

Original Research

# Influence of High-Fidelity Manikin-Based Simulation on Nursing Students' Basic Cardiac Life Support Ability and Motivation



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Article Info	Abstract
Article history: Received: 15 February 2024 Accepted: 22 April 2024	<p><i>Introduction:</i> One of the competencies that nursing students must have while dealing with cardiac arrest is the capacity to perform critical life support, namely basic cardiac life support (BCLS). Having the abilities and motivation to perform BCLS is a complex process and often goes beyond the planned laboratory session's timeframe. The study aims to determine the intervention's impact on nursing students' ability and motivation to conduct BCLS.</p> <p><i>Methods:</i> This study employed a quasi-experimental design with a pre-post-test control group and was carried out in July 2023 at the Emergency Skills Lab with fourth-year undergraduate nursing students. In this study, the sample size for the control and intervention groups was 52 for each group, selected using a simple random sampling technique. The independent variable was high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory, while the dependent variables were BCLS abilities measured using a mega code checklist and student motivation measured using a valid and reliable motivation questionnaire. Data were examined using the independent sample t-test.</p> <p><i>Results:</i> The independent t-test results for the motivation variable showed a significant difference (<math>p = 0.004</math>), indicating a significant difference in motivation among students before and after being exposed to high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory in performing BCLS.</p> <p><i>Conclusion:</i> High-fidelity manikin-based Human Patient Simulation is an educational paradigm in healthcare that involves using manikins that closely resemble real patients in realistic scenarios. It can be used as an alternative teaching method to boost BCLS performance and motivation.</p>
Keywords: cardiopulmonary resuscitation, manikins, patient simulations, problem-based learning	

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## INTRODUCTION

Nursing students spend most of their days in colleges and healthcare facilities where they may encounter medical emergencies such as cardiac arrest or unforeseen accidents. One of the competencies that nursing students must possess in managing cardiac arrest is the ability to perform critical life support, notably Basic Cardiac Life Support (BCLS). BCLS is a life-saving method that includes rapidly identifying a heart attack, initiating an emergency response system, performing adequate cardiopulmonary resuscitation (CPR), and applying defibrillation promptly [1]. Performing BCLS effectively can reduce mortality and morbidity in various emergencies, both within the hospital (In-Hospital Cardiac Arrest - IHCA) and outside the hospital (Out of Hospital Cardiac Arrest - OHCA). Cardiac arrest is responsible for >49.1% of all deaths. Quick intervention within 3-5 minutes of OHCA onset saves lives [2], [3]. Time-saving is considered "life-saving," a philosophy adopted by emergency services, meaning that a person's survival depends on the speed and timeliness of actions [3]-[5].

As technology advances, the emergence of learning media is necessary to support nursing students further, especially in performing BCLS. Educators must be able to integrate various teaching methods with the appropriate theoretical foundation to enhance students' skills and motivation in performing BCLS. The crucial role of the laboratory, through simulation methods using high-fidelity manikins, is an advanced technological teaching method that provides

the opportunity to practice in a safe learning environment until competence is achieved using standardized scenarios [4]. Through simulation, the kinesthetic learning process, which involves observing and directly performing the required skills, significantly impacts one's ability to take action [5], [6]. The impact of laboratory education with the assistance of high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory needs to be reevaluated and empirically proven for its effectiveness in improving students' skills and motivation in performing BCLS.

David Kolb's Experiential Learning Theory is a theory of learning that creates a process in which knowledge and motivation to acquire a skill are achieved through transforming experiences with a more holistic approach [7]. Kolb stated that learning involves acquiring abstract concepts that can be applied flexibly in various situations. In Kolb's theory, the impetus for the development of new concepts is provided by new experiences. Applying Kolb's learning theory benefits students, educators, and entrepreneurs. One of the significant reasons for using the experiential learning theory approach is the shift in constructivist pedagogy, emphasizing the importance of competency attainment (knowledge, attitudes, and skills) acquired through experiential learning or learning by doing [10]. Another aspect to consider is that experience plays a more significant role in students' autonomy and self-directed learning. The four learning cycles, namely concrete experience, reflective observation, abstract conceptualization, and active

experimentation, can transform learning into an effective process. Despite the crucial role of experience in education, some studies suggest that the expected benefits of student learning have not been optimally realized [8].

