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Original Article

The Effects of Flipped Classroom-based Prenatal Breastfeeding Education on Maternal Breastfeeding Knowledge, Attitude, Behavior, Self-efficacy, Satisfaction, and Exclusive Breastfeeding Rate: A Quasi-experimental Design

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Purpose: There is much evidence to support the role of education in enabling mothers to acquire sufficient knowledge and skills to successfully breastfeed. The limitations of traditional educational methods and the increasing popularity of technology have led to the development of new online educational models. The aim of this study is to examine the effects of flipped classroom-based prenatal breastfeeding education on breastfeeding knowledge, attitude, behavior, self-efficacy, satisfaction, and exclusive breastfeeding rate.
Methods: This quasi-experimental study was conducted in a baby-friendly hospital in Taiwan. Eighty-one primigravida women were enrolled; 41 in the experimental group and 40 in the control group. The experimental group participated in a flipped classroom-based prenatal breastfeeding educational program, which combined online self-learning and nursing instruction, while the control group received traditional prenatal education. Chi-square and t-tests were used to compare sociodemographic and baseline characteristics between the two groups to test for homogeneity at entry. One-way analysis of variance was performed to test the differences in outcomes between the two groups.
Results: The results revealed significantly higher scores in the experimental group in terms of maternal breastfeeding knowledge, attitude, self-efficacy, and satisfaction. Compared to the control group, the experimental group had a higher exclusive breastfeeding rate at one month postpartum and a lower bottle feeding rate at two months postpartum. However, there were no significant differences in feeding method between the two groups.
Conclusion: Flipped classroom-based prenatal breastfeeding education is a feasible strategy for improving breastfeeding knowledge, attitude, self-efficacy, and satisfaction. Compared with the traditional education mode, the flipped classroom-based education has not significantly improved the breastfeeding rate of one month and two months after giving birth.

Keywords: Flipped classroom, Prenatal breastfeeding education, Breastfeeding self-efficacy, Breastfeeding satisfaction

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1. Introduction

Improving breastfeeding rate is not only an important strategy worldwide for maternal and child health, but also a policy of most countries to safeguard public health and reduce medical costs [1]. Due to the benefits of breastfeeding for mothers and babies, assisting mothers to successfully breastfeed is important. Many studies have confirmed the effectiveness of breastfeeding education in improving breastfeeding rate [2]. However, traditional verbal, written, or video-based educational methods only enable pregnant women to receive knowledge and information passively. As many professionals have limited time and heavy workloads, it is often difficult for them to implement adequate feedback and evaluation mechanisms. This also highlights the need to develop breastfeeding education that is both effective and efficient.

Nowadays, with advancements in technology and the Internet, online education and self-learning have become feasible. Previous studies have shown that the Internet is the primary tool for learning about breastfeeding. However, this raises the issue of information accuracy [3]. Therefore, it is necessary to develop innovative prenatal breastfeeding education that combines online learning and nursing instruction. Furthermore, some scholars have pointed out that it is difficult to fully present dynamic breastfeeding behaviors using traditional static images. In a quasi-experimental study of 120 women, the control group received routine verbal breastfeeding education from nursing staff, accompanied by a pamphlet, during prenatal check-up, while the experimental group received an online course with integrated text, pictures, animations, and images. The results showed better self-assessment of sucking behavior in the early postpartum period in the experimental group when compared with the control group [4]. Integrating web-based technology may improve the effectiveness of breastfeeding education.

The flipped classroom model is a combination of online learning and teacher guidance that has been introduced in recent years with the purpose of replacing the traditional teacher-centred education system with a student-centred one. Online teaching allows students to learn on their own at home. The classroom then becomes a place where interactive discussions can be conducted between teachers and students [5]. The emphasis of these discussions is on solving problems, shifting learning from passive to active and making the classroom a problem-solving location [6]. Many studies have confirmed that flipped classrooms are better for students than traditional teaching models [7, 8], but relatively few studies have addressed the use of this model in health education.

Based on the literature, more breastfeeding knowledge leads to better breastfeeding self-efficacy, which can increase the intention to breastfeed and prolong the period of exclusive breastfeeding [9, 10, 11, 12]. Online learning enables women to view breastfeeding materials anytime and anywhere during pregnancy and discussions with professionals can enhance their breastfeeding knowledge and confidence. New mothers generally comprise a young group. As smartphone and Internet use is increasingly popular in Taiwan, particularly among this age group, the combination of Internet technology and breastfeeding education has become feasible. In addition, maternity education is consistent with the characteristics of adult learning theory, such as self-directed learning combined with life experience and development tasks, with a focus on knowledge that can be applied immediately [13].

