http://medicaleducation-bulletin.ir
Review Article (Pages: 703-713)

Comparison the Effect of Paper-based and Electronic Nursing Processes in Clinical Decision-making Skills of Nursing Students

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Abstract

Background: The nursing process is a way to develop medical students' clinical decision-making skills and can be implemented on paper and electronically. The present study aimed to compare the effect of paper-based and electronic nursing processes in the clinical decision-making of nursing students.

Materials and Methods: This quasi-experimental study was carried out on 64 nursing students who were randomly classified into paper-based and electronic groups. The students were undergoing internships in the neurology and thorax departments of Ghaem Hospital in Mashhad, Iran. The intervention was comprised of a training workshop on the nursing process for the two groups. The participants were then asked to implement the nursing process using two methods (paper-based vs. electronic) for two weeks during the course. Every student was assigned to a patient daily and performed the nursing process after examining the patient according to their groups. Students were monitored during the process, and Luari's clinical decision-making questionnaire was used before and after intervention in the two groups.

Results: 64 nursing students in equal group were participants. Clinical decision-making scores of the paper-based and electronic groups before and after intervention were 65.5 ± 3.2 vs. 63.3 ± 3.4 (range: 24-120), and 72.0 ± 9.2 vs. 78.8 ± 11.0, respectively. It means 9.9% and 24.2% improvements in the paper-based and electronic groups, indicating significant changes ($p<0.05$).

Conclusion: The students' clinical decision-making was improved considerably higher in the electronic group. The results showed that the electronic method facilitated the implementation of the nursing process and improved clinical decision-making skills and is thus suggested in teaching the nursing process.

Key Words: Clinical decision-making, Iran, Nursing process, Nursing, Student.

*Please cite this article as: Rajabpoor M, Sharafi S, Mazloum SR, Heshmati Nabavi F. Comparison the Effect of Paper-based and Electronic Nursing Processes in Clinical Decision-making Skills of Nursing Students. Med Edu Bull 2023; 4(2): 703-13. DOI: **10.22034/MEB.2022.367382.1067**

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Received date: Feb. 19, 2023; Accepted date: Jun.22, 2023

1- INTRODUCTION

Clinical decision-making is a complex process that requires extensive information processing (1). In practice, clinical decision-making includes two stages: diagnosis and management. In the diagnostic phase, the patient's condition is examined, data is collected and interpreted, and the patient's problems are determined. The management phase involves planning care and interventions for the identified problems. This process is based on the knowledge of the decision-maker (2, 3). Nowadays, due to the increasing awareness of patients and the changes in care strategies, capable nurses are in demand, and nursing students should become reliable, skilled, and efficient people (4). One of the important duties of nurses is making decisions in different clinical situations, as each patient has unique characteristics, and there is no fixed solution to the problems of different patients. Therefore, nurses, especially in new situations, require to independently address responsibilities, judgment, and correct decision-making (5).

The studies on the clinical decision-making ability of nurses show that nurses have decision-making power only in normal conditions, and they mostly do not have the ability to make independent decisions in complex and uncertain cases and refer to personal experiences, doctors, or other colleagues. Therefore, independence in making decisions is lacking for the future of the nursing profession (5). A way of improving the power of correct clinical decision-making is the nursing process, as it develops the critical thinking of students and nurses (6). If the nursing performance proceeds according to the nursing process, it will lead to receiving the appropriate care in the minimum time with the maximum efficiency (7), reducing costs, correct use of human resources, materials, and equipment, and ultimately, higher quality of care (8). Some studies indicate that only 55% of the care provided in developed countries follows scientific evidence (5). In the U.S. and the Netherlands, it is estimated that 30 to 45% of patient care is not based on scientific evidence, and 20 to 25% of the care provided is unnecessary and potentially harmful (9). In Iran, the clinical decision-making level of nurses is reported to be average (5). An obstacle to the nursing process may be its implementation method. The implementation of the nursing process in the conventional (paper-based) way requires the completion of numerous forms, searching reference books, disrupting the continuity of care, and spending a lot of time and money. The availability and requiring limited facilities are the advantages of this method, but the development of the electronic system has provided more opportunities and benefits to the healthcare staff (10). Considering the limited statistics of using the nursing process, the electronic method may help implement it better in clinical settings (11).

