

The Effect of Evidence-Based Education on Nursing Students' Clinical Decision-Making

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Abstract

Background The complexity of legal, professional, and educational issues requires that nurses acquire sufficient skills to make clinical decisions. Clinical decision-making represents a fundamental process in determining the most effective course of action to achieve the desired therapeutic outcomes. Therefore, this study was conducted to determine the effect of evidence-based education on the clinical decision-making of nursing students.

Methods This quasi-experimental investigation was conducted in 2021 at the Nursing and Midwifery Faculty of Urmia University of Medical Sciences. In this research, a total of 60 nursing students were enrolled through census sampling and were evenly divided into two groups: an intervention group ($n = 30$) and a control group ($n = 30$). Data were collected at three distinct time points: before the intervention, one week, and one month post-intervention, using a demographic questionnaire and the Clinical Decision-Making in Nursing Scale. Nursing students in the intervention group participated in six two-hour sessions focused on evidence-based nursing education, whereas those in the control group did not receive any intervention.

Results An analysis comparing the mean clinical decision-making scores between the intervention and control groups across various time points revealed that, before the intervention, the average clinical decision-making scores in the two groups were the same ($p = 0.317$). Nevertheless, a statistically significant difference emerged in the mean scores for clinical decision-making one week ($p < 0.001$) and one month after the intervention in the two groups ($p < 0.001$).

Conclusion Findings suggest that Evidence-based nursing education was associated with increased clinical decision-making skills, leading to potential improvements in quality and safe patient care. Teaching this skill to nursing students promotes the identity and independence of the profession among nurses, in addition to the benefits it provides to patients.

Keywords Clinical Decision Making, Education, Evidence-Based Nursing, Nursing

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1 Introduction

The rapid change of the healthcare environment places significant pressure on nurses in clinical settings. How nurses make decisions in this environment has important implications for patient care outcomes.^[1] Expert nurses approach the care of specific patients with a deeply ingrained understanding of what is good and right, and a vision for what makes exquisite care.^[2] Clinical judgment outcomes include clinical judgment ability, safe nursing practice, quality of nursing care, and patient safety.^[3] The dynamic and often high-stakes nature of healthcare environments means that ineffective or erroneous clinical decisions can have immediate and serious consequences for patient well-being.^[4]

Clinical decision-making represents a sophisticated cognitive process aimed at selecting the optimal action to achieve the desired outcome, with its efficacy enhanced by the availability of multiple patient care options. This intricate function augments nurses' expertise within the nursing discipline and facilitates connections to relevant resources. It requires changing information and working in a supportive environment.^[5] Analytical and intuitive decision-making are on two sides of the decision-making spectrum. Analytical decision-making starts with collecting data, making a hypothesis about what might happen, and carrying out the process of collecting and processing data until an exact decision is made, while intuitive decision-making is determined as comprehension without reason.^[6] The phases of the clinical decision-making process align closely with the stages of the nursing process, so the decision-making stages also begin with the examination and collection of information about the problem and end with the evaluation.^[7]

Accurate and timely decision-making by nurses is crucial, as it accelerates patient care processes and helps control treatment costs.^[8,9] The experience of researchers in this regard indicates that the correct and timely decisions of nurses, in addition to the cases mentioned above, will facilitate and increase the proper use of human resources, materials, and equipment, and will improve the quality of care.^[10] Conversely, the absence of prompt and accurate decision-making by nurses in healthcare facilities poses a significant risk to community health.^[8,9] According to several studies, approximately 34% of incidents occurring in UK hospitals are attributed to incorrect decision-making by nurses. Of these cases, 6% of patients suffer permanent disabilities, and 8% result in death. Notably, timely decision-making by nurses could have prevented half of these deaths.^[11]

