Investigating the Insights of Nursing Students About Clinical Pharmacology Courses

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Abstract- Nursing education, requires critical attention to the science of pharmacology as well as employment of the relevant clinical skills. Therefore, the present study intends to investigate the insights of nursing students about clinical pharmacology courses. This cross-sectional descriptive study was performed on a community consisted of all nursing students who selected their clinical pharmacology course. The researcher-built questionnaire was the tool for collecting the data. Descriptive (percentage, mean and standard deviation) and analytical (t-test and Mann-Whitney non-parametric test) statistics were utilized to analyze the data using SPSS-22. The ethical considerations of the research were observed. Based on the findings, the variables of gender and the pharmacology grade achieved in the second semester predicted the level of satisfaction with clinical pharmacology course among the students as well as studying about the medicines before starting the internship. Regarding the relative satisfaction in this study, 85% of the students found the applications employed for learning clinical pharmacology contents effective to boost their skills and knowledge so that it would be recommended to use the novel educational methods for better learning of the course.

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Introduction

Considering the professional role of nurses in promoting the health of the societies, the necessity of employing standard teaching methods in this regard cannot be denied (1). On the other hand, administering prescribed orders during the treatment procedures is the inseparable part their practice (2). Preventing medication errors is considered as one of the principles in patient safety culture (3). Notably, medication errors impose heavy costs on the health system of the countries. In England, 237 million medication errors occur annually. In this regard, the cost of medication errors is estimated to be £98,462,582 per year. The consequences of medication errors have resulted in the increase of 181,626 hospitalization days and 1,708 patient deaths (4). Medication errors would be introduced as one of the five main categories of medical errors. In Iran, 55,000 medication errors occur every year which bring about 10,500 deaths and 23,000 physical disabilities (5). As reported by Ranaei *et al*., in 2020, no accurate statistics is available in Iran regarding the exact figure of medication errors, but Julaee's study reported the level of medication errors as 19.5% committed by the nurses (6). Based on a narrative review study on the causes of nursing errors and the due strategies for cutting them down conducted by Salehi *et al*., in 2020, most of the errors made by the nurses were functional including the errors in drug injection and its speed, missing the in time medication administration to the patients, errors in reading the medications' expiration date, and the wrong time of medication administration as the most important ones (7).

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Upgrading the nurses' pharmacological informations plays an important role in reducing medication errors (8-12). The research by Tsegaye *et al*., in 2020 on the medication errors of nurses reported a statistically significant relationship between the errors and the educations concerning nurses' pharmacological information (13). Besides, the review study by Bifftu *et al*., in 2019 reported incorrect medication calculation, inappropriate administration time, and the mistakes throughout the medication preparation process as the frequent errors (14).

Concerning the significance of the nurses' empowerment in clinical pharmacology and also the role of awareness and effective education in reducing medication errors (15), in the revisions of the nursing curriculum in 2014 and 2022, the clinical pharmacology was considered mandatory for the nursing students in the 3rd semester (16). Learning clinical pharmacology requires effort from the students on one hand and the professors on the other hand to achieve the ideal results through the course. Furthermore, access to various medicines, and providing the relevant clinical experiences are the other educational prerequisites. Acquiring clinical skills requires utilizing the medical supplies and equipment as well as money expenditure. One of the important costs of teaching hospitals is related to educating medical students and providing the relevant required materials. The changes in the drug distribution cycle in the hospitals have increased the challenges behind utilizing the clinical experiences related to pharmacology. In this regard, different approaches to teaching methods of clinical pharmacology, such as establishing the pharmaceutical skill-labs, have taken place in order to boost the students' capabilities (17-20).

On the other hand, nursing students, as recipients of the educational services, would be a reliable source for identifying the possible inefficiencies of clinical education, and also the improvements, so that promotions of the quality of clinical education would require continuous reviewing of the current situation, recognition of strengths and correction of weaknesses. As a result, examining the views of students about the challenges of clinical education can help in planning to improve the efficiencies in the next two subjects (20-22).

