ORIGINAL ARTICLE

Comparing low fidelity simulation/model and hybrid simulation techniques for teaching how to perform intramuscular injections: a case control study

Keziban Amanak

Abstract

Objective: To compare low-fidelity simulation/model and hybrid simulation techniques for teaching how to perform intramuscular injections.

Methods: The case control study was conducted at the Department of Midwifery, Adnan Menderes University, Aydin, Turkey, from May 2 to 25, 2018, and comprised students enrolled in the course of Basic Principles and Practices in Midwifery II. The students were randomly divided into intervention group A and control group B. Those in group A were taught intramuscular injection at an assembly which was prepared through hybrid simulation method, while those in group B made use of the model routinely employed in the midwifery programme. Data was collected using a descriptive characteristics form, the General Self-Efficacy Scale, the State Trait Anxiety Inventory and the Guide to Performing Intramuscular Injections into the Ventro-gluteal Site. Data was analysed using SPSS 20.

Results: Of the 73 students, 37(50.7%) were in group A and 36(49.3%) in group B. There was no difference in terms of age between the groups ($p>0.05$). Group A had a better total General Self-Efficacy Scale scores compared to group B ($p<0.05$). Mean score of group A in State-Trait Anxiety Inventory was lower than that of group B ($p<0.05$). The mean score of group A was also higher in the Guide to Performing Intramuscular Injections into the Ventrogluteal Site compared to group B ($p<0.05$).

Conclusion: Students using a hybrid simulation method had better levels of self-efficacy and skill as well as lower levels of anxiety compared to those trained on the conventional method.

Keywords: Hybrid simulation, Low-fidelity simulation, Intramuscular injections, Midwifery students. (JPMA 70: 1698; 2020)

DOI: http://doi.org/10.5455/JPMA.27454

Introduction

The use of simulation in health education is a method of teaching processes under circumstances that imitate real-world conditions by providing students with a virtual or artificial experience in a safe, risk-free environment.[1] Within the complex structure of a healthcare system, clinical practice sites are limited and midwifery students are further prevented from acquiring appropriate and adequate practice due to the currently shorter stays of patients at hospitals and the fact that students spend less time in clinical settings for reasons stemming from the educational system.[2] It is for this reason that students need to be supported with different educational techniques so that they can graduate with an appropriate and adequate clinical experience they need. When the characteristics of simulation-supported education are examined, it can be seen that this method is effective in meeting students' needs for the experience. Simulation-supported education allows a student to experience a virtually close-to-life experience more than once, to work in a safe environment where continuous and planned practices are implemented, to repeat the experience without harming or wearing down a patient and to have the opportunity to make and learn from mistakes.[3] Simulation techniques are classified as manikins and models which have low technological features (partial task trainers, low-fidelity simulation/model), impersonation of the patient role by a healthy individual (standardised patients), computer-enhanced simulations (screen-based computer simulators), simulations used in learning complex functions (complex task trainers), and integrated simulations in which multiple ways of simulations are used (hybrid simulation).[1,3] Studies have indicated that simulated applications used in the transition of students from laboratory and class settings to real-life situations encourage them to the extent that their level of competence improves, as evidenced in the improvements observed in their increased levels of competence and recollection of correct procedures.[4-8] However, the most important point is to determine the simulation method that contributes most to student education.

Self-efficacy refers to the belief of individuals in their ability to be effective in life circumstances, their confidence that they can initiate the necessary steps and get results. A strong perception of self-efficacy increases success and wellbeing. A student who has a high level of

Department of Midwifery, Adnan Menderes University, Aydin, Turkey.
Correspondence: Keziban Amanak. Email: keziban.amanak@adu.edu.tr

self-efficacy is able to participate in the learning process on cognitive, motivational and behavioural levels to work systematically and regularly, displaying a higher level of achievement.[9] At the same time, the intense anxiety that accompanies the education process is known to be an important factor that adversely affects a student's achievement.[10,11] It is therefore important that educators take into account which educational techniques are instrumental in making students feel more competent and effective and less anxious. In recent years, it has been observed that most evidence-based simulation studies conducted with midwifery students have evaluated the effectiveness of using simulation.[12-14] It must be said nevertheless that a comparison of different simulation techniques is as much needed as studies on the effectiveness of using simulation. Such comparisons will help educators develop new strategies and, in doing this, provide students with the opportunity of reaching levels of optimal success. Very few evidence-based studies were found to have been conducted with midwifery students that compared different simulation techniques.[7,15,16] In addition, the expanding roles of midwives, patient safety issues, and overwhelmed midwifery curricula require midwife educators to consider using the most effective teaching strategies. In particular, they must consider the advantages and disadvantages of each simulation technique in developing students' physical examination skills before engaging in clinical practice.[2,4-7] The current study was planned to examine the efficacy of teaching intramuscular (IM) injection practice to midwifery students through low-fidelity simulation/model and hybrid simulation on their levels on self-efficacy, anxiety and skill that they experienced during the process of learning.

