

# Effects of an Experiential Learning Program on Maternal Knowledge and Behaviors in Promoting Preterm infant Development after Discharge\*

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## Abstract

**Purpose:** To examine the effects of an experiential learning program on maternal knowledge and behaviors in promoting preterm infant development after discharge.

**Design:** A quasi-experimental study.

**Methods:** This study involved 40 mothers of preterm infants, with 20 participants assigned to the experimental group and 20 to the control group. The experimental group received an experiential learning program incorporating computer-assisted instruction (CAI) and developmental assessment activities based on the Developmental Assessment and Intervention Manual (DAIM) while the control group received standard care. A set of questionnaires included a general information questionnaire and validated the Maternal Knowledge and Behavior Assessment Questionnaires on Promoting Preterm Infant Development (CVI = .95 and .93; KR-20 = .71; Cronbach's alpha = .83). Data were analyzed using independent and paired t-tests.

**Main findings:** After two weeks at home, both groups showed significant improvements in maternal knowledge. The experimental group had higher post-test knowledge scores than the control group ( $\bar{X} = 18.10$ ,  $SD = 1.29$  vs.  $\bar{X} = 17$ ,  $SD = 1.56$ ;  $p < .05$ , respectively). For maternal behaviors, the experimental group showed significantly greater improvement than the control group ( $\bar{X} = 24.50$ ,  $SD = 2.89$  vs.  $\bar{X} = 20.05$ ,  $SD = 1.36$ ;  $p < .001$ , respectively).

**Conclusion and recommendations:** An experiential learning program has been shown to enhance maternal knowledge and behaviors in promoting preterm infant development after hospital discharge. It is essential to encourage maternal involvement in this aspect of care before discharge. Additionally, accessible educational materials should be provided to ensure continuous maternal access to information on promoting development. Furthermore, a structured post-discharge follow-up system should be implemented to support and monitor maternal engagement in developmental care.

**Keywords:** child development, experiential learning, knowledge, maternal behavior, preterm infants

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# ผลของโปรแกรมการเรียนรู้จากประสบการณ์ ต่อความรู้และพฤติกรรมของมารดาในการส่งเสริมพัฒนาการทารกเกิดก่อนกำหนดหลังจำหน่ายจากโรงพยาบาล\*

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## บทคัดย่อ

**วัตถุประสงค์:** เพื่อศึกษาผลของโปรแกรมการเรียนรู้จากประสบการณ์ต่อความรู้และพฤติกรรมของมารดาในการส่งเสริมพัฒนาการทารกเกิดก่อนกำหนดหลังจำหน่ายจากโรงพยาบาล

**รูปแบบการวิจัย:** การวิจัยกึ่งทดลอง

**วิธีดำเนินการวิจัย:** การศึกษานี้ดำเนินการกับมารดาที่มีทารกเกิดก่อนกำหนดจำนวน 40 ราย แบ่งเป็นกลุ่มทดลองและกลุ่มควบคุม กลุ่มละ 20 ราย กลุ่มทดลองได้รับโปรแกรมการเรียนรู้จากประสบการณ์ ซึ่งประกอบด้วยบทเรียนคอมพิวเตอร์ช่วยสอนและการฝึกส่งเสริมพัฒนาการตามคู่มือการประเมินและส่งเสริมพัฒนาการเด็กปฐมวัย ขณะที่กลุ่มควบคุมได้รับการพยาบาลเพื่อจำหน่ายตามปกติ เครื่องมือวิจัยประกอบด้วยแบบสอบถามข้อมูลทั่วไป และแบบสอบถามวัดความรู้และพฤติกรรมของมารดาในการส่งเสริมพัฒนาการทารกเกิดก่อนกำหนด ซึ่งผ่านการตรวจสอบความตรงเชิงเนื้อหา (CVI = .95 และ .93; KR-20 = .71; Cronbach's alpha = .83) วิเคราะห์ข้อมูลโดยใช้สถิติการทดสอบที่แบบสองกลุ่มอิสระและแบบสองกลุ่มสัมพันธ์กัน

**ผลการวิจัย:** ภายหลังจากจำหน่าย 2 สัปดาห์ มารดาทั้งสองกลุ่มมีคะแนนความรู้เพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ โดยกลุ่มทดลองมีคะแนนความรู้หลังสูงกว่ากลุ่มควบคุม อย่างมีนัยสำคัญทางสถิติ ( $\bar{X} = 18.10$ ,  $SD = 1.29$  เทียบกับ  $\bar{X} = 17.00$ ,  $SD = 1.56$ ;  $p < .05$ ) และด้านพฤติกรรม กลุ่มทดลองมีคะแนนเพิ่มขึ้นมากกว่ากลุ่มควบคุม อย่างมีนัยสำคัญทางสถิติ ( $\bar{X} = 24.50$ ,  $SD = 2.89$  เทียบกับ  $\bar{X} = 20.05$ ,  $SD = 1.36$ ;  $p < .001$ )

