

Original Article

Teaching Subcutaneous Injection Using Face-to-Face and Computer-Assisted Training

Ayse Kacaroglu Vicdan, PhD**Assistant Professor, Mugla Sıtkı Kocman University Faculty of Health Sciences Nursing Department, Mugla, Turkey****Correspondence:** Ayse Kacaroglu Vicdan, Assistant Professor, Mugla Sıtkı Kocman University Faculty of Health Sciences Nursing Department, Mugla, Turkey E-mail: aysevicdan64@hotmail.com**Abstract**

Introduction: Nursing as an applied discipline is a problem-solving process in which critical thinking skills are used. Nursing education is necessary for students to acquire a variety of cognitive and psychomotor skills.

Aim: The objective of this study is to evaluate the achievements of undergraduate nursing students when using two different methods for teaching how to perform subcutaneous injection.

Methods: The study adapted a quasi-experimental design, with a comparison between an experimental group and a control group. One of the groups was randomly designated the experimental group ($n = 41$) and the other was designated the control group ($n = 44$).

Results: When scores regarding students' knowledge of subcutaneous injection of the experimental and control groups were evaluated, it was found that the score of the experimental group was 10 points (Min: 9.66 points, Max: 10.34 points), and the score of the control group was 11.98 (Min: 11.75 points, Max: 12.21 points). The difference between the groups was found to be statistically significant. It was seen that there was no difference between the experimental and the control groups in the "preparation stage" for administering a subcutaneous injection.

Conclusion: It was seen that the students in the control group were more successful in the injection administration stage and the injection termination stage.

Key-words: Computer-assisted training, Face-to-face training, Subcutaneous injection, Nursing student success

Introduction

Nursing as an applied discipline is a problem-solving process in which critical thinking skills are used. One of the main functions of a nurse is to administer medication while treating the patient, and this falls within the scope of the nurse's basic role. What is expected from a nurse is that medication is administered in the proper way, using the appropriate technique and taking the necessary measures, in line with basic principles (Potter & Perry, 2009; Gulseven, 2010; Dinc, 2011; Henderson *et al.*, 2011). Subcutaneous injections are one of the means for parenteral administration of medication and are generally used for vaccine, insulin, hormone and heparin-type medications. Subcutaneous injections are made into the fatty layer of tissue just under the skin. Injections are made there because there is little blood flow to fatty tissue, and the medication injected is generally absorbed more slowly (Berman *et al.*, 2008; Craven & Hirnle, 2008; Potter & Perry, 2009; Gulseven, 2010; Dinc, 2011).

The fields of science and technology field are subject to very rapid change and development. Education is one of the most important factors leading to these changes and to developments that improve the lives of humans. The need for knowledge and the human desire to acquire it in the fastest way possible add different dimensions to education. Education has been stated to be one of the main tools which enables the individual to participate in this process of development as an effective and constructive person. (Buckley, 2003; Cooke *et al.*, 2010).

Nursing education is necessary for students to acquire a variety of cognitive and psychomotor skills. (Fitzgerald *et al.*, 2010; Hood, 2014). Although lectures and demonstrations have conventionally been used to teach clinical nursing skills, such methods do not always meet learning needs and may be inadequate. In addition, changes in the healthcare environment, including the increasing severity of hospitalised patients' illnesses, a greater turnover of staff,

and shortages of resources have decreased the availability of practice mentors and reduced the opportunities for clinical skills education in practice. (Oermann & Gaberson, 2006; Hood, 2014). To provide safe opportunities for clinical practice and reduce cultural and practical obstacles, nurse educators need to use skill laboratories and clinical simulations more effectively in order to enhance their psychomotor skill development. In the meantime, nurse educators must view learning as an on-going process, not confined to classroom or skill laboratories. (Fitzgerald *et.al.*, 2010; Henderson *et.al.*, 2012; Kaphagawani & Useh, 2013; Khoza, 2015).