Having the abilities and motivation to perform BCLS is a complex process and often goes beyond the planned laboratory session's timeframe. Based on Kolb's experiential learning theory, skills construction consists of four main phases: stimulation, reflection, abstraction, and experimentation. The findings of this study may assist in solving the challenge of increasing the number of nursing students proficient in performing BCLS using simulation methods based on Kolb's experiential learning theory to reduce mortality and morbidity in various emergencies. Based on the description above, the researcher is interested in conducting a study on the influence of high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory on the ability and motivation of nursing students to perform basic cardiac life support skills.

## **METHODS**

### ***Study design***

The research design was quasi-experimental, with a pre-post-test control group conducted in July 2023 among fourth-year nursing undergraduate students at the Emergency Skills Lab. During the research, the treatment group was given a high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory, while the control group was given a simulation with

conventional operational procedure guidance.

### ***Population and sample***

The participants in this study were fourth-year nursing undergraduates. The sample size was determined using the mean difference method between two groups, with the same sample size and standard error as in prior studies [9]. These numbers were entered into a software formula to calculate a sample size of 47 for each group, with an additional 10% to account for dropouts. In this study, the control group had a sample size of 52, as did the intervention group, which was chosen using simple random selection methods. The selection of respondents based on groups was done by randomly drawing, ensuring that the characteristics of the students in both the control and intervention groups were homogeneous. The study's independent variable was high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory, whereas the dependent variables were ability and motivation to perform BCLS. The inclusion criteria in this study were level 4 students who were still active, indicated by showing a student identification card and having signed an informed consent form. Students who were absent due to illness, leave, or other reasons until the end of the research were excluded from this study.

### ***Intervention***

The intervention in this study was high-fidelity manikin-based human patient simulation based on Kolb's experiential

learning theory. The first cycle of Kolb's ELT is Concrete Experience (CE), during which students will actively participate in a laboratory activity focusing on BCLS techniques for cardiac arrest sufferers. The second cycle, Reflective Observation (RO), requires students to reflect on their experiences throughout ACLS practice intentionally. In the third cycle, Abstract Conceptualization (AO), students are presented with settings that demand them to think critically about what they see to generate a concept, hypothesis, or model from what they perceive. The fourth cycle is Active Experimentation (AE), which includes the BCLS hands-on skills lab. In the BCLS hands-on skills lab, the learning method will follow four directions to meet Kolb's four ELT cycles: 1) Demonstration: demonstrate BCLS skills normally without explanation; 2) Deconstruction: repeating BCLS skill steps with elaborate explanations and encouraging students to ask questions; 3) Comprehension: Students' explanations of BCLS skill steps and demonstration instructions for proper performance. The demonstration is corrected as needed, and these procedures are repeated until the student understands them completely; 4) Performance: Students practice BCLS skills while being observed and receiving feedback.

### ***Instruments***

The ability to conduct BCLS was assessed using the American Heart Association's mega code checklist, with the Concordance Correlation Coefficient = 0.96 and the Interclass Correlation Coefficient = 0.97. The

trainer will assess the participants through the mega code checklist by ticking the participants' activities. The results of measuring the mega code, namely: good (80–100), fair (60–79), and less (<60). Student motivation is measured using the Student Motivation Scale identified by Rubin, Palmgreen, and Sypher, then modified by Rodgers, a self-reported state motivation assessment. This instrument was a self-reported 12-item questionnaire designed to assess the impact of course content on motivation. The item responses were from 1 being unmotivated to 7 being highly motivated. The reliability coefficients for the version of the Student Motivation Scale utilized in this study ranged from 0.95 to 0.96.

### ***Data analysis***

Data were analyzed using SPSS version 20.0, which included descriptive data analysis to obtain the frequency distribution of each variable. The inferential data analysis used in this study was an independent sample t-test. Before evaluating the data, the Kolmogorov-Smirnov and Levene tests were performed to ensure normality and homogeneity.

### ***Ethical clearance***

This study was ethically approved by the Ethics Committee of the Bali Institute of Technology and Health, Indonesia, with certificate number 04.0293/KEPITEKES-BALI/IV/2023 dated April 27, 2023. Following an explanation and instructions on the research technique, all respondents voluntarily consented and participated in the study. The research procedure adhered to the

provisions of the Declaration of Helsinki for research involving human participants.

## RESULTS

Table 1 shows that the respondents' age range was mostly between 19 and 35, with 67.3% in the intervention group and 61.5% in the control group. Regarding gender, the majority of respondents were female, with 96.2% in the intervention group and 75% in the control group.

Based on Table 2, the results of the pre-test for motivation in the intervention group were all at the lower level, with 52 respondents (100%). The post-test results showed that all the intervention group respondents experienced increased motivation from lower to moderate, totaling 52 (100%). In the control group, the pre-test results were all at the lower level, with 52 respondents (100%). Similarly, the post-test results showed that all respondents in the control group experienced increased motivation from lower to moderate, totaling 52 (100%).

