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Effects of congruence between preferred and perceived learning environments in nursing education in Taiwan: a cross-sectional study

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ABSTRACT

Objective: To investigate the effects of congruence between preferred and perceived learning environments on learning outcomes of nursing students.

Setting: A nursing course at a university in central Taiwan.

Participants: 124 Taiwanese nursing students enrolled in a 13-week problem-based Fundamental Nursing curriculum.

Design and methods: Students' preferred learning environment, perceptions about the learning environment and learning outcomes (knowledge, self-efficacy and attitudes) were assessed. On the basis of test scores measuring their preferred and perceived learning environments, students were assigned to one of two groups: a 'preferred environment aligned with perceived learning environment' group and a 'preferred environment discordant with perceived learning environment' group. Learning outcomes were analysed by group.

Outcome measures: Most participants preferred learning in a classroom environment that combined problem-based and lecture-based instruction. However, a mismatch of problem-based instruction with students' perceptions occurred. Learning outcomes were significantly better when students' perceptions of their instructional activities were congruent with their preferred learning environment.

Conclusions: As problem-based learning becomes a focus of educational reform in nursing, teachers need to be aware of students' preferences and perceptions of the learning environment. Teachers may also need to improve the match between an individual student's perception and a teacher's intention in the learning environment, and between the student's preferred and actual perceptions of the learning environment.

Strengths and limitations of this study

- The study addresses an important issue of learner perception of the educational environment for nursing educators in Taiwan.
- First-year nursing students in Taiwan prefer a hybrid of problem-based and lecture-based instructional approaches.
- A learning environment that is congruent with students' preferences provides an opportunity to improve their outcomes.
- The study was limited to first-year nursing students at a university in Taiwan.

INTRODUCTION

Contemporary research on medical education has shown the positive impact of problem-based approaches on cognitive learning and affective development.[1 2] Learning through solving problems is a central tenet for the effective development of students' medical skills and clinical problem-solving abilities. Although problem-based teaching strategies have been recommended by medical educators, teachers do not typically use problem-based instruction in their classrooms.[3 4] The major reason is a lack of knowledge and experience with inquiry among teachers and students.[5–7] Colliver[3] concluded that there was no convincing evidence to demonstrate that problem-based learning (PBL) improves the knowledge base or clinical performance of students.

Incongruence between students' preferred and perceived learning environments may also explain why learning outcomes in PBL environments fail to meet expectations. Students perform better when the actual and preferred learning environments match closely.[8–12] Lizzio *et al*[13] indicated that students' perceptions of their learning environment were a strong predictor of learning outcomes at university.

In lecture-based instruction, students systematically investigate questions provided by a teacher through a prescribed procedure; they are then led to a predetermined discovery. In contrast, in PBL, students select a wide variety of inquiry questions and then

make their own decisions throughout each stage of the inquiry process. In medical education, studies have typically compared conventional (lecture-based learning (LBL)) and PBL, usually considered as opposite poles of one dimension.[14] The two approaches are not always mutually exclusive, however, and sometimes are even inclusive.[15 16] Lecture-based and student-centred (eg, PBL) pedagogy can coexist and jointly influence teaching and learning strategies.[17] In our opinion, PBL can be regarded as a continuum of directedness with respect to students' participation and the information a teacher provides during the instruction process. Lecture-based instruction and problem-based instruction can be viewed as two contrasting poles of teaching and learning.

Three research questions were considered important. First, what kind of learning environment do nursing students prefer? Compared with LBL approaches, PBL instruction can increase interest and satisfaction,[18 19] but it is often less preferred.[20 21] The inconsistency may stem from the varied backgrounds and general preferences of students taking medical courses.[6]

Second, are students' perceptions of the learning environment aligned with the designer's intention? The way students perceive and interpret a learning environment is influenced by their prior knowledge with respect to a clinical situation (problem), experiences and abilities in PBL and the teacher's abilities in guiding students' involvement in PBL. Discrepancies between the designers' intentions and the students' interpretations usually lead to suboptimal use of the learning environment,[8] but medical education has rarely been the target of congruence studies to determine these discrepancies.

Third, what is the effect of the congruence between students' perceptions of actual and preferred learning environments on the learning outcome? Research has been limited, and we have attempted to fill this gap. This cross-sectional study aimed to evaluate nursing students' preferences for, and perceptions of, learning environments, and also to examine the effects of the congruence on their learning outcomes in our problem-based fundamental nursing curriculum (PBFN) in one institution in central Taiwan.

METHODS

Study group

This study recruited a convenience sample of first-year undergraduate nursing students. The study was approved by the Institutional Review Board of Taipei Medical University and written informed consent was obtained from each student (TMU JIRB, approval No. 201104005).