**สรุปและข้อเสนอแนะ:** โปรแกรมการเรียนรู้จากประสบการณ์ สามารถเสริมสร้างความรู้และพฤติกรรมของมารดาในการส่งเสริมพัฒนาการทารกเกิดก่อนกำหนดหลังจำหน่ายจากโรงพยาบาลได้อย่างมีประสิทธิภาพ โดยควรส่งเสริมให้มารดามีส่วนร่วมในการดูแลและส่งเสริมพัฒนาการของทารกเกิดก่อนกำหนดตั้งแต่ออยู่ในโรงพยาบาล รวมทั้งใช้สื่อที่ทำให้มารดาเข้าถึงข้อมูลการส่งเสริมพัฒนาการได้อย่างต่อเนื่อง และควรมีการติดตามมารดาหลังจำหน่ายอย่างเป็นระบบ

**คำสำคัญ:** พัฒนาการเด็ก การเรียนรู้จากประสบการณ์ ความรู้ พฤติกรรมของมารดา ทารกเกิดก่อนกำหนด

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## Background and Significance

The critical developmental challenges experienced by preterm infants, who are at a heightened risk for developmental delays compared with full-term infants, are a significant concern.<sup>1-3</sup> This increased risk is a consequence of preterm birth, rendering organ and body system development incomplete. This is especially true for infants born before the end of the third “trimester a critical period” for the development of the nervous system and brain.<sup>4</sup> Additionally, the neonatal care unit environment exposes infants to sensory stimuli that contrast those in the intrauterine environment, with a potential impact on their development.<sup>5-6</sup> Research indicates that preterm infants score lower in cognitive, language, motor, and socioemotional domains than their full-term counterparts, highlighting the pervasiveness of developmental delays in this population.<sup>7-8</sup>

Mothers of preterm infants often encounter significant caregiving challenges due to limited early interaction, heightened anxiety, and uncertainty about their infants’ developmental needs.<sup>9-11</sup> Evidence indicates that structured educational support can enhance maternal confidence and caregiving competence, leading to improved developmental outcomes.<sup>12-13</sup> Among the various maternal factors that may influence caregiving

such as emotional readiness, self-efficacy, prior caregiving experience, and confidence this study focused on maternal knowledge and caregiving behaviors. These factors were selected for their modifiability through structured educational interventions and their well-established association with the quality of early caregiving.

Helping mothers foster the development of their preterm infants has been the focus of numerous early intervention programs globally. A comprehensive literature review from 1966 to 2023 highlights that maternal education and support, starting from Neonatal Intensive Care Unit<sup>14</sup> admission through post-discharge, are associated with improved cognitive and motor outcomes in preterm infants.<sup>15</sup> However, providing mothers with manuals alone has proven insufficient. A recent scoping review<sup>16</sup> recommends family-focused follow-up interventions that combine face-to-face engagement with remote communication to ensure continuity of care after NICU discharge. These approaches especially when integrated with accessible technologies enable real-time feedback and individualized guidance, supporting mothers more effectively in resource-limited contexts.

In Thailand, efforts to address preterm infants’ developmental milestones have involved the use of the Developmental Assessment for

Intervention Manual (DAIM), which serves as a comprehensive framework for evaluating and nurturing the development of at-risk infants up to age 5.<sup>17-18</sup> The Ministry of Public Health has implemented a policy to distribute the DAIM to the caregivers of at-risk children before their hospital discharge. This initiative aims to empower mothers to study and facilitate their infants' development upon returning home.

However, the provision of manuals alone may be insufficient. Hence, a comprehensive family-focused follow-up intervention that incorporates face-to-face interactions and remote communication modalities is recommended as evidenced by a scoping review on interventions that support families with preterm infants after NICU discharge.<sup>16</sup> This study addresses this gap by evaluating an experiential learning-based intervention grounded in Kolb's Experiential Learning Theory. The intervention was delivered during the pre-discharge phase and included personalized post-discharge follow-up via LINE, a digital platform widely used in Thai society. This approach seeks to empower mothers through scenario-based learning, practical skill development, and real-time digital support to enhance caregiving practices and promote optimal developmental outcomes for preterm infants.

### **Kolb's Experiential Learning Theory**

Kolb's experiential learning theory<sup>19</sup> provides a dynamic framework for understanding how individuals acquire and apply knowledge through direct experience. The model emphasizes learning as an active, cyclical process that involves four interconnected stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. This approach allows learners to engage with real-life scenarios, reflect on their experiences, develop conceptual understanding, and apply their insights to improve future actions.

This theoretical framework is particularly suited to mothers of preterm infants, who often face complex caregiving situations that require both understanding and adaptability. By engaging mothers in activities that simulate real caregiving challenges followed by opportunities for reflection and guided application the learning process supports the development of both confidence and practical competence. The flexibility of Kolb's model accommodates varying learning styles, making it appropriate for a diverse group of caregivers navigating the transition from hospital to home.

