Research article

Effectiveness of Nicu nurses' competence enhancement program for developmentally supportive care for preterm infants: A quasi-experimental study☆

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ARTICLE INFO

ABSTRACT

Background: Developmental support care for preterm infants contributes toward their health and shortens their hospital stay. In many countries, programs for preterm infant development such as Newborn Individualized Developmental Care and Assessment Program and Philips Wee Care have not yet been disseminated.
Objectives: To evaluate the effectiveness of neonatal intensive care unit nurses' competence enhancement program for developmental support care of preterm infants.
Methods: A quasi-experimental study using pretest and posttest designs with a nonequivalent control group was conducted in five neonatal intensive care units of university hospitals in South Korea. A total of 39 nurses (20 in the experimental group and 19 in the control group) participated. The program was composed of family support, healing environmental support, stress and pain management, sleep support, position support, nutrition optimization, skin protection, and sensory stimulation. In addition, four sessions were provided using Zoom, Padlet, online quizzes, and performance diaries.
Results: For nursing knowledge, no significant interaction effect was observed between groups and time ($F = 1.38$, $p = .258$). However, the main effect on the group ($F = 10.81$, $p < .001$), and the main effect of time were significant ($F = 12.97$, $p < .001$). For nursing attitude, the interaction effect between group and time ($F = 2.06$, $p = .142$), and the main effect on the group were not significant ($F = 0.23$, $p = .635$). Finally, for nursing competence, the interaction effect between group and time was significant ($F = 4.46$, $p = .019$).
Conclusions: The educational program was effective in improving nursing knowledge and competence in developmentally supportive care for preterm infants. This program is expected to contribute toward the growth and development of premature infants.

1. Introduction

Approximately 15 million preterm infants are born every year, and their birth rate is reported to be 5%–18% worldwide [1]. The survival rate of premature infants has greatly improved [2]. Because of technological development and active care in the neonatal

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intensive care unit (NICU), the survival rate of Korean preterm infants has improved from 62.7% in 2007 to 85.8% in 2017 [3]. The increase in the survival rate of preterm infants has caused interest and demand for quality care of developmental support after birth [4].

Preterm infants exposed to the NICU environment, which is different from the mother's uterine, experience various stressors such as noise, light, and pain [5]. Such stress negatively affects their brain development, and causes complications such as neuromotor disorders and developmental delays [2,6]. In other words, the issue of development after survival of preterm infants emerges in the NICU. Therefore, developmental support care is needed to prevent developmental delays and promote optimal growth of preterm infants in the NICU [7,8].

Developmentally supportive care (DSC) is an individual and integrated nursing practice that supports the attachment between parents and their babies, in addition to ensuring that the NICU environment is as similar to the intrauterine environment as possible to maintain the physiological stability and optimal growth and development of preterm infants [7]. Additionally, it includes interventions for family support, nutrition management, sleep management, nursing care for infants' cues, postural support, minimizing pain, stress, and sensory stimulation [9-13]. NICU nurses are very important for the growth of premature infants because they directly perform therapeutic care (including 24-h noise management through various machines and monitoring devices), respond to frequently occurring emergencies, and facilitate parental intervention [9]. Therefore, NICU nurses should have the competence to provide appropriate individual care by recognizing the behaviors and signals of preterm infants based on correct knowledge and nursing skills as well as positive attitudes about DSC for preterm infants [13].

According to previous studies [13,14], the knowledge level of NICU nurses about DSC for preterm infants is insufficient. In addition [8], reported that NICU nurses' knowledge level of DSC for preterm infants was insufficient regardless of academic background or work experience, and one-time education or intra-unit meetings had no effect on acquiring knowledge. Therefore, systematic educations are needed for NICU nurses to acquire knowledge on DSC for preterm infants [8,15].

According to Ref. [16] the more positive the NICU nurses' attitude toward DSC, the better they perform DSC for preterm infants. Additionally [17], showed that, when the attitude toward DSC performance for premature infants was positive, its quality was high. Meanwhile [8], reported that the attitudes of Korean NICU nurses toward DSC for preterm infants were not positive. Therefore, interventions are needed to improve NICU nurses' attitude toward supporting the development of premature infants, and this should be considered an important issue in developing the competence of NICU nurses.

Nursing care competence is an ongoing process of integrating knowledge, values, attitudes, and skills for quality nursing care in practice [18]. The nursing care competence of developmental support for preterm infants is important for NICU nurses, and includes efforts to pursue optimal growth and development by minimizing developmental risks and managing and caring for medical conditions of preterm infants [19]. NICU nurses with insufficient competency of developmental support for preterm infants cannot provide quality care because they do not recognize preterm infants' cues [17]. [8] reported that the nursing care competence level of developmental support for preterm infants was insufficient in South Korea.