An electronic care registration system helps expand the standardization of care (12), creating higher visibility for the components of nursing care (13-15). This system provides a valuable opportunity for nurses and nursing students to improve their clinical performance (16). The nature and importance of correct clinical decision-making (17), its weakness in nursing students (18), the undeniable benefits of implementing the nursing process (11, 19), and its limited use in clinical care (20) necessitate a comparison between different implementation methods of the nursing process in the clinical decision-making of nursing students.

As members of the healthcare team, nurses need to exchange information about the client accurately and effectively at the right time. Effective communication helps avoid redundancy and negligence in patient care. Registration and reporting are

effective methods to establish communication among the employees of healthcare centers (21). However, most nurses face problems such as lack of time, repetition of content, and worry about the incomprehensibility of recorded information. Such problems have led to the use of various methods for recording information, such as paper-based, electronic, or Subjective Objective Assessment Analysis Planning Implementation Evaluation (SOAPIE) methods (22). To the authors' knowledge, no similar study has been conducted on the impact of the electronic implementation of the nursing process on the clinical decision-making of nursing students. The present study aims to compare the effect of the paper-based versus electronic implementation of the nursing process on the clinical decision-making skills of nursing students.

2- MATERIALS AND METHODS

2-1. Study Design and Population

This quasi-experiment study with a pre-and post-intervention design was conducted on 64 undergraduate nursing students in their fifth and sixth semesters at Mashhad University of Medical Sciences (Mashhad, Iran). These students were undergoing internships in the neurology and thorax departments of Ghaem Hospital.

2-2. Method

In this study, nursing students were randomly divided into paper (n=32), and electronic (n=32) groups. The sample size was determined using the formula mentioned below during a pilot study with the participation of 20 nursing students (ten in each group) to measure the average score of clinical decision-making.

$$n= \frac{(Z_{1-\alpha/2}+ Z_{1-\beta})^2(S_1^2 + S_2^2)}{(X1 - x_2)^2}$$

Where,

$Z_{1-\alpha/2}$ (Confidence factor of 95%)=1.96,

$Z_{1-\beta}$ (The power of the test is 80%)=0.84,

S_1 (Standard deviation of clinical decision making in paper-based group) =4.7,

S_2 (Standard deviation of clinical decision making in electronic group) =5.9,

X_1 (Means of clinical decision making in the paper-based group) =75.4,

X_2 (Means of clinical decision making in the electronic group) =79.5.

2-3. Inclusion and exclusion criteria

The primary inclusion criteria were willingness to participate in the study, no independent work experience (student work, employment), and participation in the training program on the first day of the internship. The primary exclusion criterion was not completing the internship because of transfer, withdrawal, absence for more than one day, absence on the first day of the internship, and moving the internship group between the internship period in paper-based and electronic groups. The informed consent form was given to the research units to complete after providing the necessary explanations and the objectives of the study.

2-4. Intervention

The intervention involved implementing the nursing process in the paper-based or electronic form. A three-hour training workshop was conducted for each group to teach the nursing process concept and method. The training of the nursing process was similar in the two groups except for the last two hours of the program, which were dedicated to practical training. In the paper-based group, it involved the method of recording the nursing process in paper forms, and in the electronic group, it involved the method of working with the electronic software of the nursing process. This software was previously designed and evaluated by the research group and had features such as listing the nursing diagnoses based on the

priority of matching with the patient's symptoms, choosing a care plan suitable for each patient, defining a specific period to solve the patient's problems, and printing the provided care (10).

The nursing students in both groups performed the nursing process every day for one patient and a total of eight patients under their supervision during the two-week internship at the thorax or neurology department. The nursing process in the paper group involved using Gordon's patient review model, determining nursing diagnoses, and planning care. These actions were then recorded in the paper forms of the nursing process and performed on the patient afterward. The validity of the nursing process paper forms was confirmed by experts (10). In the last hour of the internship, the students of the paper-based group were asked to evaluate the actions taken for their patients and record them in the relevant part of the forms.

The patient examination method and tools were similar in the electronic group, with the difference that after the examination stage, the students entered their findings into the nursing process software. The software listed the nursing diagnoses based on the provided symptoms based on the priority of matching with the patient's symptoms, and the students could choose the nursing diagnoses applicable to their patients. After confirming the diagnoses, they selected the care for each diagnosis, which was printed and performed for the patient. The students also evaluated their actions and recorded them in the software. Researchers had close control and supervision in all stages of completing the forms or menus and implementing the nursing process between the two groups.