In this study, the experiential learning framework was used to design an intervention that enhances maternal knowledge and caregiving

behaviors. Scenario-based learning and interactive follow-up were incorporated to help mothers transform caregiving experiences into meaningful practices. Through this iterative process, the intervention aimed to build mothers' readiness to support their infant's development effectively during the critical pre-discharge and early post-discharge period as shown in Figure 1.

Kolb's model accommodates diverse learning styles, allowing participants to progress through the aforementioned stages according to their

individual predispositions. Through this iterative process, they developed knowledge and practices in promoting developmental care that are appropriate for various contexts, culminating in a continuous experiential learning cycle. In this study, these principles were applied to design an intervention that transformed maternal experiences into actionable knowledge and practical strategies to support developmental care for preterm infants during their transition from the NICU to home.

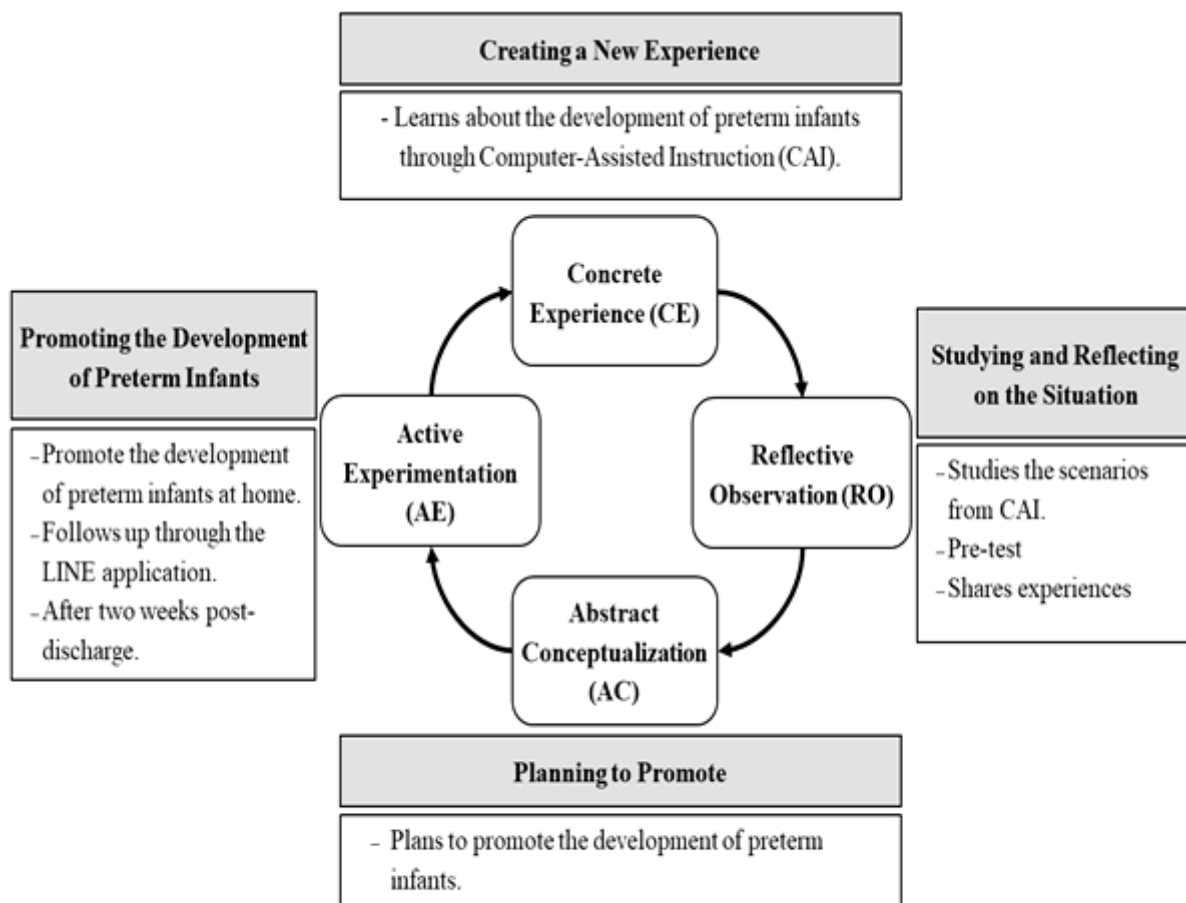


Figure 1: Conceptual Framework Diagram for Research

Adapted from Kolb<sup>20</sup>, *Experiential Learning*, 2014, Figure 2.5

## Objectives

To examine the effects of an experiential learning program on maternal knowledge and behaviors in promoting preterm infant development after discharge.

## Hypothesis

It was hypothesized that the scores of maternal knowledge and behaviors in promoting preterm infant development in the experimental group were higher than those in the control group. In addition, for the experimental group, the scores of maternal knowledge and behaviors in promoting preterm infant development after receiving the program were higher compared to those before receiving the program.