Developmental support care for preterm infants contributes toward their health and shortens their hospital stay [20]. However, in many countries, programs for preterm infant development such as NIDCAP and Philips Wee Care have not yet been disseminated [8]. Even in these countries, interest in the development of preterm infants has recently increased, and descriptive research [8,15,17] and scale development [19] are being conducted. However, intervention studies that can perform qualitative DCS for preterm infants are needed even in NICUs that do not apply NIDCAP or Philips Wee Care [8].

This study intends to apply a program to enhance NICU nurses' competence in providing DSC for preterm infants, and to verify its effectiveness. The study specifically aimed to verify the effects of the NICU nurses' competence enhance program on the nursing knowledge, attitudes, and care competence in providing DSC for preterm infants.

1.1. Conceptual framework

In this study, a conceptual framework was established by using nursing knowledge, attitude, and care competence to strengthen
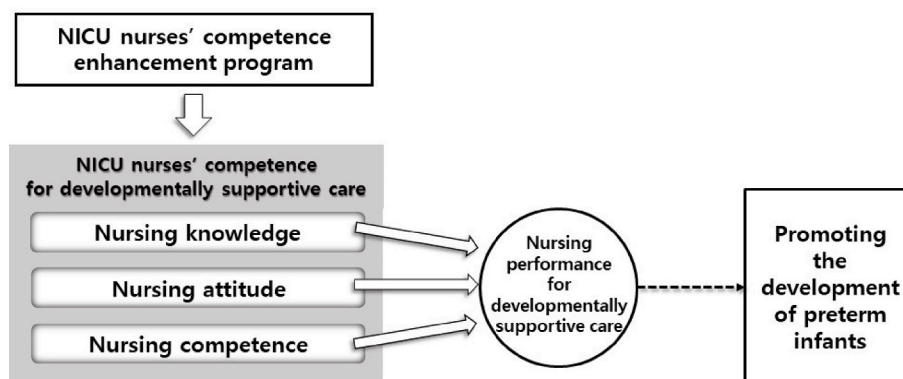

Fig. 1. The conceptual framework of this study.

NICU nurses' competency of developmental support care for preterm infants (Fig. 1). Based on the results of previous studies that NICU nurses with accurate knowledge of DSC for preterm infants provide high quality developmental support [8,21], this study considered improving knowledge to strengthen the competency of NICU nurses. Attitude is a belief in the consequences that may occur when performing a particular action [22]. [16] reported that the more positive NICU nurses' attitude toward developmental support care, the higher the intention to perform developmental support care, and the better developmental support nursing care. Based on this, promoting a positive attitude toward developmental support care for preterm infants was applied to the framework of this study. Nursing competence is an important concept in nursing practice because NICU nurses with high nursing competence of developmental support care provide excellent developmental support nursing care [7,19]. Therefore, this study was conducted based on the framework that NICU nurses' competence promotes the development of individual preterm infants through the interaction between nursing knowledge, attitude, and nursing competence.

2. Methods

2.1. Design

This quasi-experimental study used pretest and posttest designs with a nonequivalent control group.

2.2. Setting and sample

Participants in this study were registered nurses (RNs) in five NICUs of university hospitals located in Seoul, Gyeongsang-do, Jeolla-do, and Chungcheong-do in South Korea. The inclusion criteria were as follows: 1) nurses who have worked at the NICU for more than six months, 2) nurses who provide direct nursing care to preterm infants, 3) nurses with no experience in participating in the developmental support care competence program, and 4) nurses who understand the purpose of this study and voluntarily agree to participate. Nurses who did not participate in the program more than twice were excluded.

The number of participants was calculated based on effect size medium, significant level (α) 0.05, and power ($1-\beta$) = 0.80, using G-Power 3.1.9 Program [23]. The sample size calculated was 28, and 40 participants among a total of 119 RNs in five NICUs were included considering a dropout rate of approximately 30%. Twenty nurses from two NICUs in Jeolla-do and Chungcheong-do were

Table 1
NICU nurses' competence enhancement program.