Problem-based fundamental nursing curriculum

The PBFN curriculum, implemented in the second semester of the first year, has four courses with each taught for 2–4 weeks: (1) fundamental nursing theory; (2) clinical nursing skills; (3) nursing ethics and codes; and (4) communication skills. Four professors, all of whom received 48 h of PBL tutor training, were engaged in the curriculum development, instruction and evaluation of learning outcomes. Students were randomly assigned to groups, each consisting of 12–14 students.

Questionnaire assessing students' perceptions of the learning environment and preferences

The Problem-Based Learning Environment Survey (PBLES) was implemented to assess students' perceptions of, and preferences for, the learning environment in the nursing classroom. PBLES was modified from the Classroom Environment Instruments[22 23] and proposed to measure students' perceptions of the inquiry classroom learning environment. The Problem-Based Learning Environment Inventory[24] also served as a guide for creating items. PBLES consisted of two aspects: the Preferred Learning Environment Instrument (Pr-LEI) and the Perceived Learning Environment Instrument (Pc-LEI). Pr-LEI quantitatively measured the learning environment preferences of the participants. Pc-LEI evaluated the perceived learning environment. Each instrument can be further divided into two dimensions: PBL and LBL. The items in Pr-LEI and in Pc-LEI are closely related.

The development of PBLES included the following stages: item formulation, content validation, construct validation and reliability calculation. In the first stage, a comprehensive literature review of existing instruments was conducted. Four factors were chosen: preferred problem-based classroom environment (Pr-PBL), preferred lecture-based classroom environment (Pr-LBL), perceived problem-based classroom environment (Pc-PBL) and perceived lecture-based classroom environment (Pc-LBL). An 18-item questionnaire (Pr-LEI), devised by the researchers in accordance with the literature, was employed to evaluate students' preferred learning environment. These items covered curriculum content, teaching methods, the student's interactions and the learning environment.[25]

To evaluate a student's perception of the learning environment, Pr-LEI was revised into the Perceived Learning Environment Instrument (Pc-LEI). Each item in Pc-LEI corresponded to an item in Pr-LEI. For example, the following items were used in Pr-LEI:

- The teacher directs students (me) gradually towards discussion in the classroom, and the teaching of subject knowledge is reduced. My preferred, anticipated situation is… *(Problem-based)*
- I have ample opportunity to express the content and direction of my thoughts, and to communicate extensively with fellow students. My preferred, anticipated situation is… *(Problem-based)*
- The teacher chooses essential concepts and knowledge to teach in the class. My preferred, anticipated situation is… *(Lecture-based)*

- Teachers tell us in detail various solutions to problems that might arise and their potential consequences. My preferred, anticipated situation is… *(Lecture-based)*

The corresponding questions in the Pc-LEI were:

- My actual experience in the Fundamental Nursing curriculum was that the teacher directed students gradually towards discussion in the classroom, and the teaching of subject knowledge was reduced. *(Problem-based)*
- My actual experience in the Fundamental Nursing curriculum was that I had ample opportunity to express the content and direction of my thoughts and to communicate extensively with fellow students. *(Problem-based)*
- My actual experience in the Fundamental Nursing curriculum was that the teacher chose essential concepts and knowledge to teach in the class. *(Lecture-based)*
- My actual experience in the Fundamental Nursing curriculum was that the teacher told us in detail various solutions to problems that might arise and their potential consequences. *(Lecture-based)*

Students were asked to what extent they agreed that each item in Pr-LEI and Pc-LEI described their preferred or perceived experience. Each item was scored on a five-point Likert scale: 1=never, 2=rarely (ie, once or twice a semester), 3=sometimes (ie, once or twice a month), 4=often (ie, once or twice a week), 5=all or almost all classes.

To establish the content validity of the instruments, a panel of specialists including three professors was asked to evaluate the quality of each item and suggest necessary revisions. Two of the professors had over 10 years of experience in medical education research and teaching PBL. The other teacher had 20 years of experience in science education.

A pilot test was carried out with 253 students. On average, it was found that the questionnaire could be completed in 10–15 min. The KMO value (Kaiser-Meyer-Olkin Test) for the 36 items on the scale was 0.80, suggesting that a factor analysis could be applied to the data. The results of Bartlett's test of sphericity (χ^2 4276, p<0.0001) showed that the data came from a multivariate normal distribution. A principal component analysis with varimax rotation was adopted to explore the component structure underlying the instrument. No item in the scale was deleted. Therefore, a total of 36 items and four factors with eigenvalues above one were obtained. These four factors accounted for 45% of the total variance. The reliability scale internal consistency coefficient (Cronbach's α) for the pilot sample ranged from 0.77 to 0.80 for four dimensions and was found to be acceptable at 0.89 for the whole instrument. Tukey's test of additivity established that the scale items were additive (F=33.6, p<0.05).