## Methodology

### Design

A quasi-experimental design with a two-group pretest - posttest approach was employed.

### Sample and setting

Participants were recruited using convenience sampling from the neonatal intensive care unit (NICU) of a university hospital in Thailand. Inclusion criteria were: (1) mothers aged 18 years or older, (2) no history of preterm delivery, (3) singleton pregnancy, (4) intention to assume caregiving

responsibilities for at least one month post-discharge, (5) having an infant whose discharge had been scheduled at least one week in advance according to the hospital's Daily Management System (DMS), a structured discharge planning protocol used by healthcare teams, and (6) willingness to communicate via the LINE application.

Exclusion criteria included: (1) mothers of preterm infants with neurological or congenital anomalies (e.g., cerebral palsy, neural tube defects, intraventricular hemorrhage grade III or IV, Down syndrome), and (2) mothers of infants requiring supportive devices at discharge (e.g., colostomy, tracheostomy, home oxygen therapy).

Sample size was determined using a power analysis based on a previous quasi-experimental study with similar parameters<sup>21</sup>, which reported a very large effect size ( $d = 3.17$ ) of maternal behaviors promoting preterm infant development yielding a small sample size. In the current study, a conservative effect size of .80, aligning with Cohen's<sup>22</sup> classification of a large effect was selected. Based on this estimate, a power of .80, and a significance level of  $\alpha = .05$ , the required sample size was calculated to be 40 participants, evenly allocated into two groups of 20.

### Instruments

Instrument for Intervention: The Experiential

Learning Program designed by the researchers consisted of four sessions aimed at enhancing maternal knowledge and behaviors in promoting preterm infant development. The intervention was delivered through three main components: (1) computer- assisted instruction (CAI), (2) the LINE-based Online Mother's Guide, and (3) the Mother's Experience Practice Worksheet.

### 1. Computer-Assisted Instruction (CAI):

Developed based on the DAIM, the CAI covered four key topics: the concept of child development, an overview of DAIM, strategies for promoting preterm infant development, and a maternal practice module. The CAI was hosted on the LINE platform and took approximately 20 minutes to complete.

### 2. Online Mother's Guide via LINE Application:

This tool had two parts:

2.1 Rich Menu Web Access: Provided self-learning materials including CAI lessons, a corrected age calculator, video clips by age and developmental domain, and child development screening tools.

2.2 Follow-up Chat: Used for reminders, supportive check-ins, and problem-solving communication between the researcher and the mothers (in Figure 2).

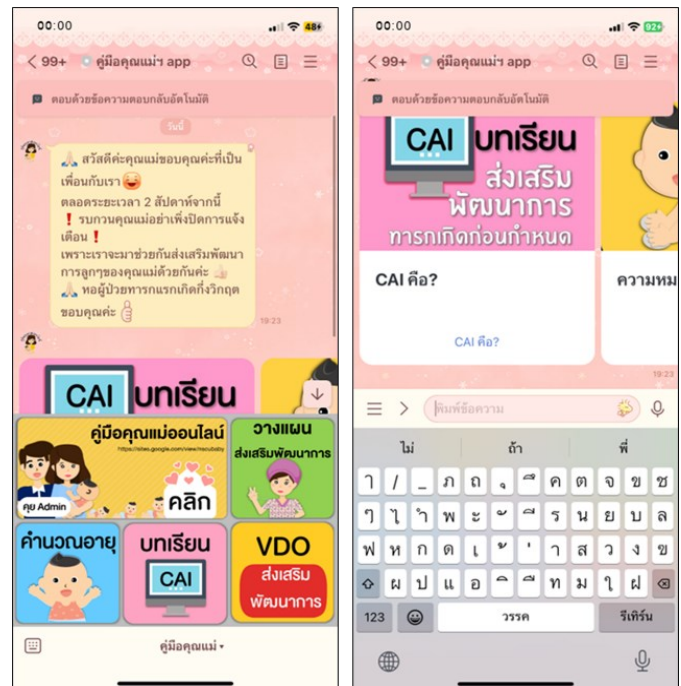


Figure 2: Screenshot of the online mother's guide via LINE application

### 3. Mother's Experience Practice Worksheet:

Used alongside the CAI, this worksheet presented sample caregiving scenarios and guided mothers through a three-part experiential learning cycle: reflective analysis, planning for developmental promotion, and recording caregiving practices.

Instrument for data collection: The Maternal Knowledge and Behavior Assessment Questionnaires on Promoting Preterm Infant Development was developed by the researchers based on the DAIM guidelines. The questionnaire was produced in a form of Google Form consisting of three parts as follows:

1) Demographic information of mothers and newborns - containing items asking about gender, age, status, educational level, gestational age, and Apgar score.