	First session	Second session	Third session	Fourth session
Topic	Concept of developmentally supportive care	Family support, healing environmental support, stress and pain management, sleep support,	Position support, nutrition optimization, skin protection, and sensory stimulation	Application of developmentally supportive care
Objectives	· It can be explained about development of preterm infants. · It can be explained about the developmentally supportive care for preterm infants.	· It can be practiced about family centered care. · It can be practiced for healing environment. · It can be practiced for management stress. · It can be practiced the sleeping support.	· It can be practiced for position support. · It can be practiced for nutrition optimization. · It can be practiced for skin protection. · It can be practiced for sensory stimulation.	· It can be explained the strategy of developmentally supportive care for preterm infants. · Developmentally supportive care can be applied to the actual situation and solve the relevant nursing problems.
Introduction	· Watching the video · Orientation	· Watching the video · Sharing the diary for last time	· Sharing the diary for last time	· Watching the video · Sharing the diary of each session
Development	· Development of premature infants · Developmentally supportive care for preterm infants	· Family centered care · Healing environmental strategy · Minimizing stress and pain · Sleeping management strategy	· Position support and minimal handling · Nutrition optimization strategy · Skin protection strategy · Sensory stimulation strategy	· Quiz solution · Discussion and feedback of diary · Wrap-up
Summary	· [Attitude] Learners' opinion sharing · [Knowledge] Quiz · [Performance] Diary · Next session notice	· [Attitude] Learners' opinion sharing · [Knowledge] Quiz · [Performance] Diary Next session notice	· [Attitude] Learners' opinion sharing · [Knowledge] Quiz · [Performance] Diary · Next session notice	· Sharing experiences about each person's changes as participating in the program
Methods & materials	· Zoom · Lecture using PPT · Quiz using the Thinkerbell	· Padlet · Lecture using PPT · Quiz using the Thinkerbell	· Padlet · Lecture using PPT · Quiz using the Thinkerbell	· Zoom · Quiz using the Thinkerbell

assigned to the experimental group. To prevent the diffusion of the intervention, 20 nurses from three NICUs in Seoul and Gyeongsang-do, located 200 km from the experimental group, were assigned as the control group. No nurses were dropped during the intervention, and one nurse in the control group was excluded due to no response at the follow-up test. Therefore, the data of 39 nurses (20 in the experimental group and 19 in the control group) were used in the final analysis.

2.3. NICU nurses' competence enhancement program

As the instructional material, online media such as Zoom (Zoom Video Communications, Inc., California, USA) and Padlet (Wallwisher Inc., San Francisco, USA) were used. For formative evaluation, an online quiz was conducted using the Thinkerbell (i-Scream media, Seongnam, South Korea) platform. For motivation, three YouTube videos related to the development of premature infants were used. In addition, to deliver the lecture content, three PowerPoint (PPT, Microsoft Corporation, Washington, USA) files were created with learning objectives for each class, and were produced as video lectures (Table 1).

In the first session, non-face-to-face education was conducted using Zoom. In the introduction stage, news videos (https://youtu.be/Ynz3Ss_phgw) about the growth and development of preterm infants were watched, and self-introduction and orientation were conducted. In the development stage, DSC of the preterm infant was taught using a PPT. To encourage practical performance, performance diaries on support care of the development of preterm infants were assigned. In the summary stage, participants shared their opinions or experiences on the topic studied to inspire motivation for DSC, and a quiz was conducted to evaluate comprehension of the learning content.

The second session was conducted for one week using Padlet. In the introduction stage, a news video (https://youtu.be/Uzv4rJRXR_E) on the importance of NICU care for premature infants was watched, and the experiences of DSC from the previous week were shared. In the development stage, educational videos on family-centered care (including family support and parent participation), NICU environmental management (including noise and lighting), stress and pain management, and sleeping management were posted. In the summary stage, the formative evaluation was performed using online quizzes. Additionally, performance diaries on the contents of the session were assigned.

The third session was conducted for one week using Padlet. In the introduction stage, the instructor summarized and posted the learners' experiences of the content covered in the second lesson. In the development stage, an educational video on position support, minimal handling, nutrition optimization including type of lactation and non-nutritive sucking, skin protection including bathing and humidification management, and sensory stimulation including kangaroo care, were posted. The summary step was the same as that in the second session.

The final session was conducted using Zoom. In the introduction stage, a video recording of the process from admission to the NICU to discharge after being born prematurely was watched. In the development stage, solutions to quizzes were provided on the entire learning content. In addition, the performance diaries written in each session were discussed, and feedback was provided. In the summary stage, participants shared their experience of the changes while participating in the program and provided each other feedback.

2.4. Measurement

The general characteristics of the participants were age, education, marital status. Additionally, total work experience and work experience in the NICU were measured.