The results of the pre-test for skills in the intervention group show that the majority were at a moderate level, with 46 respondents (88.5%). The post-test results indicate that all the intervention group respondents experienced an improvement in skills from moderate to high, totaling 52 (100%). In the control group, the pre-test results show that the majority were at a sufficient level, with 51 respondents (98.1%). Similarly, the post-test results show that all respondents in the control group experienced an improvement in skills from moderate to high, totaling 52

(100%). When looking at the mean values, it was evident that skills were more dominant in the intervention group than in the control group.

Based on Table 3, the normality test was conducted using the Kolmogorov-Smirnov test, where a variable is considered to have a normal distribution if the p-value is more significant than 0.05. For the motivation variable, the pre-test and post-test data were found to have a normal distribution with p-values of  $0.067 > 0.05$  and  $0.054 > 0.05$ , respectively. For the skill variable, the pre-test and post-test data were found to have a normal distribution with p-values of  $0.077 > 0.05$  and  $0.062 > 0.05$ , respectively.

The homogeneity test was also conducted using the Levene statistic, where data is considered homogeneous if the p-value is greater than 0.05. For the motivation variable, the pre-test and post-test data had p-values of  $0.180 > 0.05$  and  $0.302 > 0.05$ , respectively, indicating homogeneous data. For the systolic blood pressure variable, the pre-test and post-test data had p-values of  $0.107 > 0.05$  and  $0.430 > 0.05$ , respectively, indicating homogeneous data. Furthermore, for the skill variable, the pre-test and post-test data had p-values of  $0.002 > 0.05$  and  $0.264 > 0.05$ , respectively, indicating homogeneous data. Therefore, the conditions for conducting an independent t-test are met.

Based on Table 4, the results of the independent t-test for the motivation variable show a significance value (sig) of  $0.004 < 0.05$ , indicating a significant difference in motivation among students before and after being exposed to high-fidelity manikin-based human patient simulation based on Kolb's

experiential learning theory in performing BCLS (Basic Cardiac Life Support). However, for the skill variable, the significance value is  $0.685 > 0.05$ , meaning there is no significant difference in skills among students before and

after being exposed to high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory in performing BCLS.

**Table 1**

Respondents' Characteristics

Respondents' Characteristics	Intervention group		Control group	
	Σ	%	Σ	%
<b>Age</b>				
19	35	67,3	32	61,5
20	17	32,7	20	38,5
<b>Gender</b>				
Male	2	3,8	13	25
Female	50	96,2	39	75

**Table 2**

Motivation and skill in the Intervention and Control Group

Variable	Characteristic	Pre-test			Post-test		
		N (%)	Mean	SD	N (%)	Mean	SD
Motivation	<b>Intervention</b>						
	Low	52 (100%)	37,44	3,140	-	70,31	3,209
	Moderate	-			52 (100%)		
	High	-			-		
	<b>Control</b>						
	Low	52 (100%)	36,98	3,611	-	72,63	2,931
	Moderate	-			52 (100%)		
	High	-			-		
Skill	<b>Intervention</b>						
	Low	-	74,73	2,991	-	88,10	4,045
	Moderate	46 (88,5%)			-		
	High	6 (11,5%)			52 (100%)		
Variable	Characteristic	Pre-test			Post-test		
		N (%)	Mean	SD	N (%)	Mean	SD
Skill	<b>Control</b>						
	Low	-	73,15	3,967	-	86,08	3,767
	Moderate	51 (98,1%)			-		
	High	1 (1,9%)			52 (100%)		

**Table 3**

Normality test and Homogeneity test

Variable	Group	Normality test*	Homogeneity test
Motivation	Pre-test	0,067	0,107
	Post-test	0,054	0,430
Skill	Pre-test	0,077	0,002
	Post-test	0,062	0,264

**Table 4**

The difference in the influence of high-fidelity manikin-based human patient simulation on nursing students' BCLS ability and motivation

Variable	Mean		P Value
	Intervention	Control	
Motivation	32,86	35,65	0,004
Skill	13,36	12,92	0,685

**DISCUSSION**

The results of nursing students' ability to perform BCLS show that all respondents in the intervention group experienced increased motivation from inadequate to sufficient. Currently, limited specific information is available from high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory regarding its impact on motivation in performing BCLS. However, one study found that the use of high-fidelity, full-sized human patient simulation manikins, which closely resemble real patients (HF-HPSMs), can enhance nursing students' decision-making skills [10], [11]. Another critical study evaluated the use of human patient simulation manikins that closely resemble real patients in the context of

nursing pedagogy [12]–[14]. While this study did not directly address questions about motivation in performing BCLS, it does indicate that high-fidelity manikin-based human patient simulation can be an effective tool for enhancing clinical decision-making skills in nursing students [15].

