



Evaluation of the effectiveness of four different training techniques in the development of non-stress testing application skills: A randomised controlled trial



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ABSTRACT

Background: A range of teaching methods are employed to upgrade students' skills, lower anxiety levels and improve satisfaction in nursing and midwifery education.

Aim: This study was conducted to evaluate the effect of different training techniques on the development of students' non-stress test (NST) application skills, satisfaction with education and reduction of their anxiety levels.

Method: The study was designed as a single-blind randomised controlled trial and carried out in four groups ($n = 82$), namely, video demonstration (VD), simulation with birth model (SBM), hybrid simulation (HS) and control (CG). A student information form, the NST skills evaluation form and the Spielberger State Anxiety Inventory were used to collect the study data.

Results: Satisfaction with education was higher in the HS and SBM groups compared to the CG and VD groups ($p < 0.001$). No differences were found between the groups in terms of students' anxiety levels ($p > 0.05$). While there were no differences between the groups in the preparation phase in terms of NST skill scores ($p > 0.05$), the differences between the groups in the application and evaluation stages of the procedure were significant ($p < 0.001$). The highest score regarding the total score medians of NST skills belonged to the HS group, and the differences between the groups were found to be statistically significant ($p < 0.001$).

Conclusion: The findings of this study indicated that simulation techniques enhanced the students' clinical practice skills and satisfaction with their education.

1. Background

The use and development of new learning tools in health education has shown steady growth along with technological developments (Saygılı and Özkalp, 2015). It is important that midwives and nurse educators follow innovative educational techniques and choose the most appropriate training method for students' education (Mulaudzi and Chyun, 2015). Education in nursing and midwifery is a process that involves theoretical and clinical education and should include skill development along with knowledge. The main objective of clinical education is to connect theoretical knowledge to practical knowledge. It also helps students to develop their problem-solving skills. But some issues regarding changes in clinical units, ethics and patient safety have greatly decreased students' opportunities for direct experience in patient care (Kim et al., 2016). This situation may give students fewer learning opportunities or cause the learning process to be interrupted in the clinical environment. Students studying women's health face

additional problems. For example, women's privacy issues often prevent students from making observations or practicing midwifery skills (Durham and Sherwood, 2008; Kim et al., 2012). However, practical experience is very important, especially for midwifery, because it is an area in which the balance between the health and illness of the mother, foetus and newborn is extremely important. If this balance were to fail at any time, emergency medical treatment might become necessary (Terzioğlu et al., 2016).

Therefore, students should be provided with appropriate learning environments. If they are not provided with proper clinical opportunities, an unsafe environment will result for both students and service providers. New and different educational techniques have emerged to minimise these problems and improve patient safety. Recent technological advances allow nurse and midwife educators to develop creative techniques to teach students the knowledge and skills they will need to practice their profession (Holland et al., 2013; Lynch et al., 2012). For example, information and communications technology strategies, such

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as the use of videos, support the development of psychomotor clinical skills (Holland et al., 2013) that are critical for patient care and challenging to teach to students (Lynch et al., 2012). Another innovative educational technique is simulation. This is an important tool because it replicates real-life situations and creates repetition (Newey et al., 2017). Simulation in medicine and midwifery has become an important part of student education and for practicing healthcare providers (Aebersold and Tschannen, 2013). Different simulation techniques, such as low and high technology manikins, computer-aided simulations, standard patients and hybrid simulations, are used in these areas. It has been reported that the use of simulation increases the knowledge of students (O'Leary et al., 2016), their clinical skill performance, their satisfaction with their education (Stayt et al., 2015), their self-sufficiency (Einat et al., 2016; Nitsche Joshua et al., 2014; O'Leary et al., 2016) and psychomotor skills (Shin et al., 2015). Studies conducted with standard patients using hybrid simulations have been shown to improve the communication and clinical skills of students (Joeques et al., 2016; Weaver and Erby, 2012; Terzioğlu et al., 2016). On the other hand, there is scientific evidence that simulation-based instruction lowers the risks for both patients and learners (Gordon et al., 2001; Pian-Smith et al., 2009). The use of simulation techniques might pave the way for a shift from the old 'See One, Do One, Teach One' way into a 'See One, Practice Many, Do One' model of achievement (Vozenilek et al., 2004).