2) Maternal knowledge of promoting preterm infant development - containing 20 items covering the knowledge across two age groups: 0-2 months and 3-6 months. Five developmental domains were assessed for each age category: gross motor skills, fine motor and cognitive abilities, receptive language capabilities, expressive language proficiencies, and personal and social development indicators. Respondents provided binary responses to each item (yes or no), with cumulative knowledge scores ranging from 0-20 points. The higher scores, the better knowledge of promoting preterm infant development.

3) Maternal behaviors of promoting preterm infant development - containing 15 items covering the promoting behaviors of five developmental domains across two age groups: 0-2 months and 3-6 months. Each domain contained three items that assess frequency of behaviors on a three-rating scale ranging from 0 (never) to 2 (always). Total scores range from 0-30 points; the higher scores, the better developmental promoting behaviors.

All parts of the questionnaire rigorously reviewed for content validity by five qualified

experts, including a specialist nurse from the child development unit, two nursing instructors specializing in pediatric nursing, one neonatologist, and one developmental and behavioral pediatrician. The item-level content validity index (I-CVI) ranged from 0.93 to 1.00, and the scale-level CVI (S-CVI) averaged 0.95 for the knowledge questionnaire and 0.93 for the behavior questionnaire. To support internal consistency, a pilot test was conducted with 20 mothers who had similar characteristics to the target sample. The reliability coefficients obtained were 0.71 for the knowledge questionnaire (Kuder-Richardson 20) and 0.83 for the behavior questionnaire (Cronbach's alpha), indicating acceptable to good internal consistency.

#### **Ethical considerations**

This study was approved by the Human Research Ethics Committee of the Faculty of Nursing, Mahidol University (COA No. IRB-NS2021/625.0908), and the Research Ethics Committee of the Faculty of Medicine, Vajira Hospital, Navamindradhiraj University (COA No. 018/2565). The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and the institutional ethical guidelines. Participation was voluntary, and informed consent was obtained from all participants prior to data collection.

## The Experiential Learning Program and Its Implementation

The researcher collected data from the control group first, followed by the experimental group.

### Control group

At least one week before the infants were prepared for discharge, the mothers self-administered the Google Form as a pretest. On the day of discharge, the mothers in the control group received routine discharge care, which included the DAIM booklet distributed by the hospital in accordance with national guidelines for developmental surveillance in at-risk infants. However, they did not receive any structured developmental education, such as personalized instruction, guided practice, or follow-up communication. Afterward, the researcher scheduled a follow-up appointment with the mothers 2 weeks post discharge to administer the same questionnaire as a posttest.

### Experimental group

#### *Session 1: Three days before infant discharge*

(1) Creating New Experiences: The mothers engaged in learning through computer-assisted instruction (CAI), which includes the concept of development and potential issues in preterm infants. It also guides the utilization of the DAIM to determine the infant's age, explains assessment procedures, and offers strategies that promote

development in preterm infants up to 6 months old. This activity also highlights criteria for developmental milestones across different age ranges.

#### (2) Studying and Reflecting on the Situation:

The mothers observed and responded to questions regarding scenarios depicting preterm infants' development presented via CAI. Moreover, they discussed with the researchers the developmental aspects they have observed. Practical activities highlighted during the training included infant-directed speech, physical interaction, and facial engagement, all aligned with developmental goals outlined in the DAIM manual.

(3) Planning to Promote: The mothers formulated plans to promote preterm infants' development based on provided scenarios. They also documented their strategies using worksheets and presented their plans for promoting development to the researchers.

#### (4) Promoting Preterm Infants' Development:

The mothers actively promoted preterm infants' development within the provided scenarios. After training, the mothers evaluated their performance and were provided the opportunity to seek clarification on strategies for promoting development. Subsequently, they were encouraged to practice these strategies and assess their child's development during future visits.

### *Session 2: Day of discharge*

The participants were advised to use the online mother's guide for self-assessment at home and track visits over a 2-week period. Afterward, they shared notes on their infant's developmental assessments and developed their own plans to promote development themselves, which were then submitted to the researchers via LINE. The mothers then received individual feedback on their plans for promoting development through LINE as well. Feedback was sent on LINE for visits on the 3<sup>rd</sup> and 10<sup>th</sup> days after the infant's discharge from the hospital, during the time slots of 10:00-11:00 a.m. or 3:00-4:00 p.m. The experimental group was given the option to request a rescheduling of the contact time at any convenient period within the specified time slots.

### *Sessions 3-4: Postdischarge follow-up*

These sessions were conducted through messages on LINE on the 3<sup>rd</sup> and 10<sup>th</sup> days after discharge to address any issues or obstacles in promoting development, discuss solutions to problems that have emerged, and encourage mothers to engage in continuous practices.

### **Data analysis**

Data were analyzed using IBM SPSS version 28. Descriptive statistics were used to describe general information of mothers and preterm infants.

To compare differences in sociodemographic data between the study groups, chi-square test, Fisher's exact test, the Freeman-Halton test, independent t-test, and the Mann-Whitney U test were used. Comparisons of average knowledge and behavior scores regarding the promotion of preterm infant development were performed using an independent t-test and paired t-test. Assumptions for statistical use were checked and acceptable.