In summary, the flipped classroom is a teaching strategy that involves blended learning and a reversal of the traditional learning environment through the provision of online content before class (outside the classroom). It also transforms activities, including activities traditionally considered homework. In a flipped classroom, students can watch online lectures at home, then participate in discussions and practical exercises in the classroom, under the guidance of a mentor. We developed a flipped classroom prenatal breastfeeding educational model for pregnant women to gain breastfeeding knowledge and learn breastfeeding techniques online. This enables more time for asking questions and engaging in discussions with nurses about practical difficulties during prenatal visits (classroom). Women learn at their own pace and nurses assess the extent to which they absorb breastfeeding information by practicing some of the skills, such as breastfeeding posture. Different from

the traditional model in which pregnant women only receive breastfeeding knowledge passively from the nursing staff during prenatal visits, this flipped classroom-based educational model encourages pregnant women to actively learn. The aim of this study is to compare the differences between the flipped classroom-based prenatal breastfeeding educational model and the traditional educational model with regards to breastfeeding knowledge, attitude, behavior, self-efficacy, satisfaction, and postpartum breastfeeding rate.

2. Methods

2.1. Research design and participants

This quasi-experimental study was carried out in the maternity unit of a regional teaching hospital in Taiwan. On average, 1,000-1,200 babies are born every year in this baby-friendly hospital. Participants were women who were pregnant for the first time. We hypothesized that there is a significant difference between flipped classroom-based prenatal breastfeeding education and traditional prenatal breastfeeding education. The sample size was estimated using G power 3.1 software, with effect size= .662, α=.05 (two-tailed), power=.8 [14]. The estimated sample size was 74, with a minimum of 37 participants in each group (experimental and control).

Pregnant women were eligible to participate in the study if they were primigravidas over 20 years old, had the intention to breastfeed postpartum and without obstetric complications (such as premature delivery, placenta previa, preeclampsia/ eclampsia, postpartum haemorrhage), could communicate in Mandarin or Taiwanese, used electronic devices (such as computers, tablets, mobile phones, etc.), and understood Chinese. Women who were unable to breastfeed due to a disease or condition, those diagnosed with postpartum depression, and those who did not use electronic devices were excluded.

2.2. Data collection

Ethics approval was obtained from the Institutional Review Board of the hospital (project number HP160014). Women who agreed to participate in the flipped classroom-based prenatal breastfeeding educational program were assigned to the experimental group and those who agreed to participate in the traditional prenatal breastfeeding educational program were assigned to the control group. We used a code instead of group, so that the data analyst was blinded to the participants' group assignments. All subjects signed a consent form.

The researchers used Google's collaboration platform to set up a "breastfeeding teaching folder" consisting of seven units: skin-to-skin contact immediately after birth, breastfeeding posture, promotion of lactation, breastfeeding nutrition, breastfeeding auxiliary supplies, preservation of breast milk, and prevention of mastitis. About 10-15 minutes were needed to complete each unit. In addition to graphics, the website included two four-minute videos for each unit. Participants used anonymous IDs to access the website and could return repeatedly.

A trained nurse showed women in the experimental group how to access the "breastfeeding teaching folder" at 20-28 weeks gestation. The nursing staff also emphasized the benefits of breastfeeding, the importance of breastfeeding according to the needs of the baby, the importance of skin-to-skin contact after delivery, how to ensure adequate milk supply, the correct posture of the baby, and sucking techniques.

When the primigravida women returned to the hospital at 28-34 weeks gestation, they discussed the contents of the folder with the nurse. After discussion, the nurse educator conducted an assessment of their knowledge regarding the advantages of breastfeeding and how to ensure adequate milk production. In addition, they used a doll and a breast model to show the nurse the baby-holding and breastfeeding postures they had learned online.

The control group received traditional prenatal breastfeeding education through oral instructions and pamphlet. Specifically, the nursing staff provided breastfeeding knowledge during the prenatal visit, with written materials to take home. The content was similar to that received by the experimental group but in the form of text and static graphics. During postpartum hospitalization, the two groups of women participated in face-to-face consultations with the nurse educator.