Nursing knowledge on the developmental support care was measured using the knowledge tool developed and verified content validity by Ref. [8]. This tool consists of 20 items, measured on a nominal scale of "yes" and "no." The number of correct answers was converted into a perfect score of 100. The higher the score, the higher the level of nursing knowledge about the developmental support care for premature infants.

Nursing attitude toward DSC was measured using the attitude subcategory of the Agreement with Theory of Planned Behavior Statements Scale, which was developed by Ref. [16]; and translated and validated by Ref. [8]. This tool consists of eight items. Each item was measured on a five-point Likert scale, and three items were inversely converted. The higher the score, the more positive the attitude toward developmental support care. Cronbach's alpha of [8] study was 0.84, and that of this study was 0.74.

Perceived nursing competence was measured using the developmental support competency scale [19]. This tool consists of 19 items, and six sub-categories including environmental support, parental support, interaction, critical thinking, professional development, and partnership. It was measured on a four-point Likert scale. The higher the score, the higher the competence to support the development of preterm infants. Cronbach's alpha of [19] study was 0.83, and that of this study was 0.85.

2.5. Data collection

Data collection was conducted from August 30 to October 28, 2021 through face-to-face and online survey methods. Participants filled out a self-report questionnaire after providing their written consent. In the pre-test, the general characteristics, nursing knowledge, nursing attitude, and perceived nursing competence of each group were measured from August 30 to September 4, 2021. Intervention was provided to the experimental group once a week for four times from September 6 to September 27, 2021. The follow-up test was conducted from October 4 to October 6, 2021. The final test was conducted from October 25 to October 28, 2021.

2.6. Data analysis

Collected data were analyzed using SPSS WIN 24.0 program. The general characteristics of participants were analyzed as mean, standard deviation, number, and percentage. The homogeneity of the general characteristics between two groups was analyzed by χ^2-test and Mann–Whitney U test. The Shapiro–Wilk test was conducted to verify the normality of the dependent variables, and it was confirmed that all of them were normally distributed. The homogeneity test for the dependent variable was analyzed using independent t-test. To verify the program effect, changes in the dependent variables between two groups were analyzed using independent t-test and repeated measure ANOVA (RM-ANOVA). Post-hoc was analyzed using pairwise comparisons.

2.7. Ethical consideration

This study was conducted with the approval of the institutional review board of Wonkwang University (No. WKIRB-202108-SB-055). Written consent was obtained, and a copy of the consent form was also provided to the participant. To the control group who did not participate in the program, educational materials for this program were provided after the study was completed for ethical compensation. In addition, a small gift worth $10 was provided to the experimental and the control groups as a token of appreciation for their participation in the program.

3. Results

3.1. Homogeneity test

Table 2 presents the results of the homogeneity test. No significant differences were observed between the two groups in terms of general characteristics like age, marital status, educational background, and total work experience and work experience in NICU. Therefore, the general characteristics between two groups is considered homogeneous.

No significant differences were observed between the two groups for the dependent variables of nursing knowledge, nursing attitude, and nursing competence. Therefore, the baseline score of the dependent variables between two groups is considered homogeneous.

3.2. Effects of NICU nurses' competence enhancement program

Table 3 and Fig. 2 show the effects of the program. For nursing knowledge, RM-ANOVA showed no significant interaction effect between groups and time. However, the main effect on the group, and the main effect of time were significant. Additionally, mean scores of both the follow-up and final tests were significantly higher in the experimental group than the control group. Therefore, the NICU nurses' competence enhancement program affects nursing knowledge.

For nursing attitude, RM-ANOVA showed that the interaction effect between group and time, and the main effect on the group were not significant. Additionally, in both the follow-up and final tests, the difference in mean scores between two groups was not significant. Therefore, the NICU nurses' competence enhancement program did not have a significant effect on nursing attitude.

For nursing competence, RM-ANOVA showed that the interaction effect between group and time was significant. Therefore, the NICU nurses' competence enhancement program had a significant effect on nursing competence.

Table 2
Homogeneity test (N = 39).

| Variables	Categories	Experimental group (n = 20)	Control group (n = 19)	χ^2/t	p
		n (%)/Mean ± SD			
Age (year)	≤30	15 (75.0)	12 (63.2)	0.64	.423
	≥31	5 (25.0)	7 (36.8)		
Marital status	Married	14 (70.0)	12 (63.2)	0.21	.651
	Non married	6 (30.0)	7 (36.8)		
Education	College	1 (5.0)	4 (21.1)	2.85	.241
	Undergraduate	16 (80.0)	11 (57.8)		
	Graduation	3 (15.0)	4 (21.1)		
Total work experience (year)		8.47 ± 9.10	8.07 ± 6.47	0.21[a]	.833
NICU work experience (year)		4.68 ± 2.89	6.95 ± 5.60	0.80[a]	.422
Baseline score					
	Nursing knowledge	83.75 ± 9.16	81.84 ± 6.06	0.76	.450
	Nursing attitude	3.85 ± 0.34	3.99 ± 0.27	−1.39	.174
	Perceived nursing competence	2.90 ± 0.27	3.09 ± 0.37	−1.88	.068

[a] Mann-Whitney U test; NICU = neonatal intensive care unit.

