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Résumé de l'article

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Impact of Simulation-Based Learning on Learning Loss Among Nursing Students: A Quasi-Experimental Study

Alkadi Alshammari[1,*], Adnan Innab[2,*], Ahmed Nahari[3], Homoud Alanazi[4], Raeed Alanazi[5], and Ghada Almukhaini[6]
*[1]Assistant Professor, Community, Psychiatric and Mental Health Nursing Department, King Saud University; [2]Associate Professor, Nursing Administration and Education Department, Vice Dean of Student Affairs. King Saud University; [3]Assistant Professor, Medical Surgical Department, King Saud University; [4]Director of Nursing, Nursing Administration Department at Dental University Hospital, King Saud University; [5]Assistant Professor, Nursing Administration and Education Department, King Saud University; [6]Simulation Training Supervisor, Medical Surgical Department, College of Nursing; *Joint first authors*

Abstract

Nursing students faced learning losses during the COVID-19 pandemic due to the transition to virtual classes, inadequate communication, and reliance on virtual clinical training as a prerequisite for clinical practice. This study aimed to investigate the extent of learning loss experienced by nursing students and examine the impact of simulation-based learning (SBL) on mitigating this learning loss and on students' confidence, satisfaction, and performance before and after the SBL program. This quasi-experimental study used a within- and between-subjects design. Data were collected from January 2022 to May 2023 from 177 nursing students before and after the SBL program. The Learning Loss scale and Simulation Training Evaluation Questionnaire were used. Substantial learning losses were observed in nurses' knowledge, professional attitude, and skills before the intervention. The intervention group had significantly higher knowledge, professional attitude, and professional skills than the control group. The intervention significantly improved nursing students' confidence, expectations/satisfaction, and performance. The regression model revealed that age and weeks in internship were significant predictors of learning loss. Prior distance education experience did not show any significant association with learning loss. Thus, SBL is useful in crisis situations; it enhances nursing students' knowledge, professional attitudes, and professional skills. Course designers should consider integrating SBL into nursing curricula as an innovative teaching strategy to compensate for possible learning losses. This approach will help prepare graduates to enter the workforce with the ability to quickly adapt and practice confidently in clinical settings to ensure patient safety.

Keywords: learning loss, simulation-based learning, SBL, nursing student, competency, education

Introduction

Nursing education can be negatively affected during emergencies, disasters, and pandemics. During the coronavirus (COVID-19) pandemic, nursing instructors and students encountered challenges in meeting educational objectives (Kim et al., 2021). As universities shifted to virtual learning, clinical practices were disrupted in healthcare institutions (Al Shlowiy, 2021). Such changes led to reduced direct contact with instructors and hindered learning experiences (Ramos-Morcillo et al., 2020). Nurse instructors could not fully meet students' expectations, leading to practical concerns, reduced learning opportunities, and doubts about students' nursing career choices. These circumstances contributed to the deterioration of the learning process, ultimately leading to learning loss.

Learning loss, as a concept, refers to the decline in students' knowledge and skills compared to their expected academic growth trajectories, typically assessed by comparing current educational progress with historical data (Donnelly & Patrinos, 2022; Pier et al., 2021). This concept gains prominence during periods of educational disruption, such as prolonged school closures, when students may experience setbacks in achieving learning outcomes. Learning loss can have long-term consequences (Donnelly & Patrinos, 2022) on nursing graduates' competency and skills. Although several learning-loss prediction models have been developed (Azevedo et al., 2021), the actual impact of COVID-19 on students' learning progress has not been fully investigated. Before the onset of COVID-19, research highlighted the difficulties nursing students encounter due to insufficient skills and knowledge, emphasizing the need for targeted interventions to effectively address these challenges (Al Shlowiy, 2021; Kim et al., 2021; Suliman et al., 2021). The pandemic exacerbated these challenges, adversely affecting both theoretical and clinical learning, thereby intensifying learning loss (Angasu et al., 2021).