Nursing education is a discipline in which it is necessary that the administration of treatment be faultless. (Potter & Perry, 2009; Sharif & Masoumi, 2005; Bahcecik & Alpar, 2009). In particular, it is expected that students learn to perform each administration properly, using the psycho-motor skills required, before administering treatment in a hospital. (Fitzgerald *et.al.*, 2010; Henderson *et. al.*, 2012; Kaphagawani & Useh, 2013; Khoza, 2015). Thus, a well-planned course of education, which uses visual elements in order for students to acquire the knowledge required both during in-class instruction and in laboratory applications, is incredibly important.

Methods

Aim

The objective of this study is to evaluate the achievement of undergraduate nursing students when using two different methods of teaching how to perform subcutaneous injections.

Design

The study was conducted among undergraduate nursing students in a university in Turkey in 2014. The study adapted a quasi-experimental design, with a comparison between an experimental group and a control group.

Participants and setting

Participants ($N = 92$) who were attending the Principles of Nursing class for the first time were included in the study. A total of 7 students who were graduates of a medical vocational college and who were repeating the Principles of Nursing course were excluded from the study. The population of the study consisted of students who

were from two different groups in the class and who were attending the Principles of Nursing course. One of the sections was randomly designated the experimental group ($n = 41$) and the other was designated the control group ($n = 44$).

Data Collection

In this study, the literature was screened in order to evaluate the success of the students and a questionnaire form with a total of 13 questions about subcutaneous injection was applied. Each question on this form was awarded one point. In an attempt to evaluate how the injections were administered, the Subcutaneous Injection Implementation Process form, which was prepared in line with the literature, was also used. This form was evaluated with regard to how the process was or was not carried out.

Intervention

The study was conducted with 85 undergraduate students who were taking the Principles of Nursing course for the first time. One of the two groups was designated the experimental group and the other the control group. Computer-assisted training was provided to students in the experimental group. To this end, the researcher prepared a digital presentation in which subcutaneous injection was taught. The students had been informed of the aim of the research before it began and they were asked to watch and listen to this presentation under the researcher's supervision and to repeat this process if necessary. At the end of the class, the questionnaire form, consisting of 13 questions prepared by the researcher about subcutaneous injection, was given to the experimental group.

A presentation with the same subject matter was given to students in the control group face-to-face for 30 minutes in the classroom environment by an instructor who was an expert in the area of the principles of nursing. At the end of this class, the same questionnaire, consisting of 13 questions prepared by the researcher about subcutaneous injection, was given to the students.

After the classes concluded and the questionnaire form had been implemented, students in both the experimental and control groups were evaluated in terms of their ability to follow the Subcutaneous Injection Implementation Process Steps by an instructor who was an expert in the principles of nursing. The instructor conducting the evaluation was unaware which group each

student belonged to and simply noted the names of all the students during the evaluation. Afterwards, these forms were sorted into experimental and control groups by the researcher.

In line with the principle of equality, following the conclusion of the research the instructor taught the subject of subcutaneous injection to the students in the experimental group in the classroom and students in control group watched the digital presentation.

Ethical Considerations

In order to carry out the research, written permission was received from the university where the study was conducted. Students who participated were informed of the aim of the research and their oral permission was received.

Evaluation of Data

The scores gained by students from the questionnaire on their knowledge of subcutaneous injection were evaluated using the t test. The Chi-square test was used to evaluate the Subcutaneous Injection Implementation Process Steps form.

Results

The application of subcutaneous injection was assessed under the headings "preparation stage", "injection administration stage" and "injection administration termination stage". A total of 12 males and 73 females participated in the study.

Discussion

The objective of this study was to evaluate the achievement of undergraduate nursing students when using two different methods for teaching how to perform a subcutaneous injection. No statistical difference was found between the experimental and control groups for the process steps of checking the patient's name; the "name - dosage - time - implementation" of the medicine; putting materials in the medicine tray; washing hands; wearing gloves; and verbally checking patient information, which are among the process steps for carrying out subcutaneous injections (Table 1). It is thought that the students had a sounder grasp of these process steps as they are used for all administrations of medicine. No statistical difference was found between the experimental and control groups in the process steps of checking the patient's name; the "name-

dosage-time-implementation" of the medicine; putting materials in the medicine tray; washing hands; wearing gloves; and verbally checking patient information, which are among the process steps for carrying out subcutaneous injections (Table 1).