The post-examination took place in the last hour of the last day of the internship by measuring the ability to make clinical decisions as self-reported by the students (which is a preferred method due to the variable nature of clinical decision-making and the improbability of the correct evaluation of the clinical decision-making skills by observation).

2-4. Measuring tools: validity and reliability

2-4-1. Baseline characteristics

In the first part, the participants were asked eight demographic questions regarding age, gender, marital status, total and internship grade point average, interest in the nursing field, education stage, and awareness of the nursing process before the intervention.

2-4-2. Lauri Clinical Decision-Making Scale (23)

The Lauri Clinical Decision-making Scale (2001) contains 24 items related to clinical decision-making, in which the student rates the frequency of using each skill by marking a five-point scale similar to the Likert determinants. A score of one (never) means not using that skill, and a score of five (always) means using that skill frequently.

The score of the tool ranges from 24 to 120. A score less than 67 indicates systematic analytical decision-making, a score between 68 and 78 is the second level of decision-making (i.e., intuitive analysis), and a score above 78 indicates the third level of clinical decision-making (i.e., interpretative intuition) (23). Its content validity was confirmed by ten experts (in the fields of nursing, medical education, health education, epidemiology, and statistics). Its reliability was calculated by the retest method and using Cronbach's alpha correlation coefficient (0.82).

The second part of the clinical decision-making scale involved the Persian translation of the questionnaire of Lauri et al. in Turkey. This questionnaire was the result of an extensive literature review and

qualitative study (23), and its reliability and validity were confirmed by Javadi et al. (24). This scale has 24 items related to clinical decision-making, in which the student rates the frequency of using each skill by marking with a five-point Likert scale. The score of the questionnaire ranges from 24 to 120. A score below 67 is analytical decision-making, a score between 68 and 78 indicates intuitive analytical decision-making, and a score above 78 is intuitive interpretive decision-making (24, 25). The time required to answer this questionnaire is 10 to 15 minutes. In the present study, ten experts confirmed its content validity, and its reliability was calculated by the retest method and using Cronbach's alpha correlation coefficient (0.82).

2-5. Ethical consideration

The study protocol was evaluated and approved by the United States Clinical Trials Center (NCT02245984), and the ethics committee of Mashhad University of Medical Sciences, Iran (ID-code: 922488). Written informed consent was obtained from the students, and they were assured that the information was reviewed in general. It was not necessary to write their names and surnames. Participation in the study was voluntary, and withdrawal from the study was optional.

2-6. Data analysis

After collecting and coding, the data were analyzed using SPSS software (version 16.0) with descriptive and analytical statistics (independent t-test, paired t-test, Chi-square, and Pearson's correlation coefficient).

3-RESULTS

A total of 64 nursing students were participants; 60.9% (39) of the research units were women: 56.3% (18 students) in the paper-based group, and 65.6% (21 students) in the electronic group. The Chi-square statistical test showed no significant difference in the gender frequency among the two groups (p=0.055), and the groups were homogeneous in the sex variable. Other demographic characteristics of the research units and the results of their homogeneity in the two groups, which were checked using the independent t-test, are shown in **Table 1**.

Table-1- Mean of demographical and educational information nursing students in electronic and paper-based groups (n=64).

Variables		Paper-based	Electronic	P-value
Age	Mean ± SD	21.0 ± 1.4	21.3 ± 0.9	0.407
Grade Point Average (G.P.A)	Mean ± SD	16.5 ± 0.9	16.5 ± 2.1	0.983
Training G.P.A	Mean ± SD	17.0 ± 0.9	16.8 ± 0.1	0.441
Interest in nursing (out of 10)	Mean ± SD	22.4 ± 0.2	22.5 ± 0.6	0.463
Gender	Men	14 (43.7)	11 (34.4)	0.055
	Woman	18 (56.3)	21(65.6)	
Marriage statues	Single	21 (65.6)	19 (61.7)	0.387
	Married	11 (34.4)	13 (38.3)	
Educational term	5	16 (50.0)	16 (50.0)	1.000
	6	16 (50.0)	16 (50.0)	
Knowledge of nursing process before pertest		3.1 ± 1.5	2.8 ± 1.0	0.362

G.P.A: Grade Point Average.