All subjects were pre-tested for breastfeeding knowledge at 20-28 weeks and post-tested at 28-34 weeks gestation. Breastfeeding outcomes were

evaluated during postpartum hospitalization using the Breastfeeding Self-Efficacy Scale short form (BSES-SF) and Maternal Breastfeeding Evaluation Scale (MBFES). The exclusive breastfeeding rate was recorded at one and two months postpartum via telephone interviews.

The questionnaires used in this study are described below:

2.3. Demographic characteristics questionnaire

The demographic and clinical information included age, educational level, occupation, family income, marital status, mode of birth, participation in antenatal classroom-based courses, and spousal support for breastfeeding.

2.4. Breastfeeding knowledge, attitude, and behavioral scale

Breastfeeding knowledge, attitude, and behavioral scale was based on the literature and contents of the breastfeeding teaching folder. Breastfeeding knowledge was assessed using a 10-item scale with 'Yes' or 'No' the possible answers for each question. Each question was worth 10 points, for a total score of 100 points. The breastfeeding attitude and behavior questionnaire assessed the attitude and behavior of postpartum women with regard to breastfeeding. Scores for each item ranged from 1-3 (1 indicates never, 2 indicates occasionally, and 3 indicates always) and the total score ranged from 5-15. Higher scores indicated better knowledge, attitude, and behavior. The content validity index (CVI) was .92 and the half-fold reliability was 0.94.

2.5. Breastfeeding Self-Efficacy Scale-short form (BSES-SF)

BSES-SF, developed by Dennis [15], consists of 14 questions related to two factors: technique and intrapersonal communication. Scoring was done on a Likert-type scale of 1-5 (1 indicates low confidence and 5 indicates high confidence). The sum of the scores ranged from 14-70 and higher scores indicated greater confidence. This scale has been widely used by researchers and translated into Hong Kong Chinese by Ip et al. [16] and Italian by Petrozzi & Gagliardi [17]. Wheeler & Dennis [18] used this scale to test the lactation self-efficacy of premature mothers. Cronbach's α of the scale was between .88 and .94 and reliability was confirmed with Cronbach's α of 0.93.

2.6. Maternal Breastfeeding Evaluation Scale (MBFES)

MBFES, developed by Leff et al. [19], consists of 30 questions related to three factors: Maternal Enjoyment/Role Attainment, Infant Satisfaction/Growth, and Lifestyle/Maternal Body Image. Responses were scored on a Likert-type scale of 1-5 (1 indicates strong disagreement and 5 indicates strong agreement). The sum of the scores ranged from 30-150 and higher scores represented greater breastfeeding satisfaction. We obtained the consent of the original author to translate the scale into Chinese and the translated scale was examined by an obstetrician for accuracy. Afterward, a PhD graduate from an American university translated the scale into English. Finally, an American teacher compared the meanings of the original questionnaire and translated version and made final revisions. Five scholars and clinical professionals completed expert validation and 10 women completed a word test. The reliability of the scale was confirmed with Cronbach's α of .90, .86, and .77. Cronbach's α for this study were .91, .85, and .80, respectively.

2.7. Data analysis

All data were analyzed using SPSS Version 22.0 for Windows, with statistical significance set at $p < 0.05$. Continuous data and categorical data were reported using descriptive statistics of mean (SD) and n (%), respectively. Chi-square and t-tests were used to compare sociodemographic and baseline variables between the two groups to test for homogeneity at entry. One-way analysis of variance was performed to test the differences in outcomes between the two groups. Subjects who dropped out or were lost to follow-up were not included in the analysis.

3. Results

3.1. Demographic data of subjects

Ninety women were recruited for this study from April 1 to June 30, 2016. The flow diagram for subject enrollment is shown in Figure 1. During

the study period, one woman with premature birth, one woman who refused to breastfeed due to her sister's negative experience with breastfeeding, one woman who gave birth elsewhere, and one woman who was lost to follow-up were excluded from the experimental group. In the control group, fetal malformation was discovered during the 22nd week of pregnancy in one case and that pregnancy was terminated. In addition, one woman was lost to follow-up and one gave birth elsewhere. If the same option was selected for all items on any questionnaire that questionnaire was considered invalid. The experimental group consisted of 41 pregnant women, while the control group consisted of 40 pregnant women.