Midwifery is a discipline with a bachelor's degree based on participation in clinical practice. Various teaching strategies and simulation are used to prepare students for clinical practice. In midwifery education, students need to acquire skills related to pregnancy, childbirth and postpartum periods. One of these skills is the non-stress test (NST) application. The NST is a significant diagnostic foetal well-being test (Raouf et al., 2015; Erdenilgen, 2016). Preparing a woman for the NST, applying the test, evaluating the results and informing the doctor, pregnant woman and her family about the results are some of the main roles and responsibilities of a midwife. That is why knowledge and application about the NST should be improved during education. The use of simulation techniques to provide students with information and skills related to the NST is becoming increasingly widespread. In this context, it is thought that the use of different training techniques in the development of NST skills will be more effective than classical techniques. For these reasons, this study aims to evaluate the development of NST skills using different educational techniques.

1.1. Aim and questions

This study was carried out to evaluate the effect of various educational techniques on improving students' non-stress test application skills, their satisfaction with their education and reducing anxiety. Thus, the following research questions were formed:

1. Is there a difference between the groups (video demonstration group, simulation group with birth model, hybrid simulation group and control group) in the development of NST practice skills?
2. Is there a difference between the groups (video demonstration group, simulation group with birth model, hybrid simulation group and control group) in terms of anxiety in NST application?
3. Is there a difference between the groups (video demonstration group, simulation group with birth model, hybrid simulation group and control group) in terms of satisfaction with education?

2. Method

2.1. Design

This study was organised as a single-blind randomised controlled intervention.

2.2. Participants

This study enlisted all the students enrolled in their second year in the midwifery department of a state university in Ankara, Turkey during the 2015–2016 education and training period. Second-year students were selected because the NST is taught to students during this period, and this is also when they start clinical practice in obstetrics.

Inclusion criteria:

1. registered in the second semester,
2. actively attending classes, and
3. agreed to participate in the study.

Exclusion Criteria:

1. not participating or missing theoretical education,
2. not participating or missing practical training (video display, full-body birthing manikin or hybrid model) for the application groups,
3. not participating in clinical practice and not practicing on an actual pregnant woman.

G-power package version 3.1.9.2 was used to determine the sample size. Prior and post-hoc power analysis were both performed based on a fixed effect ANOVA test. Expected Cohens' *f* value for effect size was 0.4, which is considered a large effect size. For a 0.4 effect size with a 0.05 type I error and 80% power minimum required, an estimated total sample size was 76. There were 94 students enrolled in the second-year midwifery section during the relevant period.

Two students did not agree to participate in the study. For this reason, a block randomisation technique was performed with 92 students. The study was carried out using four groups: the video demonstration group (VDG), the simulation group with (full-body birthing manikin) the birth model (SBMG), the hybrid simulation group (HSG) and the control group (CG). Twenty-three students were included in each group.

This study was completed with a total of 82 students because one person in the video demonstration group, three people in the birth model simulation group and three people in the hybrid simulation group could not participate in practical training; three people in the birth model simulation group could not participate in clinical practice (Fig. 1). Post-hoc power analysis was performed to test the adequacy of the sample number at the end of the study. Post-hoc effect size of the study was calculated as 0.83 and post-hoc power as 99%. For power analyses, G-power package version 3.1.9.2 was used.

2.3. Ethical considerations

The institutional and ethics committee permissions (24.03.2016-7773) were obtained from Ankara University. At the outset, each student was informed about the purpose of the study, and their written consent was obtained. The consent form includes the information that the participants can voluntarily participate in the study without any pressure or coercion, have rights to refuse to participate in the study, quit the study at any time. The participation or refusal of the study will never affect the educational process because of the fact that it is not a part of education. During the clinical training, each pregnant woman was informed about the study, and their verbal approvals were taken. Because simulation was effective during the study, the students who did not receive simulation training in the research study were trained in simulation techniques at the end of the study.

2.4. Assessment tools

Study data were collected via the student description form, the NST skill evaluation form and the Spielberger State Anxiety Inventory.