Table 3

Effects on nursing knowledge, nursing attitude, and perceived nursing competence toward developmental support care (N = 39).

Category	Experimental group (n = 20)	Control group (n = 19)	t(p)	source	F(p)	Post hoc
	Mean ± SD					
Nursing knowledge						
Baseline test[a]	83.75 ± 9.16	81.84 ± 6.06	0.76 (.450)	Group	10.81 (<.001)	E>C
Follow-up test[b]	92.00 ± 6.96	85.79 ± 6.07	2.96 (.005)	Time	12.97 (<.001)	a<b
Final test[c]	92.00 ± 4.41	86.32 ± 6.63	3.17 (.003)	Group*Time	1.38 (.258)	
Nursing attitude						
Baseline test[a]	3.85 ± 0.34	3.99 ± 0.27	−1.39 (.174)	Group	0.23 (.635)	
Follow-up test[b]	4.19 ± 0.33	3.99 ± 0.42	1.61 (.115)	Time	3.97 (.028)	a<b
Final test[c]	4.18 ± 0.33	4.13 ± 0.46	0.39 (.699)	Group*Time	2.06 (.142)	
Perceived nursing competence						
Baseline test[a]	2.90 ± 0.27	3.09 ± 0.37	−1.88 (.068)	Group	0.01 (.931)	
Follow-up test[b]	3.36 ± 0.34	3.23 ± 0.30	1.26 (.215)	Time	17.00 (<.001)	a<b, c
Final test[c]	3.44 ± 0.40	3.35 ± 0.43	0.66 (.511)	Group*Time	4.46 (.019)	

E = experimental group; C = control group.
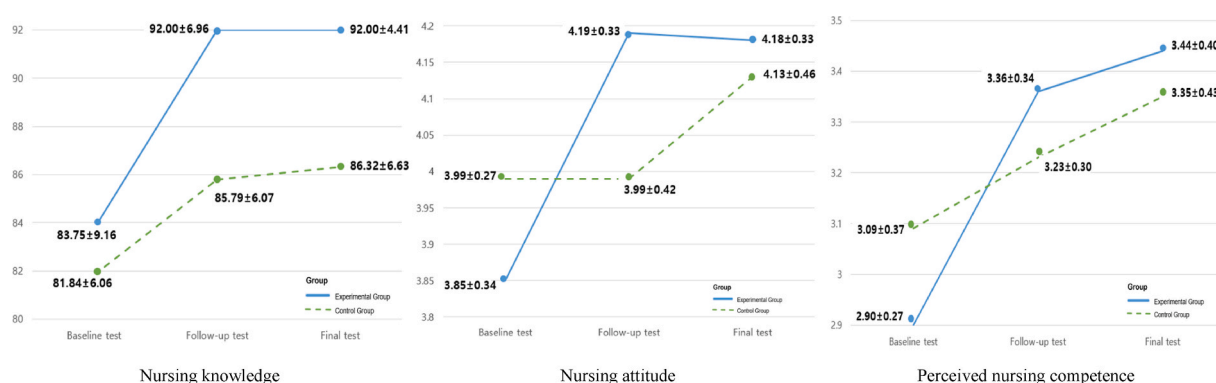
Fig. 2. Score changes of nursing knowledge, nursing attitude, and perceived nursing competence toward developmental support care.

4. Discussion

The NICU nurses' competence enhancement program was found to be effective in improving nursing knowledge. There are previous studies on training program for NICU nurses such as a postural support practice program for preterm infants [24] and developmental support care program for premature infants [13]. These studies reported that nurses' knowledge scores improved after applying the manual program, which is similar to the results of the present study. The program in this study showed a significant effect on nursing knowledge due to the effective use of Padlet's strengths. Padlet is a learning activity that shares each learner's opinion, and is effective in exploring individual lack of knowledge and correcting misunderstood knowledge [25]. In addition, Padlet allows participation repeatedly without time restrictions [26], thereby making it possible to repeatedly learn the contents of each session using Padlet, and improving knowledge. It is considered to be meaningful not only as non-face-to-face intervention in the pandemic, but also as a pedagogy that transcends time and space suitable for nurses who work shifts.