It was determined that there was a statistically significant difference between the experimental and control groups in the steps of placing the patient in a suitable position depending on the area of injection; cleaning the injection area; placing a cotton buffer between the ring finger and little finger of the non - dominant hand; removing the needle without making contact with surrounding area; pinching the skin with thumb and index finger of the non-dominant hand and separating subcutaneous tissue from muscle tissue; holding the syringe with its open end upwards; puncturing swiftly at a 45 - 90 degree angle depending on the thickness of the subcutaneous layer and the length of needle; releasing the pinched skin; stating that there is no need for aspiration since subcutaneous area is not rich in blood vessels; when pulling the needle back, pulling it slowly backwards without changing the entrance angle while pressing with a cotton buffer on the tissue; ensuring the patient is in a comfortable position; stating when the needle has entered; removing used materials from the environment in an appropriate way; washing hands after the process; and evaluating patient in terms of the effects and side - effects of the medicine (Table 1).

When the scores of both groups regarding their knowledge of subcutaneous injection were evaluated, it was found that the "knowledge score" of the experimental group was 10 ± 1.07 points (Min: 9.66 points, Max: 10.34 points), and the "knowledge score" of the control group was 11.98 ± 0.72 (Min: 11.75 points, Max: 12.21 points). The difference between the groups was found to be statistically significant ($p < 0.05$) (Table 2).

In a study carried out by Buckley in the USA on fourth-grade nursing students, a Nutrition and Health course which was traditionally taught in-class was performed using web-supported education in the second period of instruction and as a web-supported lesson without in-class education in the third period of instruction, and the learning outcomes of the students were assessed.