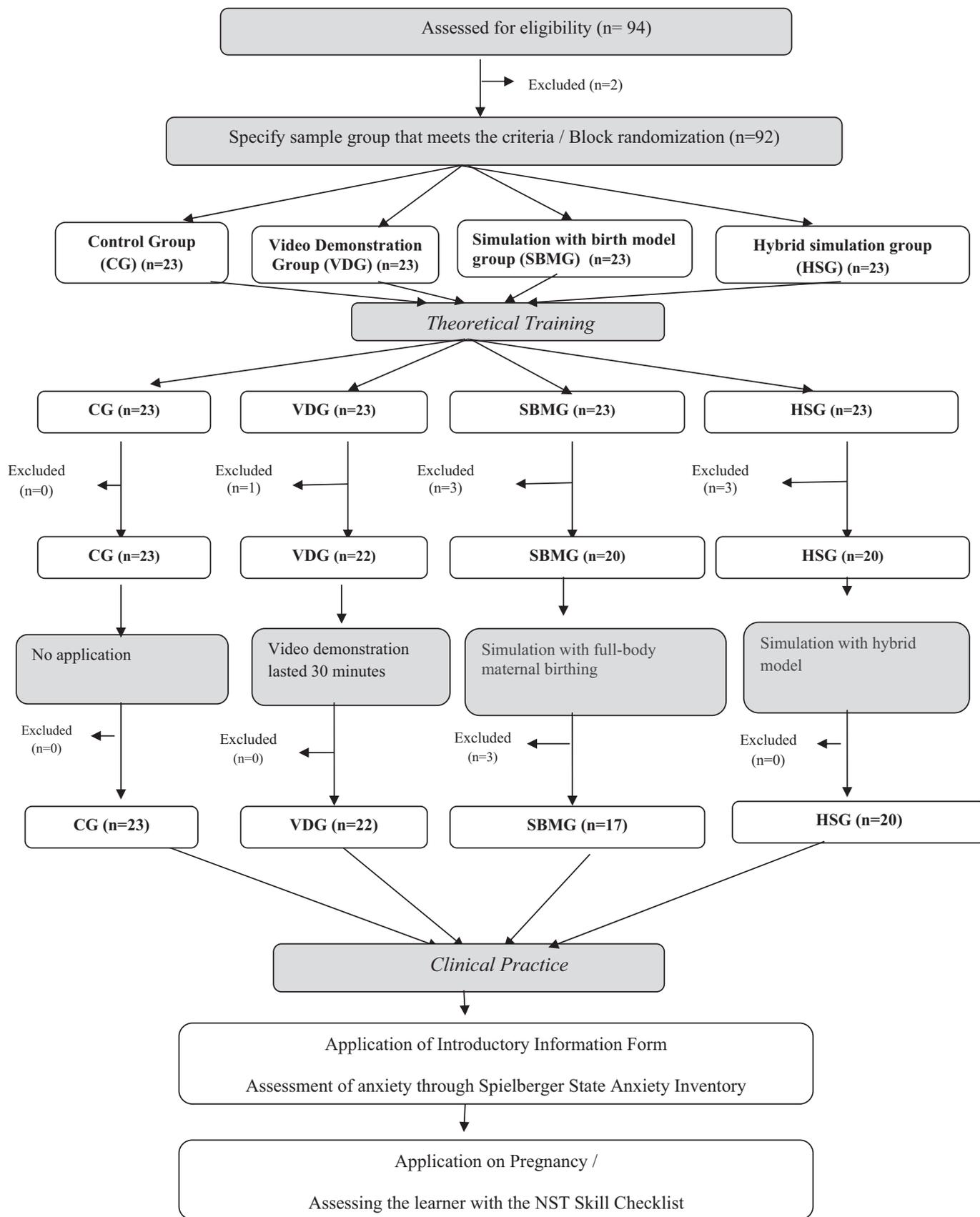


Fig. 1. Flow diagram of the study.

2.4.1. Student description form

This form consisted of 10 sociodemographic questions (age, maternal education, paternal education, etc.) and one question regarding satisfaction of NST education. Students were asked to rate their satisfaction of their NST training between 1 (*I'm not satisfied at all*) and 5 (*very satisfied*).

2.4.2. NST skill checklist

This form was developed based on relevant literature (Taşkın et al., 2011; Erdenilgen, 2016; Coşkun, 2008; Lowdermilk et al., 2016). It was validated by three experts from related fields. The form consists of 24 items divided into three parts, namely the preparation phase, the application phase and the evaluation phase. The preparation phase includes seven items that evaluate the steps to be performed before starting the NST process, such as washing hands, measuring blood pressure and asking the pregnant woman when she last ate. The application phase consists of 12 items that evaluate the applications that students should perform to launch and maintain the NST process, such as applying the first and second Leopold manoeuvres, placing the tocodynamometer in the fundus and applying gel to the Doppler ultrasound probe. The evaluation phase consists of five items to assess the procedures that should be carried out when terminating the NST process, such as interpreting the NST outcomes, informing the pregnant woman about the results and recording the operation on the observation paper. Each item on the checklist is scored '1' if the student fulfilled the procedure in the item or '0' if otherwise. Maximum scores that can be taken from the preparation, application and evaluation parts are 7, 12 and 5, respectively. The overall score that can be obtained from the form is 24. The sequence of students' training is performed in accordance with these steps.