Nursing attitudes of both the experimental and control groups improved over time, indicating that the effect of the program on nursing attitude was insignificant [27]. evaluated the effectiveness of education using virtual social networks for emergency room nurses and reported that attitude scores improved in both the experimental and control groups, similar to the results of this study. The increase in the attitude score in both groups can be interpreted as a result of the test effect affecting the post-survey results. RM-ANOVA has a limitation, in that, the post-measurement value may increase because a specific variable is repeatedly measured and the participant becomes familiar with the measurement tool [28]. In this study, even though the interval between data collection was set to three and five weeks, no effect on attitude could be considered a test effect. In other words, repeating the survey to the control group may induce continued interest in the DSC for preterm infants and affect the increase in the attitude score.

The NICU nurses' competence enhancement program was found to be effective in improving nursing competence. Education programs using practicum and discussion are effective in improving nursing information literacy competency and evidence-based practice competency of nursing students [29]. In addition, educational programs using lectures and simulation practice are effective in improving the clinical core competency of new nurses [30]. The results of these previous studies were similar to those of the present study. In this study, reflection after applying DSC for preterm infants to clinical practice was facilitated through writing performance diaries and discussions using Padlet. Reflection in diaries is effective in improving self-efficacy and learning [31]. Therefore, the educational strategy applied in this study was meaningful in enhancing the nursing competence of NICU nurses.

To overcome the limitations of program participation caused by nurses' shift work, online programs such as Zoom, Padlet, and Thinkerbell were used. In particular, the study was conducted during the coronavirus disease 2019 pandemic. In this pandemic, non-face-to-face contact has been emphasized throughout society and it has begun to change to contact-free [32]. Amid this confusion, especially in the educational field, online education was conducted using new methods and materials. Compared to face-to-face learning environments, online education enables rich information-based asynchronous, many-to-many or one-to-many, and multi-content communication [33]. Therefore, because of the advantages of online education, it is considered that the nurses who are shift workers, who are participants in this study, are suitable to participate in this program. In addition, Padlet enhances the learning effect because the participant can read the information any time, and frequently check and review the parts that are easy to miss [26]. Therefore, the teaching and learning method used in this study would be effective for educational programs for nurses working in shifts.

To encourage NICU nurses to actively practice nursing care during program participation, this study included performance diaries about experiences and reflections. Discussion and reflection diaries are effective in enhancing learning cognition and active interaction between learners [25]. Therefore, the performance diaries applied in this study helped the participants to learn cooperatively and share their own and others' experiences. Additionally, in this study, Padlet was used to organize learning contents by sharing the participants' experience. Padlet, an online bulletin board, can be regarded as a brainwriting technique because it allows participants to share opinions using post-it notes. Brainwriting is a method of writing personal thoughts on a piece of paper, and is effective for inducing personal ideas through thinking or silence, not disturbing thinking through speech, and eliciting opinions of participants who hesitate to present them [34]. Therefore, the performance diaries and experience-sharing applied in this study are meaningful, in that, they can contribute to strengthening the nursing competence to provide DSC for preterm infants.

The program in this study was effective in strengthening the competence of NICU nurses in providing DSC for preterm infants. The strength of this study is that, first, an online education was developed so that shift workers could use the program without limiting working hours. Second, the NICU nurse's competence of DSC for infants was strengthened by dealing with comprehensive topics including family support, healing environmental support, stress and pain management, sleep support, nutrition optimization, skin protection, and sensory stimulation. A limitation of this study is that the experimental group and control group were not randomly assigned.

5. Conclusion

This study was conducted to verify the effectiveness of the NICU nurses' competence enhancement program of DSC for preterm infants. The educational program was confirmed to be effective in improving nursing knowledge and competence in providing DSC for preterm infants. The implications for future nursing education are as follows: the program developed in this study will contribute toward improving the competence of NICU nurses in providing DSC for preterm infants, and ultimately in positively inducing the growth and development of premature infants. In addition, the use of Padlet and performance diaries enhanced knowledge and competence in this study. Therefore, it is advisable to use them in nursing education.

Author contribution statement

Han Na Lee: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Haeryun Cho: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no competing interests.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2023.e12944.

References

[1] World Health Organization, Preterm birth, 2018. Retrieved from, https://www.who.int/news-room/fact-sheets/detail/preterm-birth Preterm birth (who.int).