There were no significant differences in the baseline socio-demographic characteristics of the two groups of participants, including age, educational level, occupation, family income, marital status, mode of birth, antenatal class attendance, and spousal support for breastfeeding (p>.05) (Table 1).

3.2. Analysis of the effects of flipped classroom-based prenatal breastfeeding education on breastfeeding knowledge, attitude, and behavior

We tested maternal breastfeeding knowledge in both groups. For the experimental group the pre-test score was 82.7±10.3 and the post-test score was 93.7±8.9. The difference was significant (t=-5.663, p<.000). For the control group, the pre-test score was 80.3±12.3 and the post-test score was 89.0±10.8. There were significant differences in post-test scores (t=2.122, p=.037) (Table 2), but not in pre-test scores, between the two groups.

Table 3 presents the results related to attitude toward breastfeeding. The average score for the experimental group was 13.6±1.2 and that for the control group was 12.7±1.6. The difference

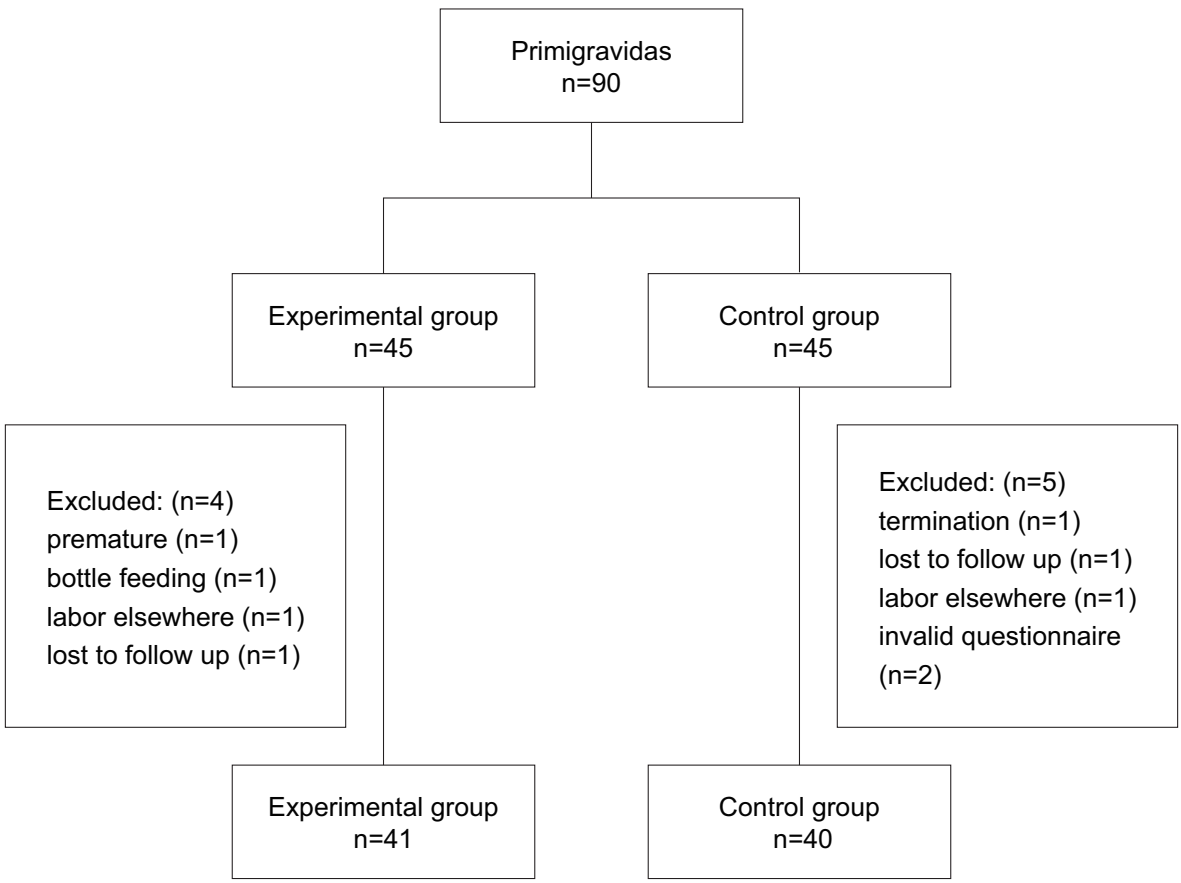

Fig. 1 Flow diagram of subject enrollment

Table 1. Baseline socio-demographic characteristics of participants and outcome measures in comparison groups (n=81)