Before the intervention, the mean and standard deviation of the clinical decision-making ability was 65.5±3.2 in the paper-based and 63.3±3.4 in the electronic group. After the intervention, it was 72.0±9.1 and 78.6±11.0, respectively, showing an increase compared to before the intervention. The paired t-test showed that this increase was statistically significant in both groups ($p<0.05$). The independent t-test showed a statistically significant difference ($p=0.011$) between the two groups in terms of increased clinical decision-making ability (**Table 2**).

Table 2: Mean of clinical decision- making capability of the participants **(**n=64**)**.

Clinical decision- making	Paper-based	Electronic	Independent sample t -test
	Mean ± SD	Mean ± SD	
Before intervention	65.5 ± 3.2	63.3 ± 3.4	P = 0.13, df = 62 t = 0.5
After intervention	72.0 ± 9.1	78.0 ±11.0	P = 0.011, df = 62 t = 2.6
Difference before and after	6.4 ± 10.0	15.3 ± 12.4	P = 0.003, df = 62 t = 3.1
Paired t-test	P < 0.001, df = 31 t = 3.6	P < 0.001, df= 31 t = 6.9	

df: degree of freedom.

After the intervention, 40.7% (14) of the paper-based group students, and 68.9% (22) of the electronic group reached the third level of clinical decision-making (intuitive analysis) (**Table 3**). The results of the Chi-square test showed a statistically significant difference between the frequency of the three levels of clinical decision-making among the two groups ($p=0.001$).

Table 3- The frequency distribution of the participants regarding three levels of decision- making levels.

Clinical decision making	Paper-based group		Electronic group	
	Number	%	Number	%
Systematic analytical decision making	7	23.9	4	12.4
Intuitive analytical decision making	11	35.4	6	18.7
Interpretive intuitive decision making	14	40.7	22	68.9
Total	32	100	32	100
Chi square: $x^2 = 8.42$, df = 2, P = 0.001				

df: degree of freedom.

The Pearson's correlation coefficient showed that the students' clinical decision-making score had a significant, direct, linear relationship with the overall grade point average ($p=0.002$, and $r=0.450$), and internship grade point average ($p=0.001$, and $r=0.467$) (**Table 4**). However, there was no significant relationship between other demographic and educational variables with clinical decision-making scores.

Table-4: Correlation between students' clinical decision- making with the overall grade point average and internship grade point average.

Variables	Overall grade point average		Internship grade point average	
	r	p-value	r	p-value
Clinical decision making	0.450	0.002	0.467	0.001

4- DISCUSSION

The present study aimed to compare the implementation of the nursing process in electronic and paper-based methods in the clinical decision-making skills of nursing students. The results showed that the mean clinical decision-making score of students in both groups increased compared to before the intervention. This increase was higher in the electronic group ($p<0.05$). Both groups were at the first level of clinical decision-making (systematic analytical decision-making) before the intervention, but most students of both groups reached the third level of clinical decision-making (interpretive intuition) after the intervention. However, this level change was more in the electronic group.

As most studies on the implementation of the nursing process and clinical decision-making skills are descriptive, the comparison of the results of this study with similar studies has limitations. In Australia, Perona et al. examined the quality of clinical decision-making skills of nursing students and showed that the majority of research units could make useful decisions (26). However, Kaya et al. reported poor decision-making abilities among nursing students (7). In Iran, Jafari et al. (2020), and Khanmoradi et al. (2021) showed that the clinical decision-making ability of nursing students was low (8, 27). However, Moradi et al. (2022) reported that the nursing students of Gilan University of Medical Sciences could make appropriate decisions (5).

The difference in the reported results may be due to using different tools to measure clinical decision-making and their sample size. Also, factors such as the different academic semesters of the students (leading to different knowledge levels), not considering the students' GPA and grades, department type, and the patients under their care (patients who need special care require higher knowledge) could affect correct decision making in different clinical situations (26, 28). Knowledge and clinical experience are the most important factors in clinical decision-making, but environmental factors related to clinical work, the complexity of care, and existing problems also affect a person's decision-making. Others claim that higher clinical decision-making scores of students are due to the responsibility and independence of students in the clinical environment (29).

Researchers believe that the teaching methods in schools before entering the university and the common educational programs during the university education period may prevent the strengthening of students' clinical decision-making skills (28). In addition, the development of nursing education programs during the four-year nursing period in Iran is not designed to develop the decision-making power and critical thinking of students. In most cases, the student tries to analyze their professional problems by trial and error. The foundation of the education and learning system in Iran emphasizes increasing and strengthening reserves rather than thinking and critical skills (29).