In such situations, integrating learning pedagogies such as simulation-based learning (SBL) is crucial (Stanley et al., 2018). The International Nursing Association for Clinical Simulation and Learning defines simulation as an educational method that replicates specific realistic scenarios to mimic real-life situations (INACSL Standards Committee, 2016), allowing students to practice and gain experience (Hung et al., 2021). Recently, SBL has become increasingly popular, offering opportunities for enhancing teaching, bridging the theory-practice gap, enhancing clinical practice and patient safety, and teaching clinical judgment skills (Lobão et al., 2023). Simulations offer a platform for learning and skill development in a safe and controlled environment, effectively improving knowledge, competency, confidence, satisfaction, self-efficacy, and self-esteem among nursing students (Hung et al., 2021; Koukourikos et al., 2021). Although immersive virtual reality (VR) technologies (including desktop, glasses, and head-mounted displays) enable students to experience the clinical environment remotely, even if they are physically elsewhere, mitigating the impact of geographic separation as experienced during the COVID-19 pandemic, these technologies also pose challenges including a lack of or limited access, inadequate training, and technical difficulties (Alshammari & Fayez Alanazi, 2023; Mariscal et al., 2020; Rushton et al., 2020).

It should be noted here the literature has revealed a scarcity of research specifically addressing learning loss post-COVID-19, particularly in countries such as the United States and Canada. Instead, studies have focused on broader impacts such as the shift to virtual learning. For example, research on nursing education in British Columbia found that nursing students perceived no significant decline in the quality of their clinical learning experiences during the pandemic, despite challenges such as technological disruptions

(Sferrazza et al., 2023). Similarly, studies on undergraduate nursing education highlighted various obstacles, including disrupted clinical experiences, potentially affecting students' career readiness (Head et al., 2022). While these studies did not quantify learning loss, they suggest it as a common concern in post-pandemic education.

Therefore, it is imperative to analyze empirical outcomes concerning student expectation/satisfaction, confidence, knowledge, attitude, and skills, particularly in light of potential learning loss exacerbated by the COVID-19 pandemic. Analyzing these outcomes will provide valuable insights into the impact of simulations on students' educational experiences. Furthermore, there is a gap in the existing research regarding the assessment of learning loss and the implications of SBL on nurse competency transfer to the clinical setting, and the assessment of learning loss during crises such as the COVID-19 pandemic, specifically in the context of Saudi Arabia. Thus, the aim of this study was to investigate the extent of learning loss experienced by nursing students and examine the impact of SBL on mitigating this learning loss, and on the levels of students' confidence, expectation/satisfaction, and performance before and after completing the SBL program.

Theoretical Framework

This study was guided by social cognitive theory (SCT), which was developed by Albert Bandura (1986) and posits that learning occurs when there is an interaction between the learner, environment, and behavior. Bandura (1986) also added the construct of self-efficacy to the SCT. This theory focuses on six main aspects: reciprocal determinism, behavioral capability, observational learning, reinforcements, expectations, and self-efficacy.

In this study, the concept of learning loss is explored through the lens of reciprocal determinism, which emphasizes the dynamic interplay between personal factors, environmental influences, and behavior. Simulation-based learning, on the other hand, is linked to behavioral capability, where students demonstrate the knowledge and skills acquired through the intervention. Students' expectations and satisfaction with the simulation align with the theory's constructs of expectations and reinforcements. This is particularly relevant as students recognize that the acquired skills help address the learning loss experienced during the COVID-19 pandemic. Furthermore, in this study, self-confidence is associated with self-efficacy, reflecting students' confidence in performing nursing skills under faculty supervision.

Method

Study Design

This quasi-experimental study utilized a within- and between-subjects design and was conducted from January 2022 to May 2023. A Convenience sampling was employed to recruit the participants.

Study Population and Sample

Nursing students in their fourth year of the bachelor's degree program and those in their fifth year (internship year) were invited to participate. This university is located in Saudi Arabia. Nursing students

were informed about the study both in class and on the institution's digital learning platform. The inclusion criteria were being a fourth- or fifth- year student of the Bachelor of Science in Nursing program and being available for the simulation sessions.