Variables	Experimental group (n=41) n (%)	Control group (n=40) n (%)	X^2/t	p
Age (years)[a]	29.7±4.4	29.4±4.9	.323	.748
Educational level			6.415	.108
Above Master's	3	4		
Graduate	32	21		
Undergraduate	3	9		
High school	3	6		
Occupation			.483	.487
Full-time job	29(70.7)	31(77.5)		
Homemaker	12(29.3)	9(22.5)		
Family income			1.787	.618
Above 100,001	1(2.4)	3(7.5)		
60,000-100,000	21(51.2)	19(47.5)		
30,000-59,999	15(36.6)	16(40.0)		
Under 29,999	4(9.8)	2(5.0)		
Marital status			2.102	.241
Married	41(100.0)	38(95.0)		
Unmarried	0(0.0)	2(5.0)		
Mode of birth			1.452	.349
Vaginal delivery	33(80.5)	36(90.0)		
Cesarean	8(19.5)	4(10.0)		
Attended antenatal class			2.767	.121
Yes	26(63.4)	18(45.0)		
No	15(36.6)	22(55.0)		
Spousal support for breastfeeding				
Yes	41(100)	40(100)		
No	0	0		

[a] M±SD

was significant (F=8.706, p=.004). In terms of breastfeeding behavior, the average score for the experimental group was 12.8±1.4 and that for the control group was 12.6±1.7. This difference was not significant (F=.359, p=.551).

Table 2. Differences in breastfeeding knowledge pre-test and post-test between the groups

	Pre-test Mean±SD	Post-test Mean±SD	t[a]
Experimental group	82.7±10.3	93.7±8.9	-5.663***
Control group	80.3±12.3	89.0±10.8	-3.484***
Independent t-test	.968	2.122*	

[a] Paired t-test
*p<.05, ***p<.001

Table 3. One-way analysis of variance for breastfeeding attitude and behavior

		M±SD	F	p
Breastfeeding attitude	Experimental group	13.6±1.2	8.706**	.004
	Control group	12.7±1.6		
Breastfeeding behavior	Experimental group	12.8±1.4	.359	.551
	Control group	12.6±1.7		

** p<.01

Table 4. One-way analysis of variance for breastfeeding self-efficacy

		M±SD	F	p
Breastfeeding self-Efficacy	Experimental group	47.6±10.4	6.426*	.013
	Control	42.1±9.1		
Breastfeeding technique	Experimental group	30.1±6.8	5.173*	.026
	Control	27.0±5.5		
Intrapersonal communication	Experimental group	17.5±4.0	7.157**	.009
	Control	15.1±4.0		

*p<.05, ** p<.01

3.3. Analysis of the effects of flipped classroom-based prenatal breastfeeding education on self-efficacy of breastfeeding

In terms of maternal breastfeeding self-efficacy, the experimental group scored 47.6±10.4 and the control group scored 42.1±9.1. The score for the experimental group was significantly higher than that for the control group (F=6.426, p=.013). In terms of breastfeeding technique, the experimental group scored 30.1±6.8 while the control group scored 27.0±5.5 (F=5.173, p=.026). In terms of intrapersonal communication, the experimental group scored 17.5±4.0 while the control group scored 15.1±4.0 (F=7.157, p=.009). There were significant differences in these two factors (Table 4).

3.4. Analysis of the effects of flipped classroom-based prenatal breastfeeding education on breastfeeding satisfaction

Table 5 shows that the average scores for maternal breastfeeding satisfaction are 126.8±11.4 in the experimental group and 116.6±12.3 in the control group. The score for the experimental group was significantly higher than that for the control group (F=15.216, p<.001). For the Maternal Enjoyment/Role Attainment factor, the experimental

Table 5. One-way analysis of variance for breastfeeding satisfaction

		M±SD	F	p
Maternal Breastfeeding Evaluation	Experimental group	126.8±11.4	15.216***	.000
	Control group	116.6±12.3		
Maternal Enjoyment/ Role Attainment	Experimental group	64.0±5.1	4.868*	.030
	Control group	61.0±7.0		
Infant Satisfaction/ Growth	Experimental group	31.5±4.6	7.365**	.008
	Control group	28.9±4.1		
Lifestyle/ Maternal Body Image	Experimental group	31.4±3.5	39.530***	.000
	Control group	26.8±3.1		