Considering the mission of nursing schools and enabling nursing students to accept the central roles of the nursing profession, the development of clinical decision-making skills essential for delivering quality care should begin

during the student training period. In this regard, the final goal of the curriculum is to create the ability to provide basic care and the correct implementation of the nursing process.^[12] Nurses and nursing students must have the ability to make independent decisions, and the realization of these goals is helped by using research evidence in clinical care.^[13] A key factor contributing to this challenge is the theory-practice gap, where students struggle to integrate academic knowledge with the nuanced demands of real-world patient situations.^[14] In response to this, evidence-based education (EBE) has emerged as a pivotal pedagogical strategy, designed to equip students with the skills to critically appraise and apply the best available evidence to their clinical reasoning.^[15] While EBE is widely endorsed, there is a need for more robust empirical evidence quantifying its specific impact on the development of clinical decision-making (CDM) skills in pre-licensure nursing students.^[16] This inherent complexity is particularly challenging for nursing students, who must transition from theoretical knowledge to competent practice amidst these demanding clinical realities.^[17]

EBE fosters critical thinking in nursing students by actively engaging them in the process of questioning assumptions, appraising diverse sources of knowledge, and making informed judgments based on current scientific evidence.^[18] Structured educational interventions based on EBE have repeatedly demonstrated enhanced acquisition and retention of critical care and clinical decision-making skills^[19] and fostered deeper engagement, cognitive involvement, and knowledge integration in students.^[20] The stages of evidence-based nursing include: turning the clinical situation into a question with a structure and answer, searching for studies to determine the best evidence to answer the question, accurately evaluating the evidence in terms of scientific trust, and using the evaluation results in clinical practice.^[21]

Presumably, the current teaching methods during nursing education are not effective in the development of this skill in nursing students. Researchers suggest that, alongside traditional nursing education methods, alternative approaches such as evidence-based education should be employed to enhance the clinical decision-making skills of nursing students.^[22] The choice of educational method in this intervention was informed by meta-analytic and experimental research showing that blended and active-learning strategies are superior to traditional lectures in promoting long-term retention of evidence-based competencies.^[23-25]

By implementing evidence-based care, effective steps can be taken to increase patients' satisfaction, improve their sense of self-efficacy and empowerment, improve nurses' professional identity, and carry out effective interventions.^[26] Unfortunately, despite its proven effectiveness, the

utilization of evidence-based approaches remains limited.^[27] In a separate study, it was determined that only 38% of nursing services were grounded in research evidence.^[28] In Melnyk et al.'s study, nurses believed that the quality of patient care would increase if clinical practices were based on research evidence. However, only 46% of nurses based their clinical practice on research evidence.^[27] Also, more than 64% of 1486 nurses working in two public hospitals in Singapore had a positive attitude about the role of evidence-based practice in nurses' clinical decision-making, but the work pressure prevented them from keeping up-to-date.^[29] Lack of time and information is one of the reasons why nurses do not use evidence-based care.^[30]

Numerous recent studies have investigated both the challenges and the effectiveness of educational interventions in this area in Iran. For instance, research shows that while traditional teaching approaches often result in insufficient practical and critical thinking skills, the use of active, student-centered methods—such as task-based learning, Situation, Background, Assessment, and Recommendation (SBAR) protocol training, and social problem-solving training—significantly enhances nursing students' knowledge, self-efficacy, and CDM abilities, as demonstrated in multiple Iranian educational settings.^[31–33] Qualitative and survey-based studies further reveal systemic barriers, including inefficient curricula and limited professional development opportunities, calling for ongoing curricular reforms and the integration of modern teaching methods to address these gaps.^[34,35] Jalali-Nia et al.'s study on nursing students showed that evidence-based nursing education affected nursing students' attitudes but not their awareness.^[36] Collectively, these findings substantiate the relevance of investigating new pedagogical strategies for improving clinical decision-making among Iranian nursing students." Accordingly, this study sought to assess the impact of an evidence-based educational intervention on the clinical decision-making abilities of nursing students.

2 Methods

Study design & setting

This quasi-experimental study examined the effect of evidence-based nursing education on the clinical decision-making of nursing students at the Nursing and Midwifery Faculty of Urmia University of Medical Sciences in 2021.