Therefore, this study was designed and aimed to evaluate the satisfaction of nursing students with the current clinical pharmacology courses.

Materials and Methods

The present research is a cross-sectional descriptive study conducted in School of Nursing and Midwifery (Mazandaran University of Medical Sciences) during the years 2023 and 2024. Census sampling was performed in such a way that the inclusion criteria included the students who have passed the clinical pharmacology course, and the exclusion criteria included being on academic probation and studying as a guest student.

The data collection tool was a checklist consisted of demographic information (age, gender and GPA of the previous semester) and a satisfaction questionnaire regarding clinical pharmacology course. The tool included 26 items scored based on a 5-point Likert scale (from "Absolutely Agree" (5) to "Absolutely Disagree (1)") with a minimum score of 26 and a maximum score of 130. The questionnaire was designed based on the educational curriculum of nursing and the review of valid scientific literature. In order to evaluate the scientific validity of 10 faculty members of Mazandaran University of Medical Sciences, who had teaching experiences in pharmacology and clinical pharmacology, CVR (89%) and CVI (92%) were calculated. To measure the tool's reliability, retest and Cronbach's alpha coefficient were used (Cronbach's alpha coefficient=80%).

In order to analyze the data collected through the questionnaires, the descriptive statistics was reported by the indicators of frequency, percentage, mean and standard deviation. In order to compare the average level of satisfaction with clinical pharmacology course among the students in terms of the academic variables, t-test and Mann-Whitney non-parametric test were employed. SPSS-22 was used for data analysis and the significance level was considered as 0.05. The research ethical considerations were observed. Having obtained the ethics code from Iran National Committee for Ethics in Biomedical Research (the ethics code of IR.MAZUMS.REC.1402.490), sampling and the following procedures were conducted.

Results

Demographic information of the participants has been presented in Table 1. The current results have been expressed based on the data obtained from 100 participants studying during the academic year, 2023-2024 (Figure 1). The outcomes indicated that 52% of the students had no study regarding the medications before starting the clinical pharmacology course (Figure 2). However, the whole students were trained through a virtual pharmacology course. The results indicated that 59% of the participants were eagor to learn via the softwares designed for studying clinical pharmacology

(Figure 3). Besides, 85% of the students found the softwares designed for learning clinical pharmacology effective in promoting the students' skills and knowledge regarding clinical pharmacology contents (Figure 4).

Table 1. Demographic informations of the participants

Variable	Demographics	No.	%
Gender	Male	58	58
	Female	42	42
Studying about the medications before starting the clinical pharmacology course	Yes	48	48
	No	52	52
Willingness to learn via the softwares designed for learning clinical pharmacology	Yes	59	59
	No	41	41
Finding the softwares designed for learning clinical pharmacology effective in promoting the students' skills and knowledge regarding clinical pharmacology contents	Yes	85	85
	No	15	15

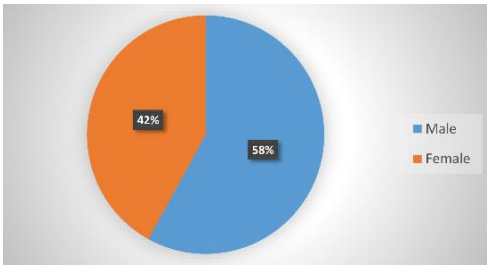

Figure 1. Gender distribution of participants

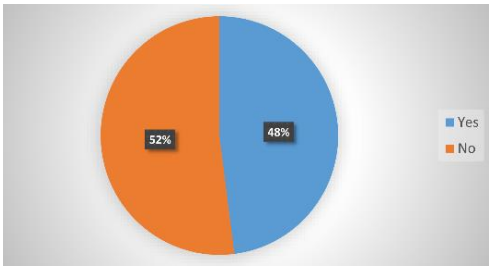

Figure 2. Studying about the medications before starting the clinical pharmacology course