*p<.05, ** p<.01, *** p<.001

Table 6. Breastfeeding rates at 1 month and 2 months postpartum

		Experimental group n(%)	Control group n(%)	p
1 month postpartum	Exclusive bf	29(70.7)	25(62.5)	.485
	Mixed bf	12(29.3)	15(37.5)	
2 months postpartum	Exclusive bf	18(43.9)	20(50.0)	.540
	Mixed bf	18(43.9)	13(32.5)	
	Bottle feeding	5(12.2)	7(17.5)	

bf: breastfeeding

group scored 64.0±5.1 while the control group scored 61.0±7.0 (F=4.868, p=.030). For the Infant Satisfaction/Growth factor, the experimental group scored 31.5±4.6 while the control group scored 28.9±4.1 (F=7.365, p=.008). For the Lifestyle/ Maternal Body Image factor, the experimental group scored 31.4±3.5 while the control group scored 26.8±3.1 (F=39.530, p<.001). There were significant differences in all of these factors.

3.5. Breastfeeding rate at one month and two months postpartum

The participants were followed up for two months postpartum to understand the breastfeeding rate. Feeding methods were classified into three types, exclusive breastfeeding, mixed breastfeeding, and bottle feeding. During hospitalization, the breastfeeding rate of both groups was 100%. In the first postpartum month, 29 women in the experimental group (70.7%) and 25 women (62.5%) in the control group continued to breastfeed exclusively. The other mothers combined breastfeeding with formula (mixed breastfeeding). At two months, 18 (43.9%) women breastfed exclusively, 18 (43.9%) women used mixed breastfeeding, and 5 (12.2%) women used bottle feeding in the experimental group, while 20 (50.0%) women breastfed exclusively, 13 (32.5%) women used mixed breastfeeding, and 7 (17.5%) women used bottle feeding in the control group. Compared to the control group, the experimental group had a higher exclusive breastfeeding rate at one month postpartum and a lower bottle-feeding rate at two months postpartum. However, these differences were not significant (p=.485, .540, respectively) (Table 6).

4. Discussion

To the best of our knowledge, this is the first study on the effectiveness of flipped classroom-based prenatal breastfeeding education. The results showed that the group receiving flipped classroom-based prenatal breastfeeding education had more knowledge, better attitude, higher self-efficacy, and greater satisfaction with regards to breastfeeding than the control group. Although there were no significant differences between the two groups in terms of breastfeeding behavior and breastfeeding rate at one and two months after delivery, the exclusive breastfeeding rate at one month postpartum was higher in the experimental group than in the control group and the rate of bottle feeding was lower in the experimental group than in the control group at two months postpartum. These findings support the effectiveness of flipped classroom-based education in improving the rate of breastfeeding, which is consistent with the results of previous research on prenatal breastfeeding education. For example, Dodt et al [20] used flipcharts and face-to-face explanations, Joshi et al. [10, 21] applied computer education to teach Hispanic women about breastfeeding, and Edward, et al. [22] adopted interactive computer agents. Compared with these studies, classroom-based flipped prenatal breastfeeding education involves a combination of online learning and interaction with nursing staff, as well as adult learning theory, i.e., self-learning that is not limited by time or space, with counseling that is based on individual needs [23] to improve learning outcomes.

In this study, post-test scores of breastfeeding knowledge in both groups were significantly higher than pre-test scores and the average post-test score of the experimental group was significantly higher than that of the control group. These results suggested that both educational methods can increase breastfeeding knowledge [21, 24]. Moreover, in terms of the knowledge gained, the integration of student-centred interactive education and technical training is superior to the traditional teaching method by verbal explanation and pamphlet. This result was the same as that obtained by Huang et al. [23] who explored the effectiveness of web-based breastfeeding education of 120 primparas in a quasi-experimental study. They found that the experimental group had higher level of breastfeeding knowledge than the control group. In this study, online teaching materials, combined with practice of breastfeeding skills and consultation, were more conducive to maternal understanding of the breastfeeding process and the enhancement of breastfeeding knowledge.