2-2: Participants and sample size

The study included 60 undergraduate nursing students in their fourth year (among 63 fourth-year students) studying at Urmia University of Medical Sciences in Northwest Iran, and a census sampling method was

used. Then, by tossing a coin, seventh-semester nursing students were assigned to the intervention group and the eighth-semester nursing students to the control group. Three students were unwilling to participate in the study (two from the intervention group and one from the control group). As participants were not randomly assigned to these groups, the study design is classified as quasi-experimental.

Inclusion and exclusion criteria

The inclusion criteria were students enrolled in the regular nursing curriculum with no evidence-based courses, and who volunteered to participate in the study. The exclusion criteria were students who transferred from other schools.

Data collection

Data were collected using a Demographic Information Form and Clinical Decision-Making in Nursing Scale (CDMNS). The research team prepared the demographic information form, which includes age, gender, and grade point average.

CDMNS consists of 40 statements divided into four subscales. Each item is answered on an ordinal scale of frequency that varies from 1–5 (1–Never; 2–Rarely; 3–Occasionally; 4–Frequently; and 5–Always) and filled in by participants themselves. The global score ranges from 40 to 200, from 10 to 50 for each subscale. Higher scores were interpreted as positive perceptions about DM, while lower ones were seen as indicative of less favorable perceptions of DM.^[37]

CDMNS is an instrument validated and translated cross-culturally for many countries. In the original study, which was elaborated and validated for nursing students in the state of Virginia ($n = 111$) in the United States, it was assessed by a panel of nurse experts and a pretest that was used to establish validity. The Cronbach's Alpha for the set of items in the instrument was 0.830, while values and correlations per item varied from 0.360 to 0.570.^[37] The confirmatory factorial analysis of this questionnaire showed that the adjustment of the factorial structure has good quality, being made up of three factors ($X^2/df = 2.056$; $GFI = 0.927$; $CFI = 0.917$; $RMSEA = 0.046$; $RMR = 0.039$; $SRMR = 0.050$). For the scale to be reliable, it had to include only the reliability of the scale required, meaning it consisted of 23 items, with correlation values ranging from 0.184 to 0.610, and a global Cronbach's Alpha of 0.851, which demonstrated its good reliability.^[38] The reliability and validity of this questionnaire were measured in 2012 in Turkey. To check the content validity, the questionnaire was confirmed with several nursing experts, and its reliability was also confirmed with Cronbach's alpha of 0.78.^[39]

In Iran, to examine the content validity, the questionnaire

was given to 10 faculty members of Tabriz University of Medical Sciences. The team comprised six master's degree holders in internal-surgical nursing, two PhD holders in nursing, and two PhD holders in educational sciences. After receiving the comments, necessary amendments were made, and then the final questionnaire was examined for reliability. In this study, Cronbach's alpha coefficient (0.82) was used to determine reliability.^[40] Also, the validity and reliability of this questionnaire were conducted by Beighi et. al in Shiraz in 2015 using the face validity method. The working method was that after translating the questionnaire from English to Persian, the translated version was provided to 10 professors at Shiraz School of Midwifery and Nursing for review. After collecting the expert opinions of these members, the Persian text of the questionnaire was approved by eminent professors of the English language and then translated back into English to ensure the similarity between the translated version and the original version. Also, to check the reliability of the questionnaire, the questionnaire was given to 30 students of Shiraz School of Nursing and Midwifery, and after completing the questionnaires and collecting them, Cronbach's alpha was reported as 82%.^[41] In Ramazani Badr and Shaban's study, the validity and reliability of the Jenkins questionnaire have been measured. For this purpose, content validity has been used. Faculty members of Tehran, Shahid Beheshti, and Iran Universities have been surveyed. Also, the validity of this questionnaire was established using the internal consistency method (by dichotomizing the questions). To assess reliability, the split-half correlation coefficient for each questionnaire was first calculated, followed by the computation of the overall reliability coefficient using the Spearman-Brown prediction formula, yielding values of 0.80 and 0.88, respectively.^[42]

Intervention

After obtaining permission from the Ethics Committee of Urmia University of Medical Sciences, sampling began. The target population was made up of all fourth-year nursing students at Urmia University of Medical Sciences, Urmia, Iran. First, a list of fourth-year nursing students who had met the inclusion criteria ($n = 63$) was prepared, and a census sampling method was used. Through a random coin-toss method, nursing students in their seventh semester were allocated to the intervention group, while those in their eighth semester were assigned to the control group. Three individuals opted not to participate in the research, with two from the intervention group and one from the control group. A total of 60 nursing students then entered the study. To prevent contamination, Participants in both groups were explicitly informed of the importance of not sharing study-related information, and a confidentiality agreement was signed to reinforce this protocol.