## **Findings**

### **Participant characteristics**

Before the experiment, both groups showed comparable baseline characteristics. The maternal age ranged from 18 to 42 years, with the majority falling within the 31-40 bracket. Moreover, a majority of the mothers in both groups held bachelor's degrees, were employed, and enlisted additional caregivers for their children. The majority of preterm infants in both groups did not present with diagnosed comorbidities and were delivered via cesarean section.

The gestational age of the experimental group was  $32.55 \pm 2.82$  weeks on average, while that of the control group was  $32.6 \pm 2.39$  weeks on average. Similarly, the average birth weights were  $1,884.05 \pm 492.15$  grams for the experimental group and  $1,706.7 \pm 396.77$  grams for the control group. In both groups, the majority showed Apgar scores of 7 or higher.

Postnatal age at discharge exceeded 37 weeks for 50% of the experimental group and 65% of the control group. The average hospital stay took  $35.25 \pm 33.69$  days for the experimental group and

$33.65 \pm 20.34$  days for the control group. As indicated in Table 1, no statistically significant differences were observed in demographic characteristics between the two groups of mothers and preterm infants.

**Table 1:** Comparisons of characteristics of mothers and preterm infants between the control and the experimental groups (N = 40)

Participant Characteristics	Experiment (n = 20)		Control (n = 20)		Statistics	p
	n	%	n	%		
<b>Pregnancy complications</b>					-	.237 <sup>1</sup>
Gestational hypertension	2	10	7	35		
Gestational diabetes	4	20	3	15		
None	14	70	10	50		
<b>First child</b>					0.902	.342 <sup>2</sup>
Yes	8	40	12	60		
No	12	60	8	40		
<b>Education level</b>					-	.160 <sup>1</sup>
Primary school	3	15	-	-		
Secondary school	7	35	5	25		
Bachelor's degree	8	40	14	70		
Master's degree or higher	2	10	1	5		
<b>Marital status</b>					-	1.000 <sup>3</sup>
Married	19	95	20	100		
Divorced	1	5	-	-		
<b>Have supporter at home</b>					2.506	.113 <sup>2</sup>
Yes	13	65	12	60		
None	7	35	8	40		
<b>Age of mothers (years)</b>					0.147-	.884 <sup>4</sup>
18-20	1	5	-	-		
	7	35	8	40		

Table 1: (cont.)

Participant Characteristics	Experiment (n = 20)		Control (n = 20)		Statistics	p
	n	%	n	%		
31-40	9	45	12	60		
> 40	3	15	-	-		
in; Max	18; 42		21; 40			
$\bar{X} \pm SD$	31.6 $\pm$ 6.42		31.3 $\pm$ 6.5			
<b>Birth body weight (grams)</b>					1.255	.217 <sup>4</sup>
< 1000	1	5	-	-		
1000-1500	4	20	9	45		
1501-2000	5	25	5	25		
2001-2499	10	50	6	30		
Min - Max	965 - 2,486		1,180 - 2,475			
$\bar{X} \pm SD$	1,884.05 $\pm$ 492.15		1,706.7 $\pm$ 396.77		1.255	.217 <sup>4</sup>
<b>Gestation week</b>					0.096	.923 <sup>5</sup>
< 32	6	30	8	40		
32-34	9	45	7	35		
35-36	5	25	5	25		
Min - Max	26 - 36		29 - 36			
$\bar{X} \pm SD$	32.55 $\pm$ 2.82		32.6 $\pm$ 2.39			
<b>Apgar score at 1 minute</b>					-	.705 <sup>1</sup>
$\geq 7$	15	75	16	80		
< 7	5	25	4	20		
<b>Apgar score at 5 minutes</b>					-	.311 <sup>1</sup>
$\geq 7$	19	95	20	100		
< 7	1	5	-	-		
<b>Delivery</b>					0.107	.744 <sup>2</sup>
Normal labour	8	40	7	35		
Caesarean section	12	60	13	65		

Table 1: (cont.)

Participant Characteristics	Experiment (n = 20)		Control (n = 20)		Statistics	p
	n	%	n	%		
<b>Comorbidities of preterm infants</b>					-	.407 <sup>1</sup>
NEC	-	-	3	15		
BPD	2	10	1	5		
No comorbidities	18	90	16	80		
<b>Post-conception age at discharge (weeks)</b>					0.559	.580 <sup>4</sup>
< 37	10	50	7	35		
≥ 37	10	50	13	65		
Min - Max	34 - 44		34 - 40			
$\bar{X} \pm SD$	37.65 ± 2.76		37.25 ± 1.62			
<b>Length of stay (days)</b>					0.582	.561 <sup>5</sup>
Min - Max	3 - 124		9 - 71			
$\bar{X} \pm SD$	35.25 ± 33.69		33.65 ± 20.34			

<sup>1</sup> = Freeman-Holtan test, <sup>2</sup> = Chi-square test ( $\chi^2$ ), <sup>3</sup> = Fisher's exact test, <sup>4</sup> = Independent t-test, <sup>5</sup> = Mann-Whitney

### Effectiveness of the experiential learning program

As shown in Table 2, the experimental group's mean scores of maternal knowledge of promoting preterm infant development were significantly higher than those of the control group after the program ( $t = 2.43$ ,  $p < .05$ ). In addition, for the experimental group, the scores of maternal knowledge in promoting preterm infant development after

receiving the program was higher compared to those before receiving the program ( $t = 9.50$ ,  $p < .001$ ).