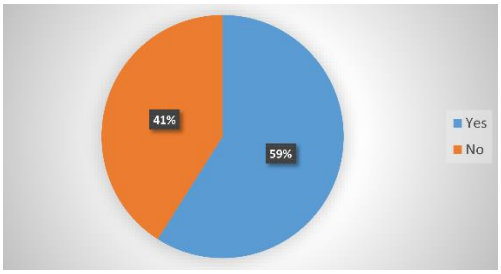

Figure 3. Willingness to learn via the softwares designed for learning clinical pharmacology

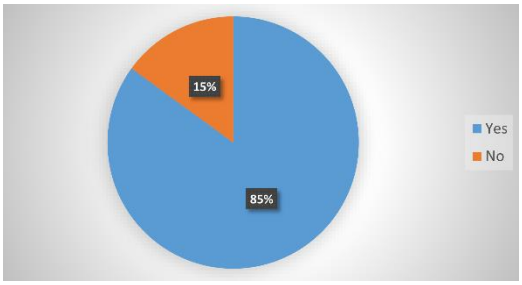

Figure 4. Finding the softwares effective in promoting the students' skills and knowledge regarding clinical pharmacology contents

As shown in Table 2, the mean age of the students was 21.52±1.77 and their mean GPA was 17.13±0.96 in the previous semester. Furthermore, the level of satisfaction with the clinical pharmacology course was estimated as 50.23±12.98.

Pursuant to the results, a significant relationship was discovered between the satisfaction level of the students and their gender (P=0.001); So that the female students' mean score of satisfaction was higher. On the other hand, no statistically significant relationship was observed between the students' level of satisfaction and their willingness to use the softwares designed for learning clinical pharmacology. Moreover, there was a meaningful relationship between the students' satisfaction level and studying about the medications before starting the clinical pharmacology course (P=0.029); So that the average level of satisfaction was higher among the students studying about medicines before taking up the course. However, no statistically meaningful relationship was found between the satisfaction level of the students and

their views on the efficacy of using the softwares designed for learning clinical pharmacology (Table 3).

The results of Pearson's correlation coefficient revealed no significant relationship between the level of satisfaction with clinical pharmacology course among the study participants and age, previous semester's GPA and the grade recorded for pharmacology credit in the 2nd semester (Table 4).

As the regression test showed, the variable of gender, the grade recorded for pharmacology credit in the 2nd semester and studying about the medications before starting the clinical pharmacology course predicted the level of satisfaction with clinical pharmacology course among the study participants (Table 5).

As presented in Table 6, the level of satisfaction was different between the various items of the questionnaire, so that the highest rates were recorded for the level of familiarity with course regulations as well as the rate of correct and principled implementation of patients' medication orders. In contrast, the lowest level of satisfaction was related to the level of familiarity with common drug interactions and types of drug errors, as well as the teacher-centered implementation of the course.

Table 2. Mean and standard deviation of age, previous semester's GPA, the grade recorded for pharmacology credit in the 2nd semester and the level of satisfaction with clinical pharmacology course among the study participants

Variable	Mean±S.D	Min	Max
Age	21.52±1.77	18	33
Previous semester's GPA	17.13±0.96	14.37	19.19
The grade recorded for pharmacology credit in the 2nd semester	16.69±2.10	11.25	20
The level of satisfaction with clinical pharmacology course among the study participants	50.30±12.98	26	89

Table 3. Comparing the mean satisfaction level with the clinical pharmacology course among the students in terms of the educational variables

Independent variable	Value	Satisfaction level		
		Mean±S.D	Satisfaction level Independent t-test	Significance level Man-Whitney Test
Gender	Man	46.36±10.69	0.001	-
	Woman	55.73±14.00		
Willingness to play online games	Yes	49.11±11.28	0.277	-
	No	52.00±15.08		
Studying about the medications before starting the clinical pharmacology course	Yes	47.47±12.70	-	0.029
	No	52.90±12.80		
Finding the softwares designed for learning clinical pharmacology effective in promoting the students' skills and knowledge regarding clinical pharmacology contents	Yes	50.72±11.90	-	0.094
	No	47.86±18.30		