The research team randomly assigned nursing students in the intervention group into two subgroups of 15 participants each, and subsequently engaged in interactive dialogue to explore the principles of evidence-based education, ultimately enhancing the quality of their educational experience, and then received six two-hour sessions of theoretical and practical evidence-based education (one session a week) from researchers. At the same time, no education was provided for the nursing students in the control group. The educational intervention was performed in classes equipped with online computers, so that an educational scenario was first prepared and then presented using a problem-solving-based approach (Table 1 and Table 2).

The educational content consisted of materials on searching for nursing resources, identifying the correct resources and evidence, searching in various paper-based and electronic resources, selecting and evaluating accurate resources, and applying the research results. Nursing students in the intervention group were also trained on how to search databases. Then, the PICO (Population, Intervention, Comparison, and Outcome) framework was utilized to formulate the questions. Population/Patient: What is the patient's problem? Intervention/ Index: What is the main treatment? Comparator/Controller: Is there any alternative to the treatment? Result: What is the main result? Is it what the patient desires?

CDMNS was recompleted one week and one month after the intervention by the nursing students in both groups. After the completion of the study, the content of the training sessions was provided to the control group nursing students in the form of compact discs, with optional online training sessions offered upon their request.

Data analysis

Data analysis was performed utilizing SPSS 16 software, employing descriptive statistical measures, including mean and standard deviation, to characterize the data. To compare the average score of clinical decision-making before and after training, paired t-tests and an independent t-test were used to compare the two groups. The repeated measures analysis of variance (rANOVA) was used to evaluate the effect of the evidence-based education intervention on nursing students' clinical decision-making outcomes. P-values of less than 0.05 were considered significant.

Ethical considerations

This research was conducted after obtaining permission from the Ethics Committee of Urmia University of Medical Sciences, with the Code of Ethics (IR.UMSU.REC.1399.299), and in coordination with the Nursing and Midwifery Faculty of Urmia University of Medical Sciences in 2021.

Table 1 Content of the sessions of evidence-based education

Session No.	Content
1st week (1st session)	Introducing oneself to participants, familiarizing group members with research objectives, providing general information about the intervention program (specifying time, place, and length of educational sessions), explaining the rules and regulations, filling in the questionnaires, taking a pre-training scenario-based test, defining and explaining evidence-based education, and posing some questions for discussion
2nd week (2nd session)	Familiarizing group members with the use of evidence-based education and its impact on clinical decision-making
3rd week (3rd session)	Reviewing the content of the previous session, reviewing the articles, familiarizing group members with different sections of an article and different types of intervening variables, and reviewing several hemodialysis-associated articles
4th week (4th session)	Reviewing the content of the previous session, educating the PICO format, getting acquainted with various databases and the way to search for articles in each of them, changing and rewriting the clinical problem in the form of searchable and answerable questions, and getting to know the meaning of operators “AND” and “OR” When searching in databases
5th week (5th session)	Reviewing the content of the previous session, providing a scenario, and finding the answer to the scenario based on the most up-to-date evidence, practicing and repeating the answers with members, and educating how to find the best evidence in the shortest time
6th week (6th session)	Reviewing the content of the previous session, designing a clear clinical question based on the patient’s problem, finding the answer to the question by searching databases, practicing and evaluating group members to ensure they are learning appropriately, re-conducting the scenario-based test after the completion of the intervention, summarizing the whole content, and acknowledging the group members