Subjects and Methods

The case control study was conducted at the Department of Midwifery, Adnan Menderes University, Aydin, Turkey, from May 2 to 25, 2018 and comprised students enrolled in the course titled, 'Basic Principles and Practices in Midwifery II'. After getting approval from the institutional ethics committee, the sample size was calculated in line with literature.[2] With effect size d=0.6625722 and at α=0.05, with a confidence interval (CI) of 95% and a power of 80%, power calculation was done using G* power.[17]

Those included were students aged 18-30 years, while graduates of the Health Vocational Schools were excluded because they already had experience of dispensing IM injections. The day of the study, five of the 86 students enrolled in the Basic Principles and Practices in Midwifery II course were absent; therefore, only 81 students were invited into the research. Of these students, 8 were excluded because they were graduates of Health Vocational Schools. The 73 students were randomly divided into intervention group A and control group B.

Data was collected using a descriptive characteristics form (DCF), the General Self-Efficacy Scale (GSES), the State Trait Anxiety Inventory (STAI) and the Guide to Performing Intramuscular Injections into the Ventrogluteal Site (GPIIVS). DCF consisted of a total of four questions on age, family income status, family type and status of willingness to enrol in the department.[1,2] GSES is the most widely used general self-efficacy tool[18] to measure a general set of expectations that an individual carries into new situations. A high score shows good self-efficacy. Psychometric properties of the Turkish version of the scale were evaluated in 1999.[19] STAI[20] determines event-specific and continuous anxiety levels separately. It has been adapted to Turkish.[21] The State Anxiety Scale of STAI (S-STAI) evaluates the current state of anxiety and the Trait Anxiety Scale of STAI (T-STAI) evaluates relatively stable aspect to find individual differences in "anxiety proneness." Scores on the STAI have a direct interpretation: high scores on both subscales indicate higher anxiety level, while low scores represent lower anxiety. GPIIVS is part of the "Basic Midwifery Practice Guidelines and Assessments" and shows the steps to be taken in perfecting the skill of performing an IM injection. The form is composed of 35 steps. The possible minimum score on the guide is 35 points; the maximum is 105.[22]

Data was collected in the laboratory class of the Basic Principles and Practices of Midwifery II course. This course is required in the midwifery first-year spring term and covers the teaching of basic midwifery skills. The course offers 4 hours of theoretical, 4 hours of laboratory and 8 hours of practical work. The subjects in the content of the course are first taught from a theoretical perspective and then laboratory education is offered with models, after which the students practise in the clinic on real patients under the supervision of a faculty member. The study was conducted in five stages.

In the first stage, written informed consent was obtained, the students were asked to fill out DCF, GSES and STAI by way of self-reporting.

In the second stage, the supervising researcher explained to the two groups of students together the purpose of performing IM injections, what they needed to learn and briefly gave them the theoretical background for the application. Then the researcher demonstrated three times the application on the model using the GPIIVS. After the demonstration, the intervention and control groups

Figure-1: Hybrid simulation setup used in the study.

were taken into different laboratories and were asked not to leave until the practice was over. Thus, both groups saw only their own applications and were kept blinded to what the other group was doing. The purpose of this blinding was to prevent the students from forming a conditioned positive or negative opinion about the teaching.