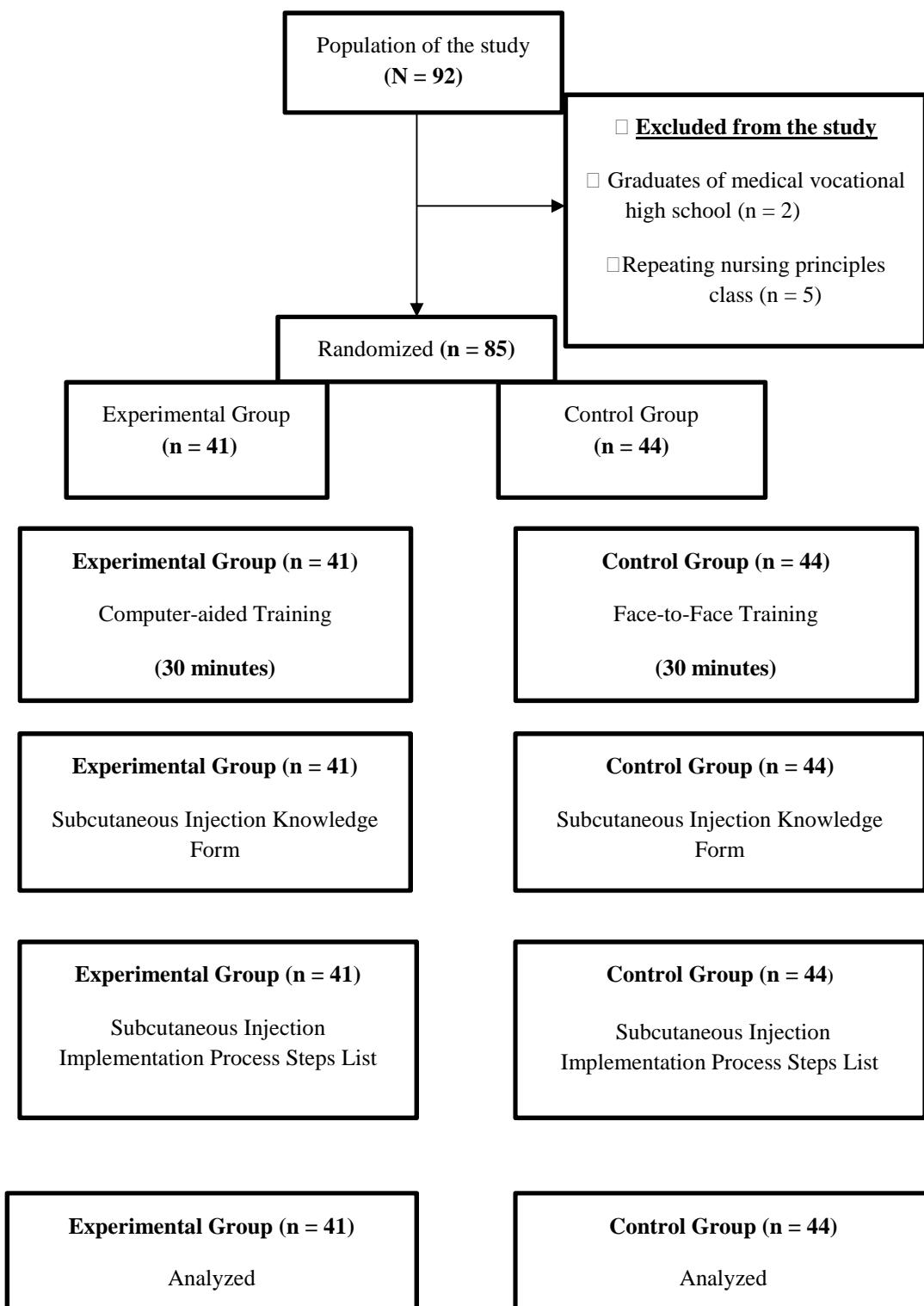
Figure 1: Flow diagram of the study

Table 1: Comparison of experimental and control group's situations of implementing subcutaneous injection process steps (N=85)

Implementing Subcutaneous Injection Process Steps	Control Group				Experimental Group				χ^2	p		
	Implemented		Did not Implement		Implemented		Did not Implement					
	n	%	n	%	n	%	n	%				
Preparation stage												
1. Checking patient's name-name - dosage-time-implementation way of medicine	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.297$	p = 0.482		
2. Putting materials in medicine tray	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.297$	p = 0.482		
2a. Drug card	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.278$	p = 0.482		
2b. Syringes drawn into drugs	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.297$	p = 0.482		
2c. Antiseptic solution is stirred cotton pads	44	100	0	0	39	95.1	2	4.9	$\chi^2 = 0.299$	p = 0.484		
2d. Waste container	44	100	0	0	39	95.1	2	4.9	$\chi^2 = 0.299$	p = 0.484		
3. Washing hands	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.297$	p = 0.482		
4. Wearing gloves	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.297$	p = 0.482		
5. Verbalization of checking patient information	44	100	0	0	40	97.6	1	2.4	$\chi^2 = 0.297$	p = 0.482		
6. Informing the patient about the procedure and receiving consent	44	100	0	0	39	95.1	2	4.9	$\chi^2 = 0.299$	p = 0.484		
Injection administration stage												
7. Giving a suitable position to patient depending on the area of injection,	44	100	0	0	24	58.8	17	41	$\chi^2 = 0.000$	p = 0.000		
8. Cleaning injection area	44	100	0	0	24	58.8	17	41	$\chi^2 = 0.000$	p = 0.000		
9. Placing cotton buffer between ring finger and little finger of non-dominant hand	44	100	0	0	23	56.1	18	43.9	$\chi^2 = 0.000$	p = 0.000		
10. Pulling the needle out without contact it with surrounding area	44	100	0	0	24	58.8	17	41	$\chi^2 = 0.000$	p = 0.000		
11. Pinching the skin with thumb and index finger of non-dominant hand and separating subcutaneous tissue from muscle tissue	44	100	0	0	23	56.1	18	43.9	$\chi^2 = 0.000$	p = 0.000		
12. Holding the injector in the position where its open end is upwards	44	100	0	0	23	56.1	18	43.9	$\chi^2 = 0.000$	p = 0.000		
13. Puncturing swiftly with 45-90 degree angle depending on the thickness of subcutaneous layer and length of needle	44	100	0	0	26	63.4	15	36.5	$\chi^2 = 0.000$	p = 0.000		
14. Releasing the pinched skin	44	100	0	0	20	48.8	21	51.2	$\chi^2 = 0.000$	p = 0.000		
15. Expressing that there is no need for aspiration since subcutaneous area is not	44	100	0	0	25	61.1	16	39	$\chi^2 = 0.000$	p = 0.000		