PICO: Population, Intervention, Control, and Outcomes

Table 2 Sample scenario

How fast can a patient be transfused during hemodialysis?	
Evaluation	This issue is very important because giving blood too quickly can have devastating consequences. The literature search did not reveal any current standard policies for the implementation of blood transfusions. No national or local standards were found.
Question	A focused question was created using the PICO (Patient or Population Problem, Intervention, Comparison, and Outcomes) format. Is there a standard, evidence-based approach used by hemodialysis nurses when transfusing blood products during hemodialysis? And does it ensure patient safety?
Search	A review of authoritative and up-to-date articles is conducted to find the answer. - To search for relevant articles, first, the user is asked to refer to the PubMed database, and a search for Blood transfusion rate in hemodialysis patients will yield 406 articles. Then, the user is asked to limit the search to articles from the last 5 years, which leaves 80 articles. Again, the user is asked to limit the search to free articles, which leaves 38 articles. We conclude by reviewing the remaining articles. -RBC transfusion during hemodialysis requires several procedural modifications based on current evidence: • Blood transfusion should be administered using an infusion pump to avoid excessive transfusion rates. • The infusion rate should be set at 60–180 mL/h. 15–45 mL should be infused over 15 minutes. Approximately 85% of all transfusion reactions occur in the first 15 minutes.
Evaluation	Is there enough reliable evidence to change practice? The work should be reviewed from reputable journals, current international data, and books. Outstanding information is extracted and incorporated into the development of the procedure.
Selection	A method is selected from the literature.

3 Results

Demographic characteristics

Participants' demographic and baseline characteristics are presented in Table 3. There were no statistically significant differences between the control and intervention groups on any measured baseline characteristics, including age ($p = 0.09$), GPA ($p = 0.40$), and gender ($p = 0.82$). This suggests the groups were equivalent at the start of the study on these key variables

To decompose the significant interaction, pairwise comparisons were conducted using Bonferroni corrections (Table 6). Within the intervention group, scores significantly increased from baseline to post-test (one week and one month after the intervention, $p < 0.001$). They were maintained at follow-up, with no significant difference between post-test and follow-up scores ($p = 1.00$). Scores in the control group showed no significant change from baseline to post-test (one week

Table 3 Comparison of quantitative and qualitative demographic characteristics between the two groups

Qualitative variables		Intervention		Control		Results of the χ^2 test
		Percentage	Frequency	Frequency	Percentage	
Gender	Male	17	40.5	16	38.1	$\chi^2 = 0.050$ df = 1 p-value = 0.823
	Female	25	59.5	26	61.9	
Quantitative variables		Mean	SD	Mean	SD	Results of the independent-samples t-test
Age		23.24	2.63	22.4	1.71	T = -1.71 df = 58 p-value = 0.09
Grade point average		16.69	2.24	16.36	1.26	T = 0.83 df = 58 p-value = 0.40

Clinical decision-making

Mean clinical decision-making scores for both the intervention and control groups at baseline, post-test, and four-week follow-up are presented in Table 4. The ANOVA revealed a significant main effect of time and a significant main effect of intervention ($p < 0.001$). Critically, there was a considerable time-by-group interaction ($p < 0.001$), indicating that the change in scores over time differed between the intervention and control groups (Table 5).

and one month after the intervention, $p = 1.00$) or from post-test to follow-up ($p = 1.00$).

4 Discussion

This study aims to find out the consequences of evidence-based nursing education on the clinical decision-making of nursing students of Urmia Faculty of Nursing and Midwifery. Based on the results, the demographic characteristics are homogeneous in the two groups

Table 4 Comparison of participants' clinical decision-making scores between the two groups at three measurement time points based on the repeated measures ANOVA

Overall mean scores of clinical decision-making	Residual sum of squares	Degree of Freedom	Mean squared error	F	P-value
Main effect of time	9440.889	2	4720.444	32.89	$P < 0.001$
Group $\times$ time interaction effect	12886.222	2	6443.111	44.893	$P < 0.001$
Error term (time)	23537.556	164	143.522		-
Main effect of the intervention	36600.671	1	36600.671	57.708	$P < 0.001$
Error term (intervention)	52007.183	82	634.234		-

Table 5 Mean scores of clinical decision-making in the control and intervention groups at three measurement time points