2.4.3. Spielberger State Anxiety Inventory

Developed in 1964 by Spielberg et al., this scale is used to measure trait and state anxiety. The Turkish adaptation of the test was conducted by Öner and Le Compte. It includes short statements aiming to do a self-evaluation. The main aim of the State-Trait Anxiety Inventory is to measure an individual's present anxiety level. Its reliability coefficient varies between 0.94 and 0.96. The Cronbach's alpha value of the inventory was found to be 0.791 in our study. Each item in the inventory is scored between 1 (almost never) and 4 (almost always). The total score that can be obtained from the inventory ranges between 20 and 80. The higher the score the higher an individual's anxiety level (Öner and Le Compte, 1998).

2.5. Procedure

The study was carried out in the spring semester of 2016. The study plan is presented in Fig. 1.

2.5.1. Theoretical training

All the students participating in the study were given standard theoretical training. This training was administered in three sessions, each of which took 50 min. The content of the training is presented in Table 1. A didactic lecturing technique was used for the theoretical training. Slide shows and relevant visuals were used as teaching materials. At the end of the training, a question-and-answer session was held. In addition, the teaching materials were shared with the students.

2.5.2. Practical training

2.5.2.1. Video demonstration group (VDG). The video used in this stage was made by the researchers. The video was shot in the skills lab using an NST device and a full-body birthing manikin. During the video shot, one of the researchers narrated and the other played the midwife. The process was performed in accordance with the steps in the skills checklist of the NST. The operation was video recorded. The video demonstration lasted 30 min. After the theoretical training sessions

Table 1
Theoretical training programme.

Sessions	Time
1st session	
- Describing NST and its use	(50 min)
- Introducing NST	
- Advantages and disadvantages of using NST	
- The duty of the midwife in the NST process	
- Gestational evaluation before NST	
- NST application steps	
2nd session	
- Interpretation of NST findings	(50 min)
- Assessment of basal heart rate and variability	
- The reasons of foetal tachycardia and bradycardia and midwifery interventions	
- Periodic changes and midwifery interventions	
- Reactive NST	
- Non-reactive NST and midwifery interventions	
3rd Session (50 min)	
- Evaluation of NST traces with examples	(50 min)

were completed, the students in the video group watched the video.

2.5.2.2. Simulation group with (full-body birthing manikin) birth model (SBMG). Following the theoretical education, the instructor applied the steps in the NST-SEF on a full-body birthing manikin. During the application, the NST device (Trimpeks Inc., Istanbul, Turkey) and a full-body maternal birthing simulator (Gaumard Scientific Company Inc., Miami, USA) were used. Each student was given a chance to practice the process on the simulation model in accordance with the steps in the NST-SEF. Each practice session took 25–30 min. The researchers observed each student and provided feedback on their performance, including a discussion of any mistakes that were made.

2.5.2.3. Hybrid simulation group (HSG). After the theoretical training, the instructor applied the steps in the NST-SEF on the hybrid simulation model. At this stage, a pregnant abdomen with a foetus was fastened to a standard patient abdomen to provide the hybrid simulation. The NST device (Trimpeks Inc., Istanbul, Turkey) was used during this process. Each student practiced the process according to the NST-SEF (based on the NST skills checklist steps). During the application, the patient responded to the student's questions and asked questions of the student about the procedure at the same time. The researchers observed each student and provided feedback on their performance, including a discussion of any mistakes that were made.

2.5.2.4. Control group (CG). Following the theoretical training, a standard application was performed in this group.

2.5.3. Clinical practice

Upon completion of theoretical and practical training, each student in the group was taken to a clinical setting to perform the NST on low-risk pregnant women. Before starting the practice, the students filled out the student information form, and the students' anxiety levels were assessed using the Spielberger State-Trait Anxiety Inventory. During the practice, the NST-SEF was completed and scored. Two instructors evaluated the students. The instructors were not involved in the survey, and they did not know to which group each student belonged.