In terms of attitude and breastfeeding behavior, women in the experimental group scored higher than women in the control group, but there was no significant difference in breastfeeding behavior. This result may be due to the baby-friendly study site. As all participants received breastfeeding education from nursing staff during hospitalization, the breastfeeding attitude and behavior of the two groups were positive, leading to a lack of significant difference in breastfeeding behavior. This was also reflected in the postpartum exclusive breastfeeding rate. Despite a higher breastfeeding rate for the experimental group in comparison with the control group one month after giving birth and a lower bottle-feeding rate for the experimental group in comparison with the control group two months after giving birth, there was no statistically significant difference between the two groups. This means that flipped classroom-based breastfeeding education is not superior to the traditional method in terms of achieving behavioral change.

Other studies have shown that breastfeeding women receiving educational intervention have higher maternal self-efficacy scores. Dodt et al. [20] adopted a pretest-posttest comparison group design to examine whether breastfeeding flip chart educational intervention is effective for increasing self-efficacy and duration of breastfeeding. Their results showed that women in the intervention group had higher maternal self-efficacy scores and longer durations of exclusive breastfeeding at two months postpartum. Chan et al. [24] found that a combination of self-efficacy-based prenatal education courses (SEBEP) and postpartum telephone counseling enhances breastfeeding self-efficacy and exclusive breastfeeding rates six months postpartum. The experimental group in our study had higher breastfeeding self-efficacy. However, it did not have higher exclusive breastfeeding rate. This may be related to the lower self-efficacy score in this study compared to that of previous studies [10, 20].

Breastfeeding self-efficacy scores of 50 and above indicate higher confidence. Our participants were moderately confident. There have been many studies supporting a positive correlation between mother's self-efficacy and breastfeeding [24, 25]. The exclusive breastfeeding rate at one month postpartum in this experimental group was 70.7%, which was higher than the rate reported (66.2%) by the Taiwanese government at one month postpartum in 2016. However, the rate of exclusive breastfeeding in the second month postpartum was 43.9%, which was far lower than the government's reported second-month exclusive breastfeeding rate (61.2%). This decrease may be related to self-efficacy, suggesting that future prenatal breastfeeding education should enhance self-efficacy or be supplemented with other methods to effectively extend the exclusive breastfeeding period.

In this study, women who received flipped classroom-based prenatal breastfeeding education had higher breastfeeding satisfaction than the control group. Previous studies have shown that prenatal breastfeeding education can effectively improve breastfeeding satisfaction. Lin et al. [26] used MBFES to examine maternal satisfaction with breastfeeding and found that those who received prenatal breastfeeding educational program had higher breastfeeding satisfaction at three days and one month postpartum. However, the results of this study showed that breastfeeding satisfaction and rate of exclusive breastfeeding decrease over time. Previous researchers have found that new mothers who are less satisfied with breastfeeding are less likely to continue breastfeeding for up to three months postpartum [27]. The better the maternal role attainment, the less likely a mother is to stop breastfeeding [28]. We did not track changes in satisfaction. Future research is necessary to understand the relationship between satisfaction and breastfeeding rate as a reference for developing effective measures.

Limitations and generalizability

There are several limitations to this study. First, a lack of randomization may have introduced selection biases. Our experimental group was more highly educated and had a higher proportion of subjects who attended antenatal class than the control group. After statistical adjustments and tests, these differences were found not to have affected the results. However, future studies should be randomized to improve the inference of results. Second, this study only included women who intended to breastfeed and who visited one teaching hospital that has been certified as baby-friendly. The results might not be applicable to mothers who are unable to breastfeed or to other types of hospitals. Third, although electronic devices and Internet access are widely available in Taiwan, those without them are unable to participate in online learning. Finally, we did not continue to track changes in breastfeeding knowledge, attitude, behavior, and self-efficacy and only reported short-term effects due to time and funding limitations. Future studies with longer tracking times are recommended to determine the long-term effectiveness of this educational method.

Conclusions

This study adds to our understanding of the effects of antenatal education by combining online learning and nursing staff participation to enhance breastfeeding knowledge, attitudes, self-efficacy, and satisfaction. Flipped classroom-based prenatal breastfeeding education enables women to complete or repeat their learning according to their schedules and to practice maternal skills under the guidance of professionals. It also eliminates the need for repeated explanations and increases the effectiveness of prenatal breastfeeding education. This model can be used by professionals who are responsible for maternal care, especially midwives and nurses.

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