Mean scores of clinical decision-making		Frequency	Mean	SD
Before the intervention	Intervention	30	138.19	13.50
	Control	30	134.30	21.01
One week after the intervention	Intervention	30	166.76	14.92
	Control	30	132.21	18.49
One month after the intervention	Intervention	30	165.90	22.05
	Control	30	132.02	12.93

Table 6 Binary comparisons of participants' clinical decision-making scores at three measurement time points based on the Bonferroni test

Group	Measurement time point	Mean difference	Standard Error	P-value
Intervention	Before and 1 week after the intervention	-28.57	2.58	$p < 0.001$
	Before and 1 month after the intervention	-27.71	3.20	$p < 0.001$
	1 week and 1 month after the intervention	0.86	1.91	1/ 000
Control	Before and 1 week after the intervention	2.10	2.58	1/ 000
	Before and 1 month after the intervention	2.29	3.20	1/ 000
	1 week and 1 month after the intervention	0.19	1.91	1/ 000

(control and intervention). The findings of this quasi-experimental study suggest that the EBE intervention was associated with a significant and sustained improvement in clinical decision-making skills among nursing students. The observed interaction effect, where the intervention group demonstrated substantial improvement while the control group did not, aligns with the growing body of literature advocating for the integration of EBE principles into nursing curricula to bridge the theory-practice gap. In a study by Camargo et al. in 2017 in Brazil evaluating the outcomes of evidence-based methods on the attitude, motivation, and ability to comprehend research among all nursing managers, the results indicated that workshops focused on evidence-based practices—particularly the importance of seeking information and integrating scientific evidence—significantly enhanced the ability of nursing leaders to provide better care in a teaching hospital.^[43] These findings align with the results of the current study, reinforcing the positive impact of evidence-based approaches on nursing leadership and care quality. In a cross-sectional study conducted by Hansen et al. in Denmark in 2019 to assess the decision-making competence of nurses and doctors regarding the continuation of patient resuscitation, the results showed that nearly one-third of the nurses and doctors lacked the competence to decide when to end resuscitation. This lack of competence in decision-making exists in both experienced and less experienced nurses and doctors, and it was considered essential to follow the provided instructions^[44] consistently. This study, consistent with the present research, highlighted the necessity of evidence-based methods—particularly the importance of considering multiple options when making final decisions. Madarshahian et al. conducted a quasi-experimental study at Birjand University of Medical Sciences in 2009 to assess the effects of evidence-based clinical education on the quality of patient care. The findings revealed that evidence-based training in nursing clinical care is not only as effective as conventional methods but also enhances nurses' knowledge, skills, and the overall quality of care provided.^[45] In this study, the effect of evidence-based education on the degree of awareness, the search for different care methods, and the

improvement of the quality of care was investigated, and it was consistent with the present study.

In 2009, Karimi et al. conducted a descriptive-cross-sectional study at Sabzevar University of Medical Sciences to compare critical thinking and clinical decision-making of nurses and nursing students. The results showed that a continuous training program should be considered to increase the decision-making skills of nurses.^[46] This study, as well as our own, showed the importance of evidence-based performance training, particularly in paying attention to values and goals.

Nouhi et al. conducted a semi-experimental study in 2012 to investigate the impact of evidence-based nursing education on improving the clinical decision-making of nurses at Kerman University of Medical Sciences. The comparison of evidence-based clinical decision-making ability in the intervention group before and after the workshop revealed a statistically significant difference, indicating an improvement in the clinical decision-making level of the participants. To improve the performance of nurses in clinical decision-making,^[35] the findings of this study, like the present study, showed the desirable effects of evidence-based nursing education in improving the clinical decision-making of nurses.

Another semi-experimental study in 2012 by Habibzadeh et al. aimed to determine the effect of evidence-based nursing education on students' nursing process implementation skills. The results showed that evidence-based nursing education, due to the strengthening of critical thinking and the development of creativity, leads to improved skills in implementing the nursing process among students more than the conventional method.^[47] This study also aligns with the findings of the present research, which confirms the elements of clinical decision-making, including attention to value and purposes.