rich in blood vessels											
Injection administration termination stage											
16. When pulling the needle back, pulling it slowly backwards without changing the entrance angle while pressing with cotton buffer on the tissue	44	100	0	0	23	56.1	18	43.9	x² = 0.000	p = 0.000	
17. Providing a comfortable position to patient	44	100	0	0	19	46.3	22	53.6	x² = 0.000	p = 0.000	
18. Removing gloves	44	100	0	0	20	48.8	21	51.2	x² = 0.000	p = 0.000	
19. Stating making an entry of injection	44	100	0	0	14	34.1	27	65.9	x² = 0.000	p = 0.000	
20. Taking used materials out of the environment in an appropriate way	40	90.9	4	9.1	12	29.3	29	70.7	x² = 0.000	p = 0.000	
21. Washing hand after process	40	90.9	4	9.1	12	29.3	29	70.7	x² = 0.000	p = 0.000	
22. Evaluating patient in terms of effects and side-effects of medicine	41	93.2	3	6.8	12	29.3	29	70.7	x² = 0.000	p = 0.000	

Chi-square test

Table 2 Comparison of experimental and control group's scores of subcutaneous injection knowledge scores (N = 85)

Groups	Minimum	Maximum	Average Rate	Sd	Status of Significance
Control Group (n = 44)	11.75	12.21	11.98	0.72	t = 9.850 p = 0.000
Experimental Group (n = 41)	9.66	10.34	10.00	1.07	

t test

At the end of the study, no difference was detected between the learning outcomes of the students. In a study carried out by Kearns et al in the USA on second-grade nursing students, the effects on the success and satisfaction levels of the students of web-based education and of adding web-supported education to face-to-face education in the traditional classroom were examined. At the end of the study, the "success scores" of students in web - based education were found to be higher than students for whom web - supported education was added to in - class learning. However, students receiving a traditional face-to-face education stated that they had a higher level of satisfaction than students receiving web-supported education.

Nursing education requires students to acquire a variety of cognitive and psychomotor skills. In particular, it is expected that students be able to

properly perform each administration requiring specific psychomotor skills before administering them in a hospital environment. Thus, forms of education that are well - planned, enriched with visual elements, and given by expert instructors, are vitally important in order for students to achieve the desired results both in the classroom and in laboratory applications.

It was determined that there was a statistically significant difference between the experimental and control groups in the steps of placing the patient in a suitable position patient depending on the area of injection; cleaning the area for injection; placing a cotton buffer between the ring finger and the little finger of the non - dominant hand; removing the needle without making contact with the surrounding area; pinching the skin with the thumb and index finger of the non-dominant hand and separating

subcutaneous tissue from muscle tissue; holding the syringe with its open end upwards; puncturing swiftly at a 45 - 90 degree angle depending on the thickness of subcutaneous layer and the length of the needle; releasing the pinched skin; stating that there is no need for aspiration since subcutaneous area is not rich in blood vessels; when pulling the needle back, pulling it slowly backwards without changing the entrance angle while pressing with a cotton buffer on the tissue; ensuring the patient is in a comfortable position; stating when the needle has entered; removing materials used from the environment in an appropriate way; washing hands after the process; and evaluating patient in terms of the effects and side - effects of the medicine (Table 1) ($p < 0.05$).

It was observed that the majority of the control group implemented the steps correctly. It was determined, however, that students in the experimental group made mistakes in implementing some steps.