G*Power (Version 3.1) (Faul et al., 2007) was used to determine the required sample size. Using a significance level of .05, power of .8, and effect size of .15, a minimum of 92 respondents was deemed necessary to run the regression analysis. The study sample comprised 177 participants, an adequate sample size. The survey was administered before and after the intervention. The intervention group comprised 102 students who participated in simulation-based scenarios, received a debriefing after each scenario, and completed a survey following the intervention. The control group comprised 75 participants.

Data Collection

Ethical approval for the study was granted by [KSU-HE22-390]. Permission to use the instruments was obtained from the authors. This study was conducted in accordance with the Declaration of Helsinki. The study objectives, risks and benefits, and the right to withdraw from the study were included in the recruitment statement. Participants were informed that their data would be used for research purposes and reported in an aggregated form. Written consents were obtained at enrollment.

A recruitment statement was distributed through social media (WhatsApp) and at the nursing college (King Saud University). Prospective participants were provided the contact information of the primary investigator (PI) to facilitate inquiries or further communication. The participants were administered a pretest online questionnaire to assess their baseline data one month prior to the intervention. The PI provided a schedule for weekly sessions, allowing students to select a suitable day. The intervention covered topics including medication preparation and administration, blood transfusions, and urinary catheterization. The posttest questionnaires were collected immediately after the intervention.

Intervention

The intervention design and its components were based on a pre-study survey that was distributed to nursing students and faculty members. The intervention design considered the key clinical competencies identified by nursing students and faculty members as being either "lost" or adversely affected in their learning experience during the COVID-19 pandemic. The intervention was delivered jointly by two nurses, a faculty member with a Doctor of Philosophy degree, and a clinical instructor with a Master of Science in Nursing degree. Table 1 outlines the components and durations of the intervention session, covering three nursing skills pertaining to patient safety: (a) medication preparation and administration, including medication errors, (b) blood transfusions, and (c) urinary catheterization and urinary tract infection. Each component included a review of essential knowledge and skills, simulation-based scenarios using the high-fidelity Laerdal SimMan® 3G Patient Simulator manikin, and debriefing. All were conducted within a single 150-minute session. The control group received the same content presented only as video-based education sessions on YouTube. Details about these three components of the intervention are shown in Table 1.

Table 1

Description and Duration of Intervention Components

Intervention component	Description	Duration, min
Medication preparation and administration	Pre-briefing of essential knowledge and skills needed for medication preparation and administration	30
	Participate in simulation-based scenarios	15
	Receive simulation debriefing	15
Blood transfusions	Pre-briefing of essential knowledge and skills needed for blood transfusions	15
	Participate in simulation-based scenarios	15
	Receive simulation debriefing	15
Urinary catheterization	Pre-briefing of essential knowledge and skills needed for urinary catheterization	15
	Participate in simulation-based scenarios	15
	Receive simulation debriefing	15

Measurements

All questionnaires were in English, including demographic characteristics (age, years of study, grade point average, and previous distance learning experience). Students' confidence, expectations, satisfaction, and performance in applying nursing procedures were measured using a simulation training evaluation questionnaire (STEQ), developed by (Aboushanab et al., 2018) (Aboushanab et al., 2018) This instrument was modified slightly to reflect simulation training in an academic setting. After modifying the questionnaire, three subject-matter experts assessed its face validity. The questionnaire included 15 items and three subscales that were measured on a 5-point Likert scale (from *strongly disagree* to *strongly agree*). Higher scores indicated greater confidence and satisfaction in performing lessons learned in the simulation training. In terms of internal consistency reliability, a Cronbach's alpha of .92 was reported by the original authors (Aboushanab et al., 2018). In this study, the Cronbach's alpha values of the subscales ranged from .83 to .86, while the reliability of the entire scale was .84.