Shahraki et al. also prepared a descriptive study in 2017 to measure the decision-making status of nurses working in critical care sectors of teaching hospitals. According to the results of this research, it was found that the involvement of nurses in all phases of clinical decision-making was at an average level, and nursing education programs were not effective in improving nurses'

clinical decision-making skills. Therefore, continuous education programs should be used to improve nurses' clinical decision-making.^[48] This study also showed the importance of evidence-based nursing education on nurses' decision-making, searching for different care methods, and, as a result, improving the quality of patient care, in line with the present study. The findings from the aforementioned studies were entirely consistent with the outcomes of the present investigation.

Following the implementation of the intervention, students' average scores in clinical decision-making significantly improved. This indicates that evidence-based nursing education positively influences the development of clinical decision-making and critical thinking skills among nursing students.

Research limitations

The most significant limitation is its quasi-experimental design. The use of pre-existing groups (consecutive academic semesters) instead of random assignment of individual participants introduces a high risk of selection bias and threatens the internal validity of the study. Although we statistically confirmed that the groups were equivalent on key measured baseline characteristics (see Table 3), it is possible that unmeasured confounding variables existed between the semester groups, which could explain the observed differences in outcomes. For example, differences in instructional quality between semesters, variations in clinical placement experiences, or exposure to external educational resources could have influenced the results independently of the intervention. Other limitations include the single-center nature of the study, which may limit the generalizability of the findings to other institutions or cultural contexts. Furthermore, the use of a self-reported outcome measure for clinical decision-making may be subject to social desirability bias. While we attempted to mitigate this with a validated instrument, future research could benefit from more objective measures of clinical performance, such as direct observation or standardized patient evaluations. Finally, the lack of long-term follow-up beyond four weeks limits our understanding of the sustained impact of the evidence-based education intervention. It is unclear whether the improvements in clinical decision-making would be maintained throughout the students' academic and clinical careers.

5 Conclusion

In conclusion, the results of this study provide supporting evidence that an evidence-based education intervention can effectively enhance clinical decision-making skills in nursing students. The significant and sustained gains observed in the intervention group are promising and highlight the potential value of such pedagogical

strategies. However, these findings must be interpreted in light of the study's limitations, including its quasi-experimental design and single-center setting. Future research utilizing randomized controlled trials is needed to establish causality and generalize the findings. Notwithstanding these limitations, this study contributes to the evidence base for innovative educational methods that prepare nursing students for the complexities of modern clinical practice.

Drawing on the results and limitations of this quasi-experimental study, several directions for future research are proposed to further clarify the effects of evidence-based education on the clinical decision-making skills of nursing students. Initially, implementing a randomized controlled trial is recommended to establish a causal relationship. Second, future studies should incorporate long-term follow-up assessments (e.g., six months, one year post-graduation) to determine whether the improvements in clinical decision-making are sustained in clinical practice. Our study only measured outcomes up to a four-week follow-up; a more extended timeline would assess the actual translational impact of the educational intervention on patient care and safety. Third, to enhance the external validity of our findings, this intervention should be replicated in a multi-center study across different nursing schools with diverse student demographics and curricular structures.

Declarations

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Artificial Intelligence Disclosure

The authors confirm that no artificial intelligence (AI) tools were used in the preparation of this manuscript.

Authors' Contributions

Farideh Namadi, Shima Yadegar, and Parisa Ghodsi contributed to the investigation, data gathering, and manuscript draft preparation. Farideh Namadi and Shima Yadegar contributed to manuscript draft preparation and revision. Leyla Alilu and Farideh Namadi provided expertise and revised key sections of the study.

Availability of Data and Materials

The data supporting this study's findings are available from the corresponding author upon reasonable request.

Conflict of Interest

There is no conflict of interest in the present study.

Consent for Publication

Not applicable.

Ethical Considerations

This research was conducted after obtaining permission from

the Ethics Committee of Urmia University of Medical Sciences, with the Code of Ethics (IR.UMSU.REC.1399.299), and in coordination with the Nursing and Midwifery Faculty of Urmia University of Medical Sciences in 2021.

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