability and relevance of this pedagogical approach [29].

Finally, Saeidi *et al.* (2017) demonstrated that simulation-based training significantly improves nursing students' knowledge of neonatal resuscitation compared with traditional teaching methods. The authors reported a significantly higher mean post-test score in the simulation group ($p < 0.001$), with no significant difference at pre-test ($p = 0.452$), thereby confirming the effectiveness of simulation in acquiring clinical competencies [30].

4.3. Confidence and Satisfaction with Learning

Participants in the experimental group also showed high levels of confidence and satisfaction after the simulation. This is consistent with the results of other empirical studies [10, 31], which showed that students are generally more confident in their professional skills after participating in simulation activities [22].

Furthermore, they were more satisfied with their simulation learning. Mills (2016) explains that this increased confidence results from the fact that simulation allows students to operate in a safe learning environment, where they can make mistakes without endangering the lives of patients [22, 32].

5. STUDY LIMITATIONS AND AVENUES FOR FUTURE RESEARCH

Although the results of this study are promising, it is important to note certain limitations. First, the sample size may have limited the generalizability of the results. It would be useful to extend the study to a larger number of students and to replicate the experiment across diverse training institutions to confirm the universality of the effects of procedural simulation.

Another limitation is that the study did not thoroughly explore the different types of procedural simulation (*e.g.*, high-fidelity *versus* low-fidelity simulation) and their respective impacts on student performance. Further research could explore the relative effectiveness of these different approaches.

Finally, it would be relevant to study the effect of simulation on students' perceptions of their preparation for clinical practice. Although this study focuses on clinical knowledge and performance, it would be interesting to also measure the impact of simulation on self-confidence and stress reduction, important factors in the success of midwifery practice.

CONCLUSION

In conclusion, this study highlights the positive impact of procedural simulation on the theoretical knowledge and clinical performance of midwifery students. It confirms that this method not only improves clinical performance but also increases students' confidence in their professional skills.

These results suggest that the integration of procedural simulation into the midwifery-training curriculum at ISPITS Casablanca could represent a major asset for the quality of training and for the preparation of future professionals for complex and urgent clinical situations.

Indeed, future training programs may benefit from the wider adoption of this innovative approach to strengthen the practical and theoretical skills of midwifery students.

AUTHORS' CONTRIBUTIONS

It is hereby acknowledged that all authors have accepted responsibility for the manuscript's content and consented to its submission. They have meticulously reviewed all results and unanimously approved the final version of the manuscript.

LIST OF ABBREVIATIONS

ECM	= External Cardiac Massage
SSLS	= Scale Student Satisfaction with Learning
SLCS	= Student Learning Confidence Scale
ILCOR	= International Liaison Committee for Resuscitation
CPR	= Cardiopulmonary Resuscitation
MCQ	= multiple-choice questionnaire
CLUSS	= Confidence in Learning Using Simulation Scale

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted with the approval of the Board of Directors of the Higher Institute of Nursing and Health Techniques professions (ISPITS) of Casablanca, Morocco, under approval number 603/2025.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Informed consent was obtained from all participants prior to their inclusion in the study.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The data sets used during the current study can be provided by the corresponding author [A.L.] upon reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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