Table 4. Correlation between age, Previous semester's GPA, the grade recorded for pharmacology credit in the 2nd semester and the level of satisfaction with clinical pharmacology course among the study participants

Study variable	Age	previous semester's GPA	the grade recorded for pharmacology credit in the 2nd semester	level of satisfaction with clinical pharmacology course among the study participants
Level of satisfaction with clinical pharmacology course among the study participants	-0.022 *P*=0.827	0.114 *P*=0.261	-0.146 *P*=0.146	1
the grade recorded for pharmacology credit in the 2nd semester	0.141 *P*=0.162	0.332 *P*=0.001	1	
previous semester's GPA	-0.236 *P*=0.018	1		
Age	1			

Table 5. The results of linear regression test between the level of satisfaction with clinical pharmacology course among the study participants and educational variables

Variable	Non-standard coefficients		Standard coefficient	T	*P*
	Beta	Standard error	Beta		
Constant	33.787	31.020		1.089	0.279
Age	0.334	0.725	0.046	0.461	0.646
Gender	9.293	2.575	0.355	3.609	0.001
previous semester's GPA	0.684	1.457	0.051	0.469	0.640
the grade recorded for pharmacology credit in the 2nd semester	-1.471	0.620	-0.238	-2.372	0.020
Studying about the medications before starting the clinical pharmacology course	5.438	2.428	0.210	2.239	0.028
Willingness to utilize the softwares designed for learning clinical pharmacology	2.525	2.448	0.096	1.031	0.305
Students' view about the softwares designed for learning clinical pharmacology	-2.490	3.417	-0.069	-0.729	0.468

Table 6. The level of satisfaction concerning the different items of the questionnaire

Row	Questions	Answer Frequency & frequency %				
		Very high	High	Average	low	Very low
1	I've got familiar with the regulations of clinical pharmacology course.	69	25	4	2	0
2	During the course, the instructor has encouraged me to be more careful in correct implementing of the medication orders.	41	48	11	0	0
3	To implement the patients' medication orders, I follow the correct and approved principles.	66	30	2	2	0
4	I've got acquainted with the principles of transferring drug orders to the ward's medicine Kardex and cards.	46	42	9	3	0
5	I've learned to take more care about the venous routes in implementing the medication orders.	41	44	14	1	0
6	I've been trained about the durability of the consumable equipment.	34	49	14	1	2
7	I've got acquainted with high-risk, high-alert drugs, similar medicines in appearance, phonetically identical, and refrigerated medicines.	59	30	9	2	0
8	I've got to know the ACLS drugs of the emergency Crash Cart.	43	41	13	3	0
9	I've got familiar with standard nursing terms and abbreviations in the implementation of medication orders	42	33	23	2	0
10	I've got acquainted with the antidote of some drugs.	35	45	20	0	0
11	I've been trained about intravenous solutions, uses, contraindications and interactions.	26	38	32	3	1
12	I've been trained how to adjust serum drops and microsets.	32	40	19	9	0
13	I've been trained how to do pharmaceutical calculations and convert the units.	66	26	6	2	0
14	I've learned how to record the medicinal measures taken in the patient's file.	39	45	12	4	0
15	I've been given the necessary training (monitoring the patient's vital signs, laboratory test results, etc.) before administering the medicines.	26	45	27	1	1
16	I've learned about emergency Crash Cart drugs and the medicines used in CPR.	36	31	26	6	1
17	I've got acquainted with different catheters and the related safety tips for chemotherapy process.	29	45	23	3	0
18	I've got familiar with common drug interactions and types of drug errors.	17	22	30	24	7
19	I've got acquainted with the types of IV nutrition therapy, their uses, solutions and the drugs used.	26	35	28	10	1
20	I've got acquainted with types of insulin and the related nursing tips.	32	39	24	5	0
21	I've got familiar with unwanted drug side effects and ADR form.	46	36	17	1	0
22	I'm satisfied with the duration of clinical pharmacology course.	31	39	25	5	0
23	I'm satisfied with teacher-centered method in performing the clinical pharmacology course.	19	27	34	14	6
24	At the end of the course, I've acquired sufficient mastery in implementing the medication orders.	42	41	15	2	0
25	I fear to of catching a contagious disease during the course	28	50	20	2	0
26	I am satisfied with the rational and compassionate treatment of our course instructor.	27	20	19	21	13