2.6. Statistical analysis

The data of the study were analysed using the SPSS for Windows 20 software. In the analysis of the data, percentages, numbers, median, the Mann Whitney *U* test for comparing two groups in terms of test scores and the Kruskal Wallis test were used for the comparison of more than two groups. The Bonferroni-corrected Mann-Whitney *U* test, which is a

multiple-comparison test, was used to determine which two groups differed in multiple groups with a significant difference. Spearman's correlation test was used to determine the relationship between the students' educational satisfaction scores, their skills scores and their anxiety scores.

3. Results

3.1. Participant characteristics

The mean student age was 20.35 ± 1.384 (min = 19, max = 28). Education level: 40.2% of the students' mothers were primary school graduates, and 36.6% of the fathers were secondary school graduates. The longest inhabited place of 57.3% of the students was a province. For employment: 14.6% of the students' mothers and 90.2% of their fathers were employed. The groups were similar in terms of the socio-demographic characteristics of the students.

3.2. Scores for satisfaction with education, anxiety, and skills

The median for students' satisfaction with their education score was found to be CG = 4 (Min:3–Max:5); VDG = 4 (Min:2–Max:5); SBMG = 5 (Min:2–Max:5); HSG = 5 (Min:2–Max:5). There was a significant difference between groups in terms of their satisfaction with their education, and the difference was higher in the HSG and SBMG groups in comparison to the CG and VDG groups ($P < 0.001$). The students' anxiety levels were evaluated using the Spielberger State-Trait Anxiety Inventory before the application on pregnant women, and no significant differences were found between the groups ($p > 0.05$) (Table 2).

The NST application skill was examined as the total score for the preparation phase, process implementation phase, evaluation phase and NST skills. No statistically significant differences were found between the groups for the preparation phase ($p > 0.05$). In the implementation phase, the lowest score belonged to the VDG, while the highest score belonged to the HSG, and the difference between the groups was statistically significant ($p < 0.001$). In the evaluation phase, the median score of the CG and VDG was 2, and the median score of the SBMG and HSG was 4. The difference between the groups was statistically significant ($p < 0.001$). The total score medians for NST skills were CG = 15 (Min: 10–Max: 20); VDG = 16 (Min: 8–Max: 21); SBMG = 19 (Min: 12–Max: 23), and HSG = 20 (Min: 17–Max: 23), and the differences between the groups were found to be statistically significant ($p < 0.001$) (Table 3).

There was a positive statistically significant relationship between the score for satisfaction with education and the NST practice skill score ($r = 0.308$; $p = 0.005$). This shows that the satisfaction with education increases as the scores for NST practice skills increase. There was no relationship between the median for satisfaction with education and the state anxiety median ($r = -0.118$; $p = 0.290$) (Table 4).

Table 2
Distribution of the students' state anxiety and satisfaction scores ($n = 82$).

Group	n	State anxiety level		Statistical analysis	Satisfaction with education score		Statistical analysis
		Median (Min–Max)	Mean rank		Median (Min–max)	Mean rank	
CG (a)	23	40 (27–58)	40,07	KW = 5017 df = 3 p = 0,171	4 (3–5)	38,52	KW = 26,803 df = 3 p < 0.001
VDGG (b)	22	42,5 (29–63)	50,48		4 (2–5)	24,89	
SBMG (c)	17	38 (28–57)	34,03		5 (2–5)	45,88	
HSG (d)	20	38,5 (29–66)	39,63		5 (2–5)	59,48	
Differences						(a–b; a–d; b–c; b–d)	

Note. CG: Control Group; VDG: Video Demonstration Group; SBMG: Simulation with Birth Model Group; HSG: Hybrid Simulation Group.
 $p < 0.001$ (Kruskal Wallis Test)

4. Discussion

This study found that there was a significant difference between the groups in terms of satisfaction with their education and that the use of simulation increased their satisfaction with their education. In addition, it was determined that as the satisfaction with education increased, NST practice skill scores increased as well. In their study, Stayt et al. (2015) found that when comparing a traditional lecturing method to the use of simulation that the simulation group was significantly more satisfied with their education. Lubbers and Rossman (2017) found that satisfaction and self-confidence were higher in students experiencing simulation. They also revealed high levels of satisfaction with the effectiveness of the simulation technique. Catling et al. (2016) reported that students mainly commented about the simulations as positive learning experiences. According to the post-application questionnaire, the participants found the learning experience either 'reasonably useful' or 'very useful' (84%) (Catling et al., 2016). Similarly, Terzioğlu et al. (2016) stated that the more real-like the instructional environment was, the more satisfaction the students had.