Additionally, as indicated in Table 3, the experimental group's mean scores for the Maternal Behavior Assessment Questionnaire on Promoting Preterm Infant Development were significantly higher than those in the control group after the intervention program ( $p < .001$ ).

**Table 2:** Within-group and between-group comparison of mean knowledge scores of mothers for promoting development of preterm infant before and after intervention (N = 40)

Group	Experimental Group	Control Group	Statistic	p
	$\bar{X} \pm SD$	$\bar{X} \pm SD$		
Before intervention	12.45 ± 2.12	12.30 ± 1.69	0.25 <sup>1</sup>	.806
After intervention	18.10 ± 1.29	17.00 ± 1.56	2.43 <sup>1</sup>	< .050
Difference score	5.65 ± 0.57	4.70 ± 0.56	-	.502 <sup>2</sup>
Statistic	9.50 <sup>3</sup>	8.43 <sup>3</sup>		
p	< .001	< .001		

<sup>1</sup> independent t-test; <sup>2</sup> Mann-Whitney U test; <sup>3</sup> paired t-test

As shown in Table 3, the experimental group's mean scores of maternal behaviors of promoting preterm infant development were significantly higher than those of the control group after the program ( $t = -6.23$ ,  $p < .001$ ). In addition,

for the experimental group, the scores of maternal behaviors in promoting preterm infant development after receiving the program was higher compared to those before receiving the program ( $t = 9.02$ ,  $p < .001$ ).

**Table 3:** Within-group and between-group comparison of mean behaviour scores of mothers on promoting preterm infant development before and after intervention

Group	Experimental Group	Control Group	Statistic	p
	$\bar{X} \pm SD$	$\bar{X} \pm SD$		
Before intervention	18.40 ± 2.82	19.50 ± 3.10	1.17 <sup>1</sup>	.248
After intervention	24.50 ± 2.89	20.05 ± 1.36	-6.23 <sup>1</sup>	< .001
Difference score	6.10 ± 0.68	0.55 ± 0.68	-5.78 <sup>1</sup>	< .001
Statistic	9.02 <sup>2</sup>	0.81 <sup>2</sup>		
p	< .001	.430		

<sup>1</sup> independent t-test; <sup>2</sup> paired t-test

## Discussion

This study examines the outcomes of a program that aimed to bolster preterm infant development

during the critical pre-discharge period. Maternal knowledge about promoting preterm infant development at home after two weeks did not

significantly differ between the two groups whereas the experimental group showed distinct behavioral scores. This highlights the efficacy of the program, which is rooted in Kolb's experiential learning theory.<sup>19</sup> Through a multifaceted approach that included CAI, an online mother's guide, and hands-on exercises, the program aimed to cater to diverse learning styles and empower mothers to effectively nurture the development of their premature infants.

In phase 1 of the study, termed Concrete Experience, the mothers participated in experiential learning activities facilitated through CAI three days before their preterm infants were discharged from the hospital. This educational approach used visually rich materials to effectively explore the complexities of preterm infant development and promoted active participation and self-directed learning. Through the use of multimedia tools tailored for preterm infant care, this strategy not only kept mothers interested but also led to positive health outcomes for the infants.<sup>11,23-24</sup> Furthermore, studies have highlighted the significant impact of multimedia interventions on the improvement of maternal knowledge, especially regarding infant care practices.<sup>25</sup> These findings underscore that multimedia resources are crucial in promoting maternal engagement and supporting the transition

toward subsequent phases of the experiential learning cycle, such as observation and reflection, ultimately fostering preterm infants' optimal developmental outcomes.