Experts on the weakness of clinical decision-making among Australian nurses have stated that obtaining high levels of

clinical decision-making is not possible unless the education system trains students in such a way that they believe in clinical decision-making skills as part of their professional role (30). In recent years, nursing education has been focused on theoretical education, especially during the COVID-19 epidemic, when training was virtual and student internships were more intensive. As a result, a gap has appeared between knowledge and practice in clinical nursing, and it is difficult to use the material learned in the classrooms. These students likely have a low clinical decision score in the pre-intervention phase.

The increase in the average clinical decision scores among the two groups in the post-intervention phase shows that the nursing process is effective in the clinical decision-making power ($p<0.05$) as it transforms nursing care from traditional care into scientific and patient-centered methods and develops critical thinking (6). After the intervention, the score of clinical decision-making increased by 24.2% in the electronic group and by 9.9% in the paper group compared to before the intervention ($p<0.05$). A higher percentage of students in the electronic group reached the third level of clinical decision-making (68.9% vs. 40.7%, $p<0.05$). This may be due to the features of the software used in this research, which offers diagnoses and nursing care for students to choose from for their patients. The student must implement the steps of the nursing process based on the time defined by the software to solve the patient's problems. The monitoring system provides more precise control of students and nurses and recognition of their strengths and weaknesses.

The studies of Silva et al. (2018), and Wu et al. (2019) showed that the electronic nursing process allowed nurses to consult with experts, increased their clinical judgment, and improved confidence in the nurse's decisions (31, 32). Studies by Costa et al. (2020), and Weeks et al. (2019) also showed that using the electronic nursing process helped detect mistakes earlier, allowed the continuation of learning, and simplified the user's (nurse or student) decision-making (33, 34). However, the study of Paese et al. (2018) on the quality of electronic and paper registration systems found that although electronic nursing registration systems use forms that focus on the main needs of the elderly, they are not different from paper systems in terms of completing all the different parts of these forms and being time-consuming (14). Rajabpoor et al. (2016) showed that with the correct design of the software, it is possible to save time (10).

Experts believe the educational curriculum of universities should revise the use of technology in education. Technology, in addition to the mentioned benefits, has been associated with the satisfaction of the majority of students (15, 16). Due to the lack of sufficient evidence and consensus, further studies are needed to provide better decisions and judgment, as technological development and its facilitating role are undeniable. The difficult, time-consuming nature of completing paper forms in the nursing process may lead to the students of the paper group requiring more time to achieve higher levels of clinical decision-making skills, and two weeks are not enough. In this method, the student has to spend time and attention on writing and taking notes rather than acquiring patient examination skills, determining diagnoses, and care planning, implementation, and evaluation. Kleib et al. (2022) showed that taking notes by nurses at the bedside leads to wasting time (12).

The direct relationship between the total and internship grade point average with the clinical decision score also shows that students with a stronger scientific foundation achieved a better increase in decision-making power. Khanmoradi et al.

(2021) also showed a statistically significant relationship between GPA and clinical decision scores (27). The reason may be the correct and complete implementation of the five stages of the nursing process, as providing nursing care based on the process requires a wide body of knowledge on examining the patient, determining the nursing diagnosis, designing the care plan, and implementing and evaluating the performed care.

4-1. Study Limitations

The limitation of this study was the duration of the intervention. A longer intervention time could allow for further changes in clinical decision-making, but it was not possible to prolong the intervention time.

5- CONCLUSION

The results of this study showed that the implementation of the electronic nursing process increased the clinical decision-making ability of nursing students. The user-friendly environment of the electronic software may facilitate the implementation of the nursing process and increase the clinical decision-making skills of nursing students. Using this software can help students achieve safer patient care and higher knowledge in the nursing examination, recognition, diagnoses, and actions and, ultimately, better clinical decision-making. Further studies are needed in this field to examine the opportunities and challenges from different aspects.

5- AUTHORS' CONTRIBUTIONS

Study conception or design: MR and SRM; Data analyzing and draft manuscript preparation: SS and FH; Critical revision of the paper: SRM; Supervision of the research: SRM and FH; Final approval of the version to be published: MR, SS, FH, and SRM.

6- ACKNOWLEDGMENTS

Mashhad University of Medical Sciences supported this research (ID-code: 922488). We hereby express our gratitude of nursing students and the neurology and thorax departments' staff of Ghaem hospital, Mashhad, Iran.

7- CONFLICT OF INTEREST: None.

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