Due to a lack of instruments that measure learning loss among university students, the researchers of this study developed a tool to measure learning loss, comprising three subscales: nursing knowledge, nursing professional skill competencies, and nursing professional attitude. The tool was evaluated by experts in the academic and clinical nursing fields to assess its content validity. Pilot testing was conducted among nursing students to ensure the clarity of the questions. Examples of items in the nursing knowledge subscale included: "I am aware of basic nursing principles and concepts related to patient safety," and "I believe basic nursing procedures were discussed adequately in my nursing program." In the nursing professional skill subscale, examples included: "I believe that my training has enabled me to be an effective team member," and "I believe that my training has made me more competent in performing patient health assessments."

Within the nursing professional attitude subscale, examples encompassed: "I feel I can take appropriate measures to prevent or minimize the risk of potential complications associated with basic nursing procedures," and "I feel optimistic about my future nursing career because I have received adequate education." These examples highlight various dimensions of nursing education and practice evaluated across the three subscales. In this study, the Cronbach's alpha values of the subscales ranged from .84 to .92, while the internal consistency reliability of the entire scale was .89, indicating that this instrument was reliable for measuring learning loss.

Data Analysis

Data analysis was performed using IBM SPSS Statistics for Windows (Version 29.0). The measures of central tendency (i.e., mean) and variability (range and standard deviation) for continuous data and frequencies and percentages for categorical data were calculated. Homogeneity between groups was tested using Levene's test. A paired-sample *t*-test was used to determine whether there was a significant difference between the pre- and post-intervention scores for the overall learning loss scale and its subscales. An independent sample *t*-test was used to determine the differences between the intervention and control groups in knowledge, professional attitude, professional skills, confidence, expectations/satisfaction, and performance with SBL in applying nursing skills. Pearson's product-moment correlation was used to determine the relationship between the learning loss and the STEQ subscales. Multiple linear regression was used to assess the influence of other factors (e.g., individual characteristics) on students' learning loss.

Results

Demographic Characteristics

Table 2 shows the characteristics of the 177 respondents in this study. The intervention and control groups consisted of 102 and 75 participants, respectively. The majority were aged between 20 and 22 years, had prior experience with distance education, and had been exposed to distance education for at least three semesters. More than one-third of participants had not yet started the internship year (41.8%), but the average number of weeks for those who had already started the internship was 4.44 (SD = 3.90).

An independent sample *t*-test was used to determine the differences between the groups according to the number of semesters in distance education and the internship period. In terms of semesters in distance education, there was no significant difference between the control and intervention group. In terms of the number of weeks in the internship, participants in the control group had an average of 3.9 weeks compared to those in the intervention group who had 4.7 weeks in the internship ($p > .05$).

Table 2

Participants' Demographic Characteristics

Characteristic	*n*	%
Age (years)		
20–22	144	81.4
23–26	33	18.6
Group		
Control	75	42.4
Intervention	102	57.6
Prior experience with distance education		
Yes	150	84.7
No	27	15.3
Semesters in distance education		
1	20	11.3
2	40	22.6
3	48	27.1
> 4	42	23.7
Started the internship		
Yes	67	37.9
No	74	41.8
Missing	36	20.3
Internship period		
< 1 month	42	23.7
> 1 month	21	11.9
Missing	4	2.3

Note. $N = 177$. For semesters in distance education, $M = 3.01$, $SD = \pm 1.5$. For internship period, $M = 4.44$, $SD = \pm 3.9$.

Nursing students faced some learning loss during the COVID-19 pandemic due to the transition to virtual classes, inadequate communication, and reliance on virtual clinical training as a prerequisite for clinical practice. Therefore, to investigate the learning loss among students, a paired-sample *t*-test was used to determine the differences between the pre- and post-intervention learning loss scores (Table 3). The higher the score, the lower the learning loss among nursing students. The learning loss scores after the intervention were higher than those before the intervention. There was also a significant increase in nursing knowledge ($p < .001$), nursing professional skills ($p < .001$), and nursing professional attitudes ($p < .001$) after the SBL, indicating that the intervention was effective in ameliorating learning loss.