The results of nursing students' ability to perform BCLS show that all respondents in the intervention group experienced an improvement in skills from sufficient to good. The findings of this research align with a study, [16] which found that the use of high-fidelity full-sized human patient simulation manikins (HF-HPSMs) can enhance nursing students' decision-making skills in performing BCLS. This study involved 232 nursing students in Singapore and found that prior experience with high-fidelity

simulation, direct practice, and active participation in debriefing were significant predictive indicators in improving nursing students' decision-making skills in performing BCLS [16]. Previous research also found that high-fidelity human patient simulation can positively impact cognitive and clinical skills in performing BCLS [17]–[19]. A study discovered that high-fidelity patient simulation benefits nursing students in terms of knowledge, values, and realism [20]. From these findings, it can be concluded that high-fidelity manikin-based human patient simulation can enhance skills in performing BCLS.

Based on the difference test using an independent t-test with the SPSS 20 program for Windows, there is a significant difference in motivation among nursing students before and after being exposed to high-fidelity manikin-based human patient simulation based on Kolb's theory in performing BCLS. On the other hand, for the skill variable, there is no difference in skills among nursing students before and after being exposed to high-fidelity manikin-based human patient simulation based on Kolb's theory in performing BCLS. High-Fidelity Manikin-Based Human Patient Simulation is an educational methodology in healthcare that involves the use of manikins that closely resemble real patients in realistic patient scenarios [12], [19], [21], [22]. These manikins are computerized and contain hydraulics and compressors that can produce breath sounds, heartbeats, peripheral pulse, pupil dilation/constriction, and display EKG, pulse oximeter, blood pressure, arterial waveforms, pulmonary artery waveforms,

anesthetic gases, and other readings. Human patient simulation based on manikins closely resembling real patients is highly specialized and can mimic a woman giving birth, a newborn or premature baby, and more diminutive pediatric manikins. Kolb's experiential learning theory is a learning model that emphasizes the importance of experience in the learning process.

According to this theory, learning occurs through a four-stage cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Increased Emotional Engagement: Realistic simulations allow participants to deeply experience emergencies, which can enhance their emotional engagement in learning [11], [23], [24]. They may feel more connected to the importance of BCLS and be motivated to understand and master the skill. Providing Realistic Context: Kolb's experiential learning theory emphasizes experience as the foundation of learning. Simulations provide a real context in which participants can apply their knowledge and BCLS skills, motivating active learning as they see the direct relevance of their learning. Deep Reflection: Kolb's theory includes reflection as an essential component of learning [25], [26]. Simulations provide experiences that participants can reflect upon, enhancing their understanding of BCLS procedures and motivating them to improve their skills continually [27], [28]. Boosting Confidence: Participating in realistic simulations and practicing BCLS in situations resembling real-life scenarios can boost participants' confidence. With increased confidence, they

may be more motivated to respond to emergencies and perform BCLS effectively in real life. Opportunity for Feedback: In simulations, participants receive direct performance feedback. This feedback can help them understand areas where they need to improve their skills, serving as a source of motivation as they can see their personal growth and efforts to improve.

### **IMPLICATIONS**

The implications of the research are that learning through a method assisted by high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory can be an additional reference or piece of literature to increase the competency achievements of nursing students, especially in growing skills and motivation in carrying out BCLS. Teaching BCLS skills through high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory can build the competencies students must achieve in carrying out BCLS. Increasing knowledge and skills about BCLS can foster a positive attitude. Students become more confident in new roles and relationships when assisting patients experiencing cardiac arrest.

### **LIMITATIONS**

This research has tried as hard as possible to get the best results. However, there are still limitations, namely that this research only carried out measurement evaluations once at the posttest, and no follow-up was carried out again.

### **CONCLUSION**

The study's findings demonstrated that high-fidelity manikin-based human patient simulation based on Kolb's experiential learning theory substantially impacted student motivation and BCLS performance abilities. The application of experiential learning theory enables students to learn at every step. Most importantly, the students were able to demonstrate how they may apply it in future practice.

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### **CONFLICT OF INTEREST**

The authors have declared that they have no conflicts of interest regarding the research, authorship, or publication of this work.

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