In phase 2, the mothers engaged in the analysis and reflection of preterm infant development using scenario-based approaches and CAI. This pedagogical approach was consistent with findings focusing on the significant impact of maternal education on caring for preterm infants, with the experimental group displaying heightened knowledge, skill, and competence levels compared with the control group.<sup>12</sup>

In phase 3, the mothers transitioned into an abstract experiential stage involving the formulation of plans for promoting preterm infant development based on scenario analyses. While the majority were proficient in devising appropriate plans for promoting development, some encountered initial challenges. Tailored support from researchers was aligned with findings emphasizing the efficacy of empowering mothers to make autonomous decisions and plan for their infants' care.<sup>14</sup>

In phase 4, the mothers implemented their plans before and after discharge, with researchers providing follow-up and support through LINE. Challenges emerged particularly among infants discharged before 37 weeks of gestation,

which prompted researchers to offer tailored recommendations and ongoing support. These findings were consistent with those that highlight the positive impact of continuous support on preterm infants' growth and development.<sup>2,5</sup> A program for promoting development, including home health visits, enhances the maternal ability to facilitate infant development. Mothers who received this support showed a better promotion of social-emotional and cognitive development compared with those in the control at five months. Moreover, this ongoing support improves infants' developmental outcomes, as evidenced by recent studies.<sup>24,26</sup>

Therefore, the implementation of different experiential learning approaches has helped mothers significantly increase their average scores for both knowledge and behaviors in promoting preterm infant development before discharge, with statistical significance. However, with regard to knowledge about promoting preterm infant development, the difference in average scores before and after program implementation showed no statistically significant differences (difference score) ( $\bar{X} = 5.65$ ,  $SD = .57$ ,  $p = .502$ ). Studies suggest that maternal anxiety following preterm infant discharge often leads to increased efforts to learn about infant care.<sup>10,27</sup> In this study, the mothers in

the control group may have received additional information from other sources or from the DAIM distributed on-line, potentially accounting for their increased knowledge.

An examination of the details of mothers' knowledge and behaviors showed no significant differences in pre-experiment practices between groups, including such activities as eye contact and conversing with their infants, with approximately 20% reporting occasional engagement. However, after the intervention, a noteworthy improvement was observed in the mothers' daily engagement in these activities, reaching 100% in the experimental group and 85% in the control group. This places emphasis on the significance of structured parent training programs in enhancing preterm infants' development. Moreover, the findings underscored that the implementation of an empowerment training program amplifies mothers' involvement in the care of their premature infants.<sup>28</sup> Early intervention strategies, complemented by the provision of written information such as the booklet used in this study, showed efficacy in augmenting mothers' engagement in their infant's care.

Moreover, the notable increase in maternal behavior scores in the experimental group reflects clinically meaningful changes. These improvements translated into more frequent engagement in key

developmental activities, such as eye contact, responsive communication, and physical interaction. Such behaviors are strongly associated with enhanced cognitive, motor, and emotional development in preterm infants, particularly during the early post-discharge period. Therefore, the program's impact extended beyond statistical outcomes to include practical benefits for early caregiving quality.

To analyze inappropriate behaviors, both groups demonstrated similar practices such as allowing their infants to lie on their backs for long periods. Within the control group, 45% of the mothers engaged in this behavior daily as opposed to 30% in the experimental group. This pattern may be associated with the period of the infants' hospitalization, during which mothers were likely to not arrange sleeping positions themselves. However, after discharge, the mothers in the control group minimized their practice of letting their child lie on their back every day by 20%. Conversely, none of the mothers in the experimental group allowed their infants to lie on their backs continuously. Discouraging prolonged supine positioning in infants has been beneficial for the development of their major muscle groups. This practice aligns with World Health Organization

recommendations, which advocate placing infants in a prone position for at least 30 minutes daily to promote muscle and neural development.<sup>29</sup>

In conclusion, this study provides a comprehensive approach rooted in Kolb's experiential learning theory, improving mothers' knowledge levels and behaviors. Nurses can use these insights to empower mothers with the knowledge and behaviors essential for nurturing preterm infant development, heralding a paradigm shift in infant care practices.

#### **Limitations**

This study has several limitations. First, the follow-up period was limited to only two weeks, which may not have been sufficient to demonstrate clear and sustained behavioral changes. As a result, the long-term impact of the intervention on preterm infant development remains unknown. Second, participants were recruited via convenience sampling, which may introduce selection bias and affect the generalizability of the findings. Third, the assessment of maternal behaviors in this study relied on self-reported questionnaires, which are subject to response bias. Lastly, the study did not directly assess infant developmental outcomes, which limits the ability to draw definitive clinical conclusions regarding the program's impact.

## Conclusion and Recommendations

The findings underscored the significant effects of integrating an experiential learning program with smartphone applications on enhancing mothers' knowledge and behaviors in promoting preterm infant development, surpassing the effectiveness of traditional educational methods. With Kolb's experiential learning framework as an anchor, this approach allows participants to progress through learning stages tailored to individual aptitudes, which empowers them to apply personal experiences and cultivate contextually relevant practices. By incorporating contemporary technology, notably smartphone applications complemented by streamlined CAI in mobile formats, this study facilitates convenient, self-directed learning opportunities for mothers in the comfort of their homes.

These findings have significant implications for the creation of discharge strategies that promote developmental outcomes for other high-risk infant populations. Nonetheless, one must recognize the need for adjustments tailored to each healthcare facility's contextual nuances before implementation. These changes ensure that intervention strategies are optimally aligned with the target population's unique needs and circumstances, thus maximizing the potential for successful outcomes.

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