It is thought that the influence of the educator during the course had an effect on this result. It has been stated that the levels of success of students educated in a computer-assisted environment decrease when they are not guided by an educator and that students should thus receive this guidance. In the study conducted by Ozturk and Bulut on teaching subcutaneous injection, it was determined that there was a statistically significant difference between the experimental and control groups in the steps of correctly positioning the injection site ($p = 0.0001$) and grasping the skin with the thumb and forefinger of the free hand to separate the subcutaneous tissue from the muscle ($p = 0.001$). In a study carried out by Engum et al students receiving a traditional form of education stated that they preferred working with an educator than with computer - supported education as their instructors were able to give them help. In a study carried out by Lu et al in Taiwan on second-grade nursing students, the effect on students' levels of success and skills of the addition of online education videos to face-to-face education in-class when teaching intramuscular injection was examined. At the end of the study, it was determined that complementing face-to-face education in class with educational videos available online increased the success and skill scores of the students. In a study carried out by Cooke et al it was stated that using web technologies in nursing

education as a course tool rather than traditional face - to - face education would be beneficial. In a study carried out by Kelly et al in Ireland on nursing students, online education videos were used in teaching how to use a spirometer. At the end of the study, it was determined that using videos in addition to in-class demonstration increased students' levels of success.

When the average scores of the experimental and the control groups relating to subcutaneous injection administrations were examined, it was seen that the average of the study group was 10.00 ± 1.07 while the average of the control group was 11.98 ± 0.72 . The difference between the groups was found to be statistically significant ($p < 0.05$) (Table 2). The reason why the distribution of scores between the groups was in favor of the control group is that the control group students were able to ask the educator when they did not understand something, and the statements and repeated points made by the educator had a positive effect. In the study conducted by Ozturk and Bulut about teaching subcutaneous injections, it was confirmed that score of the experimental group who followed the subject using a CD was 14.42, while the control group who were instructed by an instructor received 10.78. In a study carried out by Ozturk and Dinc with the aim of assessing the effect of web-supported education in teaching nursing students how to perform bladder catheterization, the average test scores of the students in the experimental group after web-supported education were found to be 15.02 ± 2.43 over 20 and the average skill scores for the control group to be 28.24 ± 4.13 over 34. When in-class education was added to web-supported education, the average scores of the students increased significantly and the test score averages were determined as 17.32 ± 1.78 , and the average skill scores for the control group as 30.81 ± 2.35 .

Conclusion

It was seen that there was no difference between the experimental and the control groups in the preparation stage of subcutaneous injection administration. However, the students in the control group were more successful in the injection administration stage and the injection termination stage. The difference between the experimental and the control group was found to be statistically significant ($p < 0.05$). When the average scores of the experimental and the control groups relating to subcutaneous injection

administrations were examined, it was seen that average score of the study group was 10.00 while the average score of the control group was 11.98. The difference between the groups was found to be statistically significant ($p<0.05$) (Table 2). Nursing education consists of a process requiring students to acquire theoretical knowledge, attitudes and psychomotor skills. In this process, students should receive immediate feedback about their observations, interpretations and what they have learned. Thus, it can be considered most appropriate to use computer-supported education to support face-to-face education in class.

Implications for Nursing and Health Policy

Subcutaneous injection is one of many subjects taught within the scope of the Fundamentals of Nursing lesson. The Fundamentals of Nursing lesson encompasses a number of nursing practices requiring knowledge and skills. Thus, it is suggested that new videos should be prepared about these nursing practices within the scope of the Principles of Nursing course, in parallel with technological developments, and that students' levels of success be further assessed.

Limitations of the study

The fact that the research was conducted in a single university with 85 nursing students is the limitation of study.