In the third stage, the students in the intervention group performed IM injections in 3 minutes in accordance with the hybrid simulation prepared by the researcher in line with GPIIVS.[22]

For this, the researcher developed scenarios in line with literature[23,24] to distribute to each of the students attending the education. The scenarios presented case summaries that revealed the age, gender, education, civil status and other sociodemographic characteristics of the patients as well as information about their medical history and hospitalisations. They were designed to allow a real patient to play the role of an actual patient who would show the same reactions that a standard patient in real life would demonstrate while receiving an IM injection. The content validity and technical features of the scenarios used in the study were evaluated by three faculty members. Additionally, an ovine gluteus maximus muscle was fitted with a skin-toned nylon stocking to simulate and this was wrapped around the standard patient's hip using stretch film. This facilitated the creation of a simulator that was as close to actual appearance as possible. Written consent was obtained from the standard patient participating in the study. The ovine gluteus maximus muscle used in the study was obtained from by consulting Adnan Menderes University's Faculty of Veterinary Medicine (Figure 1).

Students in the control group made use of the model routinely employed in the midwifery programme to perform the injections into the ventrogluteal site, which they performed in 3 minutes and in keeping with the steps suggested in GPIIVS.[22]

In the fourth stage, students in the intervention and control groups were asked to again fill out the self-reporting GSES and STAI forms.

In the fifth stage; the students in the intervention group were again asked to perform intramuscular injections into the ventrogluteal site in 3 minutes using the hybrid simulation technique and in keeping with the steps suggested in GPIIVS. During this practice, the researcher used GPIIVS to evaluate the students' skills.

In the fifth stage, students in the control group were again asked to perform IM injections into the ventrogluteal site of the model in 3 minutes, in keeping with the GPIIVS steps.[22] The researcher used GPIIVS to evaluate the students' skills in performing the injections (Figure 2).

Once the study was over, the students in the intervention group were directed to complete their education on the traditional model and the students in the control group were directed to complete their hybrid simulation education. Data was analysed using SPSS 20. Numeric data was expressed as mean ± standard deviation (SD), and categorical data as frequencies and percentages. The comparisons of two groups' sociodemographic