[2] E.F. Bell, S.R. Hintz, N.I. Hansen, C.M. Bann, M.H. Wyckoff, S.B. DeMauro, et al., Mortality, in-hospital morbidity, care practices, and two-year outcomes for extremely preterm infants in the United States, 2013-2018, J. Am. Med. Assoc. 327 (3) (2022) 248–263, https://doi.org/10.1001/jama.2021.23580.

[3] Korean Neonatal Network, Annual Report 2017. Seoul. South Korea, Korean Neonatal Network, 2017.

[4] H. Lee, H.J. Park, H. Cho, Analysis of research on developmentally supportive care for prematurity in neonatal intensive care unit: a scoping review, Child Health Nurs. Res. 28 (1) (2022) 9–22, https://doi.org/10.4094/chnr.2022.28.1.9.

[5] Ł. Bieleninik, C. Gold, Early intervention for premature infants in neonatal intensive care unit, Acta Neuropsychol. 12 (2) (2014) 185–203.

[6] R. Montirosso, E. Tronick, R. Borgatti, Promoting neuroprotective care in neonatal intensive care units and preterm infant development: insights from the neonatal adequate care for quality of life study, Child Develop. Perspect. 11 (1) (2017) 9–15, https://doi.org/10.1111/cdep.12208.

[7] J. Kim, H. Shin, Concept analysis of developmental care for preterm infants: hybrid model, Child Health Nurs. Res. 20 (4) (2014) 350–358, https://doi.org/10.4094/chnr.2014.20.4.350.

[8] H.N. Lee, J.H. Park, H. Cho, Developmentally supportive care among neonatal intensive care unit nurses in South Korea knowledge, perceived importance, perception, and perceived competence, Adv. Neonatal Care (2021), https://doi.org/10.1097/ANC.0000000000000943. September, 30, 2021.

[9] L. Altimier, R. Phillips, The neonatal integrative developmental care model: advanced clinical application of the seven core measures for neuroprotective family-centered developmental care, N.born Infant Nurs. Rev. 16 (4) (2016) 230–244, https://doi.org/10.1053/j.nainr.2016.09.030.

[10] M. Coughlin, S. Gibbins, S. Hoath, Core measures for developmentally supportive care in neonatal intensive care units: theory, precedence and practice, J. Adv. Nurs. 65 (10) (2009) 2239–2248, https://doi.org/10.1111/j.1365-2648.2009.05052.x.

[11] N. Griffiths, K. Spence, A. Loughran-Fowlds, B. Westrup, Individualized developmental care for babies and parents in the NICU: evidence-based best practice guideline recommendations, Early Hum. Dev. 139 (2019), 104840, https://doi.org/10.1016/j.earlhumdev.2019.104840.

[12] P. Halder, D. Bera, A. Banerjee, Developmentally supportive care in neonatal intensive care unit (NICU): a review, Indian J. Med. Res. Pharmaceut. Sci. 2 (2) (2015) 17–23.

[13] Y. Sathish, L.E. Lewis, J.A. Noronha, B.S. Nayak, M.S. Pai, L. Altimier, Promoting developmental supportive care in preterm infants and families in a level III neonatal intensive care unit (NICU) setting in India, Nurse Educ. Pract. 40 (2019), 102612, https://doi.org/10.1016/j.nepr.2019.08.006.

[14] M.R. Nejad, Z. Eskandari, M. Heidarzadeh, A. Afjeh, A. Almasi-Hashiani, F. Akrami, Assessing infant-oriented care with developmental support approach in Iranian NICUs, J. Matern. Fetal Neonatal Med. 31 (14) (2018) 1851–1855, https://doi.org/10.1080/14767058.2017.1330879.

[15] X. Zhang, S.Y. Lee, J. Chen, H. Liu, Factors influencing implementation of developmental care among NICU nurses in China, Clin. Nurs. Res. 25 (3) (2016) 238–253, https://doi.org/10.1177/1054773814547229.

[16] S.M. van der Pal, C.M. Maguire, S. Le Cessie, S. Veen, J.M. Wit, F.J. Walther, J. Bruil, Staff opinions regarding the new-born individualized developmental care and assessment program (NIDCAP), Early Hum. Dev. 83 (7) (2007) 425–432, https://doi.org/10.1016/j.earlhumdev.2007.03.007.

[17] H. Hong, H.M. Son, Factors influencing developmental care performance among neonatal intensive care units nurses, Child Health Nurs. Res. 26 (2) (2020) 131–139, https://doi.org/10.4094/chnr.2020.26.2.131.