The second aim was to assess the confidence and satisfaction levels of nursing students before and after completing the SBL program. The post-intervention STEQ score for the intervention group was significantly higher than the pre-intervention STEQ score for the same group. Furthermore, confidence, satisfaction with

the simulation, and performance were significantly higher post-intervention ($p < .001$), indicating that the simulation training evaluation was effective. See Table 3.

Table 3

Paired Sample t*-Test Results for Learning Loss and Simulation Training Evaluation*

Variable	Pre-intervention	Post-intervention	*t*	95% CI	
	M (*SD*)	*M* (*SD*)		*LL*	*UL*
Learning loss scale	3.51 (0.64)	4.08 (0.60)	8.69	.240	.409
Nursing knowledge	3.58 (0.67)	4.09 (0.62)	7.80	.204	.388
Nursing professional skill	3.50 (0.77)	4.07 (0.66)	8.03	.237	.424
Nursing professional attitude	3.46 (0.69)	4.06 (0.65)	4.77	.250	.442
Simulation training evaluation	3.45 (0.80)	3.92 (0.82)	6.66	.177	.345
Confidence	3.40 (0.85)	3.92 (0.90)	6.12	.190	.393
Expectations/Satisfaction	3.70 (0.80)	4.01 (0.84)	6.69	.095	.258
Performance	3.31 (0.84)	3.86 (0.85)	6.66	.213	.416

Note. $N = 102$. $p < .001$, CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

An independent samples *t*-test was performed on the data with a 95% confidence interval (CI) for the mean difference between the intervention and control groups (see Table 4). The results revealed a statistically significant difference between the mean values of the two unpaired groups. Nursing knowledge in the intervention group ($M = 4.09$, $SD = 0.62$; $t = 3.676$, $p < .001$) was significantly higher than that in the control group ($M = 3.74$, $SD = 0.62$). This indicates that the SBL program helped nursing students improve their knowledge of patient safety and nursing procedures. Moreover, nursing professional skill competencies ($M = 4.07$, $SD = 0.66$) and professional attitudes ($M = 4.066$, $SD = 0.65$) were significantly higher in the intervention group than in the control group ($p < .001$). Students' confidence ($M = 3.93$, $SD = 0.90$), expectations/satisfaction ($M = 4.01$, $SD = 0.84$), and performance ($M = 3.86$, $SD = 0.84$) were significantly higher in the intervention group ($p < .001$) compared to the control group.

Table 4

Comparison of Differences in Learning Loss and Simulation Training Evaluation

Variable	Control		Intervention		*t*	*p*	95% CI	
	M	*SD*	*M*	*SD*			*LL*	*UL*
Learning loss	3.58	0.58	4.08	0.60	5.44	< .001	.670	.313
Nursing knowledge	3.74	0.62	4.09	0.62	3.67	< .001	.539	.162
Nursing professional skills	3.56	0.72	4.07	0.66	4.86	< .001	.714	.302
Nursing professional attitude	3.44	0.70	4.06	0.65	5.98	< .001	.821	.414
STEQ	3.47	0.67	3.94	0.82	4.06	< .001	.698	.241
Confidence	3.34	0.77	3.93	0.90	4.58	< .001	.854	.340
Expectations & satisfaction	3.80	0.68	4.01	0.84	1.837	< .05	.451	.016
Performance subscale	3.27	0.79	3.86	0.84	4.720	< .001	.844	.346

Note. Control group $n = 75$. Intervention group in the learning loss category $n = 102$; Intervention group in the STEQ category $n = 101$. CI = confidence interval; *LL* = lower limit; *UL* = upper limit; STEQ = simulation training evaluation questionnaire.

An independent samples *t*-test and one-way analysis of variance (ANOVA) were used to determine the association between learning loss and sociodemographic characteristics. The results revealed that neither learning loss ($p > .05$) nor its subscales (nursing knowledge, nursing professional skills, and nursing professional attitudes) were associated with any demographic factors. The results also revealed that the STEQ scores were not associated with sociodemographic factors ($p > .05$), indicating that participants' scores were not affected by covariates.