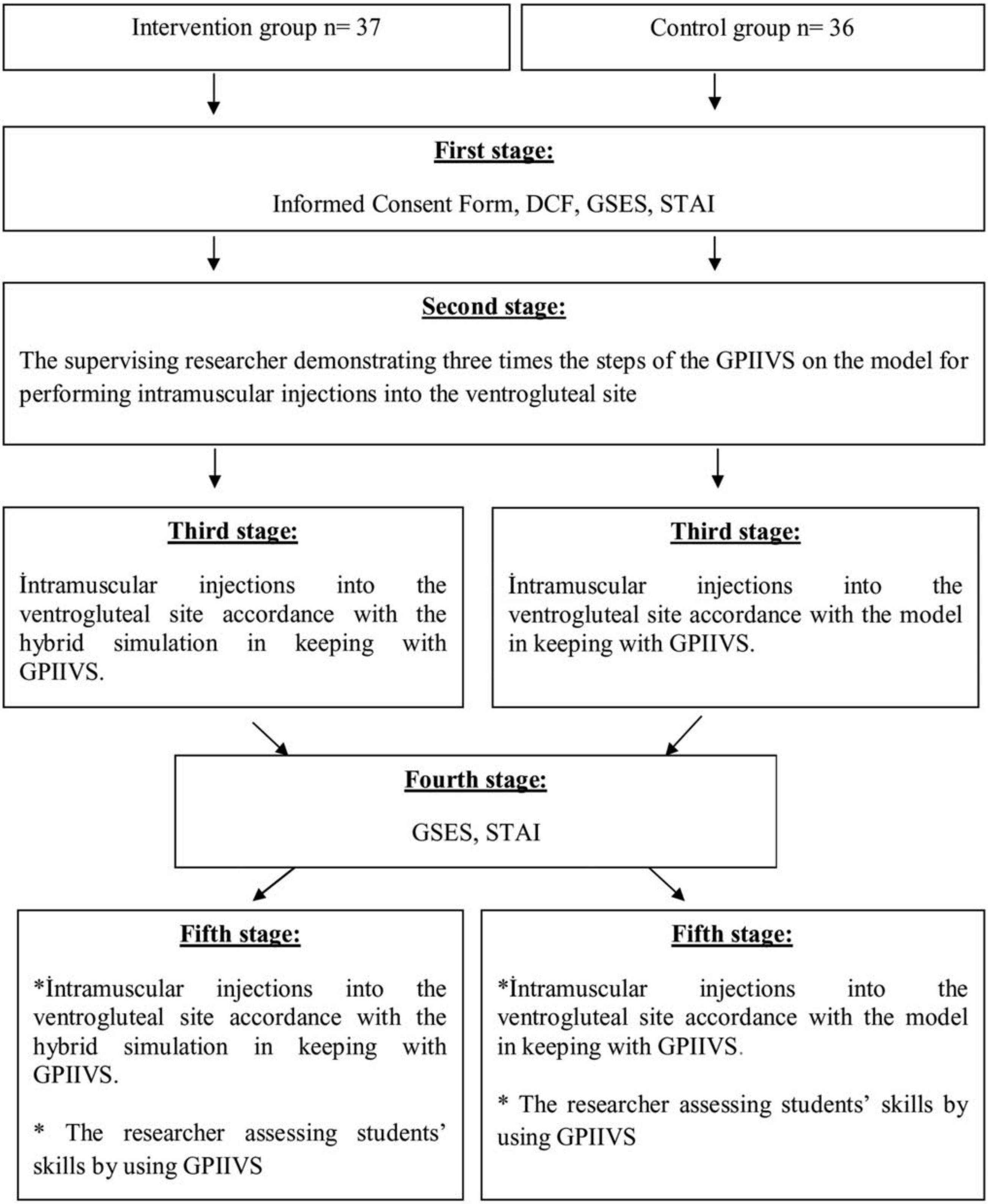

Figure-2: Study implementation steps.
DCF: Descriptive Characteristics Form, GSES:The General Self-Efficacy Scale, STAI:The State Trait Anxiety Inventory, GPIIVS:The Guide to Performing Intramuscular Injections into the Ventrogluteal Site .

characteristics were carried out with chi-square test. Comparisons between the groups in terms of their GSES, STAI mean scores at the first and third stage (normal distribution) were carried out within dependent samples t-test. Data that did not distribute normally was analysed with Mann-Whitney U test. Comparisons between the two groups regarding their GPIIVS mean scores at the first and fifth stage (normal distribution) were carried out with dependent samples t-test. Data that did not distribute normally was analysed with Mann-Whitney U test. The limit of significance was $p<0.05$ for all tests.

Results

Of the 81 students approached, 73(90%) participated. Of them, 37(50.7%) were in group A and 36(49.3%) in group B. There was no difference in terms of age, income level, family type and school enrolment between the groups ($p>0.05$) (Table 1).

Baseline GSES mean scores showed no significant differences, but post-intervention, the difference was significantly higher for group A (Table 2).

Table-1: Characteristics of the students.

Descriptive characteristics	Intervention group (n=37) n(%)	Control group (n=36) n(%)	P
Age, Mean ± SD	18.84±0.767	18.63±0.707	0.240*
Income status			
Income less than expense	5(13.5)	7(19.5)	0.558
Income equal to expense	32(86.5)	29(80.5)	
Family types			
Nuclear	29(78.4)	30(83.3)	0.45
Large	8(21.6)	6(16.7)	
Status of willingness to enroll in the department			
Yes	28(75.7)	23(63.9)	0.137
No	9(24.3)	13(36.1)	

*t-test, ** X^2 applied where required

Baseline STAI mean scores showed no significant difference between the groups, but post-intervention the scores were significantly lower for group A (Table 3).

Mean GPIIVS scores of group A was higher than group B ($p=0.001$) (Table 4).

Discussion

The sociodemographic characteristics, GSES and STAI mean scores of the intervention and control groups before the intervention were similar, indicating that the two groups were homogeneous prior to the intervention and that the groups were comparable in terms of their self-efficacy, competence and anxiety levels.

Table-2: Students and General Self-Efficacy Scale (GSES) total and subscale mean scores.

GSES	Intervention group X ± SD	Control group X ± SD	t or Z/P
Pre-intervention			
Starting the behaviour	30.21±5.03	31.37±4.96	-0.618/0.426*
Maintaining the behaviour	25.32±4.32	24.56±4.78	1.226/0.815*
Completing the behaviour	18.03±3.16	18.11±3.41	0.683/0.643*
Struggling with obstacles	9.14±2.47	9.21±2.39	-1.694/0.433*
Total GSES	82.65±11.24	83.18±11.56	-0.321/0.715*
Post-intervention			
Starting the behaviour	32.93±5.49	30.81±6.43	2.959/0.003**
Maintaining the behaviour	27.87±5.32	26.01±3.49	-3.153/0.002**
Completing the behaviour	19.78±2.96	18.88±3.56	-3.246/0.004**
Struggling with obstacles	10.62±2.11	9.61±2.03	2.569/0.046**
Total GSES	91.10±14.98	85.23±12.05	-7.073/0.000**

* t test was applied because normal distribution was observed. Values are P values.
** The Mann-Whitney U test was applied because normal distribution was not observed. Values are Z values.
SD: Standard deviation.