Discussion

This research was implemented to investigate the satisfaction level of the nursing students with the clinical pharmacology course. Based on the results, satisfaction level with the course was estimated as 50.23±12.98, which indicated a relative satisfaction. In fact, despite being acceptable, the current setting can be improved, so that it would be more efficient and useful. This study indicated that, 85% of the students considered utilizing the softwares designed for learning clinical pharmacology as effective in promoting the students' skills and knowledge. In this regard, a study by Hosseini *et al*., in 2021, which designed and evaluated a simulation based method for learning clinical pharmacology indicated an increase in the relevant knowledge of

students through the course (23). This would support the data presented in the current research. Besides, according to a study by Arcoraci *et al*., in 2019, medical simulation would result in a more stable learning of pharmacology (24). Therefore, implying such technologies, would lead to higher rate of satisfaction among the nursing students. On the other hand, Oestreich *et al*., in 2022, emphasized that pharmacology curricula should integrate active learning into educational planning. Game-based learning would be very effective in pharmacology education if it is well designed. Effective implementation of educational games in pharmacology requires specialized infrastructure, software and financial resources (25). All the above shows that using games for academic purposes can lead the learning process to a more active form. In this regard, the study by Izadpanah *et al*., in 2021 employed a game application for teaching clinical pharmacology. According to the survey done among the clinical department's faculty staff of the Faculty of Pharmacy, all of them agreed that playing games would improve the quality of learning. Interestingly the students had a positive attitude towards the educational application and considered it as a useful tool to boost students' motivation in better studying the course by the pharmacy students (26). This would be consistent with insights of the students in this research, strongly suggesting that, as technology advances, educational methods must be updated. Accordingly, using computer simulation in teaching pharmacology to pharmacy students came up with a high level of satisfaction and led to their active participation and deep learning (27). Notably, the results of the current study showed that the variable of age and the grade recorded for pharmacology credit in the 2nd semester could predict the level of satisfaction with clinical pharmacology course among the students. Although, this finding has not been approved in some studies. As an instance, a study in 2013, found no statistically significant relationship between gender, age, the grade recorded for pharmacology credit in the 2nd semester, the overall GPA of the students and the level of weakness expressed concerning pharmacology information (28). However, the aims and study design were not completely consistent in the two research. According to the present findings, pre-studying about the medications has been a predictor of satisfaction level with clinical pharmacology course among the students. It must be noted that getting prepared and recalling the knowledge of pharmacology has a positive impact on the ability to improve drug administration skills. Moreover, the semi-experimental study in 2021 in which the effect of being trained through clinical pharmacology credit on pharmacology knowledge and pharmaceutical calculation skills of nursing students was evaluated, exposed a statistically meaningful difference in the mentioned skills of the students in the control and test groups after the intervention; so that by teaching the knowledge of clinical pharmacology to the third semester nursing students, their pharmaceutical calculation skills can be enhanced and improved (29). Also, another study conducted on the nurses in the northwest of Iran, disclosed that the clinical pharmacology knowledge would be effective in reducing and preventing medication errors in hospitals (30). The noted points show that, the quality of the courses through which nurses learn pharmacology, directly impacts their performance while pursuing the nursing profession and subsequently the quality of health services in societies.