Pearson's correlation *r* was used to determine the relationship between the learning loss and simulation training evaluation subscales. Results are shown in Table 5. Nursing knowledge was significantly correlated with nursing professional skills ($r = .658$, $p < .01$), nursing professional attitude ($r = .737$, $p < .01$), confidence ($r = .432$, $p < .01$), satisfaction with the simulation ($r = .371$, $p < .01$), and performance ($r = .461$, $p < .01$). Further, nursing professional skills were significantly correlated with nursing professional attitudes ($r = .799$, $p < .01$), confidence ($r = .442$, $p < .01$), satisfaction with simulations ($r = .31$, $p < .01$), and performance in applying nursing procedures ($r = .503$, $p < .01$). Nursing professional attitudes were significantly correlated with confidence ($r = .482$, $p < .01$), satisfaction ($r = .291$, $p < .01$), and performance ($r = .498$, $p < .01$). In sum, all learning loss subscales were significantly correlated with the STEQ subscales ($p < .01$).

Table 5

Pearson Correlation Matrix for Learning Loss and Simulation Training Evaluation Subscales

Subscale	*n*	1	2	3	4	5	6
1. Nursing knowledge	177	–					
2. Nursing professional skills	177	.658*	–				
3. Nursing professional attitude	177	.737*	.799*	–			
4. Confidence	176	.432*	.442*	.482*	–		
5. Expectations/Satisfaction	176	.371*	.310*	.291*	.761*	–	
6. Performance	176	.461*	.503*	.498*	.845*	.761*	–

**$p \leq .01$.

Multiple linear regression was used to examine the relationship between learning loss and demographic characteristics (i.e., weeks in internship, age, number of semesters in distance education). The regression model was significant: $F(3.50) = 4{,}865$, $p = .005$, $R^2 = .226$. Age and weeks in internship were found to be significant predictors of learning loss (Table 6). Number of semesters in distance education did not have any significant impact on learning loss ($\beta = .39$, $p > .05$).

Table 6

Multivariable Linear Regression for Learning Loss

Demographic characteristic	Unstandardized coefficients		Standardized coefficients	*t*	*p*
	B	*SE*	Beta		
Constant	10.543	.960		10.983	< .001
Age[a]	-1.356	.605	-.280	-2.243	.029*
Number of semesters with distance education	.390	.205	.241	1.909	.062
Number of weeks in internship program	.136	.061	.284	2.246	.029*

Note. [a] Age = 20–22 years vs. 23–26 years.

* $p < .05$

Discussion

The findings showed a substantial learning loss, considering the pre-intervention level of knowledge, skills, and attitude. These findings are consistent with previous studies that examined nursing students' perceptions of COVID-19's impact on their education and the challenges they faced during the pandemic (Angasu et al., 2021; Diab & Elgahsh, 2020; Smith et al., 2021). Evidence has shown that COVID-19 adversely affected theoretical and practical experiences among nursing students and prompted a transition to virtual education during the pandemic (Ilankoon et al., 2020; Kim et al., 2021).

The current study showed that the SBL intervention effectively mitigated learning loss and significantly improved student scores in knowledge, attitude, and performance skills. These results are similar to previous studies (Aqel & Ahmad, 2014; Gates et al., 2012; Haukedal et al., 2018). In Iran, a randomized clinical trial examining the impact of SBL on nursing students found substantial increased knowledge and performance in adult life support cardiopulmonary resuscitation, both immediately and 3 months after intervention (Habibli et al., 2020).

The findings of this study showed high levels of expectations/satisfaction and increased confidence and performance among nursing students who had access to SBL. These findings are consistent with those of previous research (Al Khasawneh et al., 2021; Alsalamah et al., 2022; Demirtas et al., 2021; Omer, 2016; Saied, 2017; Zapko et al., 2017). Moreover, Alharbi & Alharbi (2022) conducted a cross-sectional study in Saudi Arabia involving nursing students and found that they reported high levels of satisfaction and confidence after participating in human patient simulation experiences.