References

- Bahcecik, N., & Alpar, SE. (2009). Nursing education in Turkey: from past to present. *Nursing Education Today*, 29 (7), 698-703.
- Berman, A., Snyder, S.J., Kozier, B., & Erb, G. (2008). *Kozier & Erb's fundamentals of nursing concepts, process, and practice*. (8th ed.), Pearson Education Inc., Upper Saddle River, New Jersey,873-874.
- Buckley, K.M. (2003). Evaluation of classroom-based, web-enhanced, and web-based distance learning nutrition courses for undergraduate. *Journal of Nursing Education*, 42 (8), 367-370.
- Cooke, M., Watson, B., Blacklock, E., Mansah, M., Howard, M., Johnston, A., Tower, M., & Murfield, J. (2010). Lecture capture: first year student nurses' experiences of a webbased lecture technology. *The Australian Journal of Advanced Nursing*, 29 (3), 14-21.
- Crave, R.F., & Hirnle, C.J. (2009). *Fundamentals of nursing*. (6th ed.), Wolters Kluwer Lippincott Williams & Wilkins, Philadelphia, 529-530.
- Dinc, L. Medicines (2011). *Clinical Application Skills and Methods*. Eds: Atabek Asti T, Karadag A. Nobel Bookstore, Adana, pp. 693-761. (in Turkish)
- Engum, S.A., Jeffries, P., & Fisher, L.(2003).Intravenous catheter training system: computer-based education versus traditional learning methods. *The American Journal of Surgery*, 186 (1),67-74.
- Fitzgerald, C., Kantrowitz-Gordon Katz, J., & Hirsch A. (2012). Advanced practice nursing education: challenges and strategies. *Nursing Research and Practice*,18,1-9.
- Gulseven Karabacak, B. (2010). Parenteral drug applications. Evaluation of clinical skills, patient care and follow-up. Eds. Sabuncu N, Akca Ay F. Nobel Medical Bookstore, İstanbul, pp. 260-266. (in Turkish)
- Henderson, A., Briggs, J., Schoonbeek, S., & Paterson, K. A. (2011). Framework to develop a clinical learning culture in health facilities: ideas from the literature, *Internation Nursing Review*,58,196-202.
- Henderson, A., Cooke, M., Creedy, D.K., & Walker, R. (2012). Nursing students' perceptions of learning in practice environments. A review. *Nursing Education Today*,32(3), 299-302.
- Hood, L.J. (2014). *Leddy & Pepper's Conceptual Bases of Professiyonal Nursing*. Wolters Kluwer Lippincott Williams & Wilkins, Philadelphia, 7-8.
- Kaphagawani, N.C, & Useh, U. (2013).Analysis of nursing students learning experiences in clinical practice: literature review. *Studies on Ethno - Medicine*, 7(3),181-185.
- Kearns, L.E., Shoaf, J.R., & Summey, M.B. (2004). Performance and satisfaction of second-degree bsn students in web-based and traditional course delivery environments. *Journal of Nursing Education*, 43 (6),280-284.
- Kelly, M., Lyng, C., Mc Grath, M., & Cannon, G. (2009). A multi-method study to determine the effectiveness of, and student attitudes to, online instructional videos for teaching clinical nursing skills. *Nursing Education Today*,29 (3), 292-300.
- Khoza, L.B. (2015). Nursing students' perception of clinical learning experiences. *Journal of Human Ecology*,51(1,2),103-110.
- Lu, D.F., Lin, Z.C., & Li YJ. (2009). Effects of a web-based course on nursing skills and knowledge learning. *Journal of Nursing Education*, 48 (2),70-77.
- Oermann, M.H., & Gaberson, K.B. (2006). *Evaluation and Testing in Nursing Education*, 2nd Springer Publishing Company, New York.
- Ozturk, D., & Bulut, L. (2012). Using computer assisted learning in nursing education: a pilot study in Turkey. *International Journal of Caring Sciences*, 5 (3), 302-310.
- Ozturk, D., & Dinc, L. (2014). Effect of web-based education on nursing students' urinary catheterization knowledge and skills . *Nursing Education Today*,34 (5),802-808.

- Potter, P.A, & Perry, A.G. (2009). Fundamentals of Nursing. 7th Ed. St. Lous Missouri,752-753.
- Sharif, F., & Masoumi, S.A. (2005). Qualitative study of nursing student experiences of clinical practice. BioMed Central Nursing, 4 (6) ,1-7.