Table-3: Students and State Trait Anxiety Inventory (STAI) mean scores.

STAI	Intervention group X ± SD	Control group X ± SD	t or Z/P
Pre-intervention			
S-STAI	37.31±8.89	38.05±8.45	0.856/0.751*
T-STAI	41.96±6.63	40.84±5.09	-0.125/0.987*
Post-intervention			
S-STAI	32.02±8.81	35.12±7.82	2.037/0.045*
T-STAI	35.01±6.96	38.21±8.01	-4.746/0.068**

* t test was applied because normal distribution was observed. Values are P values.
** The Mann-Whitney U test was applied because normal distribution was not observed. Values are Z values.
SD: Standard deviation.

Table-4: Students and Guide to Performing Intramuscular Injections into the Ventrogluteal Site (GPIIVS) mean score.

GPIIVS	Intervention group X ± SD	Control group X ± SD	Z/P
Post-intervention	28.02±5.36	21.86±2.85	-7.056/0.000*

* The Mann-Whitney U test was applied because normal distribution was not observed. Values are Z values.
SD: Standard deviation.

Following the intervention, students in the intervention group exhibited higher mean scores on the GSES subscale and on the total scale compared to the students in the control group and that this difference was statistically significant. Cohen et al.[12] found that midwives and nurses attending a simulation-based education programme displayed a pronounced improvement in self-efficacy. These results are similar to the findings of the current study.

Following the intervention, students in the intervention group exhibited significantly lower mean scores on the STAI compared to the students in the control group in the study. The intense anxiety experienced over the course of education is a factor that adversely affects a student's achievement[10,11] and it appears that the hybrid simulation method, which more closely simulated real situations compared to routine models, was a more effective technique to address anxiety.

The intervention group exhibited significantly higher GPIIVS mean scores compared to the control group after the intervention in the current study. Scholes et al.[4] evaluated the responses of student midwives in a simulation of postpartum haemorrhaging as part of an obstetrical emergency lesson and reported that a large majority of the students were quite successful in dealing with the situation before the emergency team arrived at the incident. Similarly, Catling et al.[5] found that midwifery first-year students working in a simulation workshop prior to their clinical practice exhibited increased comprehension, self-confidence and improvement in their clinical skills, leading to an enhanced readiness to work in the clinical setting. In another study conducted with midwifery and nursing students, researchers demonstrated that education in a virtual class was effective in developing students' skills regarding maternal and neonatal health practices.[6] A study[7], meanwhile, showed that a neonatal resuscitation model structured specifically for midwifery students increased their success in the practical setting. Another study[8] reported that a simulated clinical model devised to determine the amount of post-delivery blood loss was highly effective. One study[15] found that progressive and medium-fidelity simulation yields better outcomes than low-fidelity simulation. These outcomes are shown that more advanced and moderate simulation produced better results than simulation at lower levels. These results are parallel to the findings of the current study.

The study has some limitations. Being a single-centre study, the findings are not generalisable. Besides, the entire dataset was based on self-reporting and the possibility of bias cannot be ruled out.

We recommend that future studies shall address these limitaions and also compare the outcome of differently planned simulation techniques that are introduced into health education.

Conclusion

Students in the intervention group were found to be better in terms of their self-efficacy, competence and skill levels compared to students in the control group and similarly, their anxiety levels were lower.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