[18] Z. Nabizadeh-Gharghozar, N.M. Alavi, N.M. Ajorpaz, Clinical competence in nursing: a hybrid concept analysis, Nurse Educ. Today 97 (2021), 104728, https://doi.org/10.1016/j.nedt.2020.104728.

[19] J.S. Kim, H.S. Shin, Development of the developmental support competency scale for nurses caring for preterm infants, J. Korean Acad. Nurs. 46 (6) (2016) 793–803, https://doi.org/10.4040/jkan.2016.46.6.793.

[20] C. Moody, T. Callahan, H. Aldrich, B. Gance-Cleveland, S. Sables-Baus, Early initiation of Newborn Individualized Developmental Care and Assessment Program (NIDCAP) reduces length of stay: a quality improvement project, J. Pediatr. Nurs. 32 (2016) 59–63, https://doi.org/10.1016/j.pedn.2016.11.001.

[21] R.E. Mohammed, G.M. Khamis, Y.Y. Sabry, Effect of preterm neonates' developmental supportive care program on nurses' performance, Nurs. Health Sci. 7 (4) (2018) 33–45.

[22] I. Ajzen, The theory of planned behavior, Organ. Behav. Hum. Decis. Process. 50 (2) (1991) 179–211, https://doi.org/10.1016/0749-5978(91)90020-T.

[23] F. Faul, E. Erdfelder, A. Buchner, A.G. Lang, Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses, Behav. Res. Methods 41 (2009) 1149–1160.

[24] A. Spilker, C. Hill, R. Rosenblum, The effectiveness of a standardised positioning tool and bedside education on the developmental positioning proficiency of NICU nurses, Intensive Crit. Care Nurs. 35 (2016) 10–15, https://doi.org/10.1016/j.iccn.2016.01.004.

[25] E. Lee, Analysis of the characteristics of free-riding learner in online collaborative learning, J. Korea Cont. Assoc. 19 (1) (2019) 358–396, https://doi.org/10.5392/JKCA.2019.19.10.385.

[26] S. Livy, T. Muir, C. Murphy, A. Trimble, Creative approaches to teaching mathematics education with online tools during COVID-19, Int. J. Math. Educ. Sci. Technol. 53 (3) (2021) 573–581, https://doi.org/10.1080/0020739X.2021.1988742.

[27] T.N. Ghezeljeh, J.M. Aliha, H. Haghani, N. Javadi, Effect of education using the virtual social network on the knowledge and attitude of emergency nurses of disaster preparedness: a quasi-experiment study, Nurse Educ. Today 73 (2019) 88–93, https://doi.org/10.1016/j.nedt.2018.12.001.

[28] S.B. Plichta, E.A. Kelvin, Comparing the of three or more related-measures ANOVA and Fredman's ANOVA by rank, in: H. Surrena (Ed.), MUNRO'S Statistical Methods for Health Care Research, 6th., Lippincott williams & wilkins, New York, 2015, pp. 215–246.

[29] M.G. Cho, M.O. Gu, Development and effects of a nursing information literacy competency education program for undergraduate nursing students, J. Korean Acad. Soc. Nurs. Educ. 27 (2) (2021) 210–222, https://doi.org/10.5977/jkasne.2021.27.2.210.

[30] H. Jeong, S.H. Moon, D. Ju, S.H. Seon, N. Kang, Effects of the clinical core competency empowerment program for new graduate nurses led by clinical nurse educator, Crisisonomy 17 (6) (2021) 109–123, https://doi.org/10.14251/crisisonomy.2021.17.6.109.

[31] Y. Kim, Y. Park, J. Hur, A case study of real-time art education in a virtual space: focusing on theater classes using Zoom and Padlet, J. Qualit. Inquiry 2 (2) (2021) 1–28, https://doi.org/10.22768/JFLS.2021.2.2.1.

[32] Y.M. Jung, I.Y. Yoo, Career development needs of Korean nursing students and professionals: a cross-sectional survey, Nurse Educ. Today 108 (2022), 105209, https://doi.org/10.1016/j.nedt.2021.105209.

[33] S.H. Lim, Content analysis on online non-face-to-face adult nursing practice experienced by graduating nursing students in the ontact era, J. Korea Acad. Industr. Cooper. Soc. 22 (4) (2021) 195–205, https://doi.org/10.5762/KAIS.2021.22.4.195.

[34] E.J. Yun, T.I. Kim, Development and effectiveness of an educational program on developmental positioning for neonatal intensive care unit nurses in South Korea: a quasi-experimental study, Child Health Nurs. Res. 28 (1) (2022) 70–81, https://doi.org/10.4094/chnr.2022.28.1.70.