In the current study, the intervention group also demonstrated significantly higher nursing professional skill competencies and confidence than the control group. These results were consistent with previous studies (Arrogante et al., 2021; Azizi et al., 2022; Demirtas et al., 2021; Hsu et al., 2014; Mariani et al., 2017; Pol-Castañeda et al., 2022). Previous researchers reported that 85.6% of nursing students successfully acquired nursing competencies to effectively manage the reversible causes of cardiac arrest through clinical simulations (Arrogante et al., 2021). A mixed-method study involving 179 nursing students examined the impact of simulation on the six rights of medication administration, revealing that compliance with the six Rs improved, except for data documentation, which decreased from 54.8% to 45.8%. The students expressed their satisfaction with SBL, stating that it provided a realistic experience of healthcare practice (Pol-Castañeda et al., 2022).

Our study also highlighted the positive impact of SBL on nursing students' expectations. Significant differences were observed pre- and post-intervention, indicating a shift in the students' perceptions of learning through SBL and their anticipation of the learning environment. Our findings are consistent with those of earlier research involving medical students and anesthesia residents (Keskitalo & Ruokamo, 2016). Previous research revealed that actual experiences with SBL surpassed initial expectations, as revealed by significant differences in pre- and post-intervention questionnaire mean scores; students' expectations and experiences were positive.

Our results revealed a significant correlation between components of learning loss and simulation training. Mohsen et al., (2023) reported a significant positive correlation between nurses' total knowledge and practice scores immediately after the educational program and follow-up. However, a study assessing the impact of education programs on defibrillation cardioversion found no significant relationship between knowledge and practice (Ahmed et al., 2019).

Furthermore, we found a positive correlation between nurses' attitudes and their clinical performance. Our findings were consistent with those of other studies (Alias & Ludin, 2021; Nagy et al., 2022). For example, a cross-sectional study revealed a positive and strong association between participants' attitudes and practice (Alias & Ludin, 2021). Our study also revealed a significant positive correlation between nursing

knowledge and confidence. Similarly, a descriptive correlational study conducted among 114 nurses revealed a positive relationship with nurses' attitudes (Mattar et al., 2015).

Our findings highlighted age and internship duration as significant predictors of learning loss. This finding is inconsistent with the evidence in the literature, which states that nursing students' competence is shaped by internship experience and age. Increasing age, along with additional training during internships, enhances confidence and self-directed learning readiness (Aboshaiqah et al., 2018; Alkorashy & Abuassi, 2016; Numminen et al., 2013). Similarly, Shinnick et al., 2012 ruled out age as a predictor of knowledge.

Implications, Strengths, and Limitations

This study is novel in that it examined learning loss among nursing students following a pandemic, while also exploring self-confidence, expectations/satisfaction, and students' performance with simulation training post-COVID-19. However, the study limitations include an incomparable sample of the intervention and control groups, absence of randomization, and lack of follow-up knowledge retention assessment. However, quasi-experimental studies offer valuable insights despite such limitations, and future research should consider measuring knowledge retention over an extended period.

The findings confirmed the effectiveness of integrating simulation as an educational strategy as it improved nursing students' confidence, expectations/satisfaction, and performance in the intervention group. These findings provide a basis for developing guidelines for implementing SBL in nursing education. Continuous evaluation and improvement of SBL programs are recommended to maximize the benefits of these pedagogical approaches and enhance the overall learning experience. To equip students for success in the clinical field and to bridge the gap between theory and practice, nursing schools must prioritize essential competencies that foster critical thinking and ensure students' competence as nurses.

Conclusion

This study highlighted the effectiveness of simulation interventions in enhancing various aspects of nursing students' development, including knowledge, professional attitudes, professional nursing skills, confidence, expectations/satisfaction, and performance. Our examination of these aspects has generated novel and significant findings that hold implications for nursing education not only in Saudi Arabia but also in international contexts. The integration of immersive simulation-based activities with traditional learning has proven to be an effective approach to address educational disruptions caused by crises, thereby preparing students for future crisis scenarios. This study has broader implications beyond Saudi Arabia, particularly in light of global uncertainties and crises such as pandemics. The insights gained from this study can guide nursing education practices worldwide.

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