References

1. Dikmen Y. Simulation in nursing education: virtual reality and haptic systems. J hum rhythm. 2017; 3:172-6.
2. Kartal YA, Yazıcı S. The determination of anxiety and stress levels of midwifery student's beginning the first clinical experience and post-experience period. HSP. 2017; 4:190-5.
3. Weller JM. Simulation in under graduate medical education: Bridging the gap between theory and practice. Med Educ. 2004; 38:32-8.
4. Scholes J, Endacott R, Biro MA, Bulle B, Cooper S, Miles M. et al. Clinical decision-making: midwifery students' recognition of, and response to, postpartum haemorrhage in the simulation environment. BMC Pregnancy Childbirth. 2012; 12:1-12.
5. Catling C, Hogan R, Fox D, Cummins A, Kelly M, Sheehan A. Simulation workshops with first year midwifery students. Nurse Educ Pract. 2016; 17:109-15
6. Agrawal N, Kumar S, Balasubramaniam SM, Bhargava S, Sinha P, Bakshi B. et al. Effectiveness of virtual classroom training in improving the knowledge and key maternal neonatal health skills of general nurse midwifery students in Bihar, India: A pre- and post-intervention study. Nurse Education Today. 2016; 36:293-7.
7. Bull A, Sweet L. Midwifery students receiving the newborn at birth: A pilot study of the impact of structured training in neonatal resuscitation. Nurse Educ Pract. 2015; 15:387-92.
8. Buckland SS, Homer CSE. Estimating blood loss after birth: Using simulated clinical examples. Women Birth. 2007; 20:85-8.
9. Kızılcı S, Mert H, Küçükgüçlü Ö, Yardımcı T. Examination of self-efficacy levels of Nursing Faculty students in terms of gender. Deuhfed. 2015; 8:95-100.
10. Lee J, Graham AV. Student's perception of medical school stress and their evaluation of a welness elective. Med Educ. 2001; 35:652-9.
11. Jimenez C, Navia-Osorio P, Vacas Diaz C. Stress and health in novice and experienced nursing students. J Adv Nurs. 2010; 66:442-55.
12. Cohen SR, CraginL, Wong B, Walker DM. Self-efficacy change with lowtech, high-fidelity obstetric simulation training for midwives and nurses in Mexico. Clin Simul Nurs. 2012; 8:15-24.
13. Stitely ML, Cerbone L, Nixon A, Bringman JJ. Assessment of a simulation training exercise to teach intrauterine tamponade for the treatment of postpartum hemorrhage. J Midwifery Womens Health. 2011; 56:503-6.
14. Andrighetti TP, Knestrick JM, Marowitz A, Martin C, Engstrom JL. Shoulder dystocia and postpartum hemorrhage simulations: Student confidence in managing these complications. J Midwifery Womens Health. 2012; 57:55-60.
15. Brady S, Bogossıan F, Gıbbons K. The effectiveness of varied levels of simulation fidelity on ıntegrated performance of technical skills in midwifery students-A randomized intervention trial. Nurse Educ Today.2015; 35:524-9.
16. Bogossian F, Mckenna L, Higgins M, Benefer C, Brady S, Fox-Young S, et al. Simulation based learning in Australian Midwifery

Curricula: Results of a national electronic survey. Women Birth. 2012; 25:86-97.
17. Erdfelder E, Faul F, Buchner A. GPOWER: A general power analysis program. Behav Res Methods Inst Comp. 1996; 28: 1-11.
18. Sherer M, Maddux JE. The self-efficacy scale construction and valudation. Psychol Reports. 1982; 51:663-71.
19. Gözüm S, Aksayan S. Öz etkililik yeterlik ölçeğinin Türkçe formunun güvenilirlik ve geçerliliği the ability and validity of Turkish form of the self-efficacy scale. Atatürk Üniversitesi Hemşirelik Yüksekokulu Dergisi. 1999; 2:35-43.
20. Spielberger CDGRLLRE. Manual for the State-Trait Anxiety Inventory (Self-Evaluation Questionnaire). Palo Alto, CA, Consulting Psychologists press; 1970.
21. Oner N, Le Compte A. Manual of State-Trait Anxiety Inventory. Istanbul: Bogaziçi Universitesi Yayınları, 1983; pp-1-8.
22. Yavuzaslan F, Öztürk G. Intramuscular Injection. Basic midwifery practice guidelines and evaluation. In: Black Pine Z, Çoban A, Taşpınar A, eds. Nobel Medical Bookstore Ltd. Şti. Ankara 2018; pp 96-97.
23. Taylor CR, Lillis C, LeMone P, Lynn P. Skill checklists to accompany fundamentals of nursing. The art and science of nursing care 2008. 6th ed. USA: Lippincott Williams & Wolters Kluwer, 2006; pp-1856.
24. Potter PA, Perry AG. Study Guide and Skills Performance Checklists for Fundamentals of Nursing 7th ed. Canada: Mosby, 2008; pp-392