In this study, the anxiety levels of the students were assessed before they practiced on pregnant women, and no significant difference was found between the groups. Similarly, Suk Jeong et al. (2013) studied the effect of simulation on the clinical skills and self-esteem of nursing students and found that there was no difference between the control and experimental groups in terms of the pre-clinical practice anxiety state. Similarly, Gantt (2013) found in a study on the effect of preparation on anxiety and performance in summative simulations that there was no difference in anxiety levels between the experimental and control groups. Contrary to these findings, there are studies in the literature that show that simulation training reduces the anxiety levels of students (Terzioğlu et al., 2016; Khadivzadeh and Erfanian, 2012). These differences are thought to have stemmed from the individual characteristics of the students involved in the study. In addition, it is also believed that the students in our study had similar anxiety levels because they practiced the NST application on actual patients for the first time.

According to the results of this study, simulation focusing on skills training made the connection between theory and practice for the students, which then paved the way for a deeper understanding. During the study, it was determined that there was a statistically significant difference between the groups in terms of mean NST practice skill scores. Simulation and hybrid simulation methods with birthing manikin were proven to be more effective in skills development than standard teaching and video demonstration methods. In their study, Shin et al. (2015) revealed that patient simulation education was more effective than traditional learning methods. In another study, nursing students were randomly assigned to control and intervention groups. The former received traditional training, and the latter received simulation training. It was concluded, as a result of the study, that simulation-based training may provide some benefits as an educational strategy to deal with patients with deteriorating health (Stayt et al., 2015).

Table 3
Distribution of the students' skill of NST application skill score (n = 82).

Group	n	Preparation phase		Process implementation phase		Evaluation phase		Medians for NST skills/total		Statistical analysis
		Median (Min–Max)	Mean rank	Median (Min–Max)	Mean rank	Median (Min–Max)	Mean rank	Median (Min–Max)	Mean rank	
CG(a)	23	6 (4–7)	32,98	7 (3–11)	28,61	2 (0–5)	30,93	15 (10–20)	25,76	KW = 37,381 df = 3 P < 0.001 (a–c; a–d; b–c; b–d)
VDC (b)	22	7 (3–8)	44,66	6,5 (3–11)	31,75	2 (1–4)	25,77	16 (8–21)	28,52	
SBMG(c)	17	6 (5–8)	44,00	9 (5–12)	50,97	4 (1–5)	58,41	19 (12–23)	56,18	
HSG (d)	20	6 (5–9)	45,70	10 (7–12)	59,00	4 (2–5)	56,58	20 (17–23)	61,40	
Differences										

Note. CG: Control Group; VDC: Video Demonstration Group; SBMG: Simulation with Birth Model Group; HSG: Hybrid Simulation Group.
p < 0.001 (Kruskal Wallis Test)

Table 4

The relationship between median satisfaction scores, median NST application skill and median state anxiety (n = 82).

	r	Median NST application skill score	Median state anxiety score
Median satisfaction with education	p	0.308 0.005	–0.118 0.290

p < 0.01 (Sperman's Correlation Test)

It was also revealed that the highest skill scores in the study belonged to the HGS. This is possibly because the students in the hybrid simulation group were in contact with standard patients, which made the hybrid simulation technique more effective than other training techniques. In the literature, the use of standard patients has been shown to improve students' communication and clinical skills prior to clinical practice (Joeques et al., 2016; Weaver and Erby, 2012; Terzioğlu et al., 2016).

Simulation and skills training improve midwifery skills. They also enhance the learning ability of students by building connections between theory and practice. The learning process profits greatly from the chance to operate in a joint and mutual group in an open environment (Lendahls and Oscarsson, 2017).

5. Conclusion

The study results show that simulation techniques increase students' clinical practice skills and satisfaction with their education. For this reason, it is suggested that simulation techniques should take the place of traditional teaching techniques for topics requiring skills in midwifery. Given the cost of simulation models, the hybrid simulation may be a practical and cost-efficient alternative in teaching the necessary skills to novice learners.

6. The strengths and weaknesses of the study

The strength of this study is that it compares four different training techniques and is a randomised, controlled and single-blind study. The study's weaknesses include the small sample size, the use of only one institution (as there is only one midwifery school in Ankara) and the lack of comparison between universities.

Conflict of interest

There are no conflicts of interest. No funding source was utilized.

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