Based on the data obtained from the current study, the highest satisfaction level among the students was with observing the principles of correct implementing of the patient's medication orders and being familiarized with the educational regulations of clinical pharmacology course. On the other hand, the nursing students expressed the minimum satisfaction level with the amount of training time to get familiar with common drug interactions and errors and also employing the teacher-centered method to perform the course. So, it seems that increasing internship hours would be an approach to improving the course efficiency. However, increasing the hours, requires curriculum redesign and would be associated with the particular challenges. In a qualitative study done on the nursing students, the most important learning challenges in clinical pharmacology courses were stated as data overload with several titles within a short period of time, and the disproportion between the volume of the contents and the allocated credit (31). Thus, considering this concern seems crucial during curriculum reviews and policy making in this regard.

The teacher-centered method in clinical pharmacology course was also one of the reasons for the students' dissatisfaction in the current study. Given The rapid increase in the volume of pharmacological knowledge in recent years, the dissatisfaction would be justifiable. Notably, the results of the semi-experimental study by Rezaei *et al*., in 2021 displayed that simulation was effective in improving clinical decisions during the process of medication administration and clinical judgment among the students (32). Also, a review study conducted in 2021 aimed to evaluate the effect of the digital games related to patient care in pharmacy education in which, the findings suggested the requirement for further research in this regard (33). Since computer games are always attractive to young people,

the products can increase the time spent practicing clinical decision-making through designing sample cases, where the learner has to choose the right action to earn points. Therefore, investing can be very logical and profitable in such projects. Accordingly, another study by Abdul Rahim et al. in 2020, reported that more than 96 percent of students were satisfied with employing online games in learning and testing processes. Overally, according to the reported data the students are inclined to substitute the novel learning assessment methods for the traditional ones (34). So, as mentioned earlier, educational games are very likely to have a prominent role in the near future. Notably, the descriptive and analytical study of Pence in 2022 showed that using virtual simulation in educating nursing students for clinical pharmacology promoted the students' self-confidence and satisfaction (35). Therefore, the technology must be considered as part of education due to effectiveness and optimality. Interestingly, pleasant educational environment exerted a remarkable effect on students' learning motivation and effort (36). In this regard, another important variable that is neglected in many educational centers is the principled design of the physical structures. Considering the prevalence of medication errors among the nursing students, it is required to strive for broadening the clinical pharmacology knowledge. It is crucial to be remembered that, reducing the medication errors among the nursing students has a tremendous effect on increasing patient safety (37). Regardingly, the virtual simulation approach is a creative and flexible option to educate the nursing students, which requires creativity and scientific evidence. Based on today's needs, it is necessary to introduce simulation-based educational approaches in the nursing undergraduate courses combined with evidence-based practice to design virtual simulation contents (38). It is also possible to increase and develop clinical reasoning in nursing students through the mentioned contents (39), so that simulation through computer-based multimedia learning environments would play an important role in the effectiveness of learning (40).

As a conclusion, the present results showed that, one of the items that the students were least satisfied with, was the level of familiarity with common drug interactions and types of drug errors, in relation to which software-based technologies can be a solution. Besides, implementing the course through a teacher-centered method was the other factor which caused dissatisfaction. In this regard also, using the mentioned technologies would be very helpful. Notably, empowering the nursing students in clinical pharmacology is a significant step to lower the medication errors in hospitals. Reducing medication errors is directly associated with increasing patient safety. The current study revealed that the students are willing to utilize the softwares designed for learning clinical pharmacology. It is a must to develop the required creative methods for teaching this course to the nursing students consistent with their interests and needs. Overally, clinical pharmacology nursing instructors are advised to make efforts in designing simulation-based teaching methods via combining the clinical scenarios and the scientific contents for clinical pharmacology. Educational games can be one of the outputs of this combination, where the learner actively and enthusiastically practices clinical decision-making, when faced with pre-designed cases. As a result, the learner spends hours tirelessly making the right clinical decisions and earning points in the game. Moreover, the teachers with experiences in IT and medical education are also required to cooperate as a group to program the contents for better preparation of the discussed softwares. It is important to note that designing supplementary studies including a long-term multicenter evaluation would add valuable findings to the present results and in fact, complement this research.

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