Fundamental nursing learning achievement test

Fundamental nursing learning achievement test (FNLAT) consisted of four 25-question multiple-choice items and five open-ended items designed to measure the learning of students in each of the PBFN courses. Four professors established the validity of the content of FNLAT by checking how well the items tested the important concepts introduced in the courses.

Self-efficacy in the nursing instrument

To assess nursing students' self-efficacy, a Chinese version of the Six-Dimension Scale of Nursing Performance (Six-D Scale) originally developed by Schwirian in 1978[26] was administered. The original Six-D Scale consisted of the following six subscales: leadership, critical care, teaching/collaboration, planning/evaluation, interpersonal relations/communications and professional development. Schwirian reported reliability ranging from 0.84 to 0.98 for the six scales. For the purpose of evaluating nursing students' self-efficacy, the beginning of each item in the Six-D Scale was revised to: "I can…"; "I am confident that…"; "It is easy for me…"; etc. Examples of items in Self-efficacy in the nursing instrument (SENI) are shown in table 1.

Attitudes towards nursing inventory

ANI was derived from the Attitude towards Clinical Nursing Inventory (C Y Liau. *A study of work value in the "X" generation of Nurses*. Taipei: Unpublished Doctoral Dissertation, Taipei Medical University, 2001) and consisted of four subscales (professional development, self-perception, motivation towards work, and working/learning load) with 36 items, each rated on a five-point Likert scale. Liau (Unpublished Doctoral Dissertation, 2001) reported reliability ranging from 0.61 to 0.91 for the four scales. Table 1 shows examples of items in ANI.

Table 1 Examples of items in the Self-efficacy in Nursing Instrument (SENI) and Attitude towards Nursing Inventory (ANI)

Instrument	Example of content
SENI	▶ When I have something to do relevant to nursing, I know precisely what is expected. ▶ I am confident that I could help a patient communicate with others. ▶ I can display self-direction in nursing work and learning. ▶ I spend a good deal of my spare time for ongoing personal and professional growth.
ANI	▶ Because nursing learning is interesting, I find that studying new things can often be really exciting. ▶ Nurses are compensated sufficiently for their work by the knowledge that they are helping people. ▶ At school/work, I find it difficult to organize my time effectively ▶ There seems to be too much knowledge to acquire in nursing

Research design and procedures

A quasi-experimental one-group pretest–post-test design was used.[25] The data were collected in three phases: (1) the preferred learning environment and preinstructional nursing literacy of each student were investigated using Pr-LEI, ANI and SENI; (2) after the 13-week Fundamental Nursing course, the learning outcomes, attitudes, self-confidence and perceptions of the learning environment of each student were evaluated with Pc-LEI, ANI, SENI, FNLAT, and by interview.

Congruence between preferred and perceived learning environments

Pr-LEI and Pc-LEI were scored on the basis of the Likert scale responses to questions. The midpoint, 3, in each of the problem-based and lecture-based axes could be taken to represent the psychological cut-off point that divided the preferred or perceived learning environments into a PBL versus non-PBL orientation or a LBL versus non-LBL orientation. The mean scores for the responses of the students on the PBL and LBL subscales were transformed into the format (X, Y)—that is (PBL, LBL)—and then plotted on a four-quadrant diagram to display preferences and perceptions, as shown in figure 1.

To analyse the extent of the congruence between the preferred and perceived learning environments, we used the following two strategies:

The preferred-perceived spaces (PCS) method

We derived a two-dimensional numerical PCS score for each student by calculating the distance between the preferred point for each student (preferred PBL environment (X-axis), preferred LBL (Y-axis)), and the perceived point plotted in the aforementioned quadrant diagrams (perceived PBL (X-axis), perceived LBL (Y-axis)); (figure 1A, B). Each PCS score was calculated using the following equation:

$$\mathrm{PCS} = \sqrt{(\mathrm{PP} - \mathrm{CP})^2 + (\mathrm{PL} - \mathrm{CL})^2}$$

PCS represents the variance between the preferences of a student before instruction and the perception of the student about the classroom after instruction, and thus indicates the extent to which the learning environment matched the original preferences of the student. A short distance showed that the classroom environment was matched well to the preferences of the student. Participants were then divided equally on the basis of their PCS scores. Half the students, those with lower PCS scores, were assigned to the 'preferred environment aligned with perceived learning environment by the PCS method' (PrAPc_PCS) group; this indicated that the curriculum was congruent with their preferred method. The other half, with higher PCS scores, were assigned to the 'preferred environment discordant with perceived learning environment by the PCS method' (PrDPc_PCS) group.

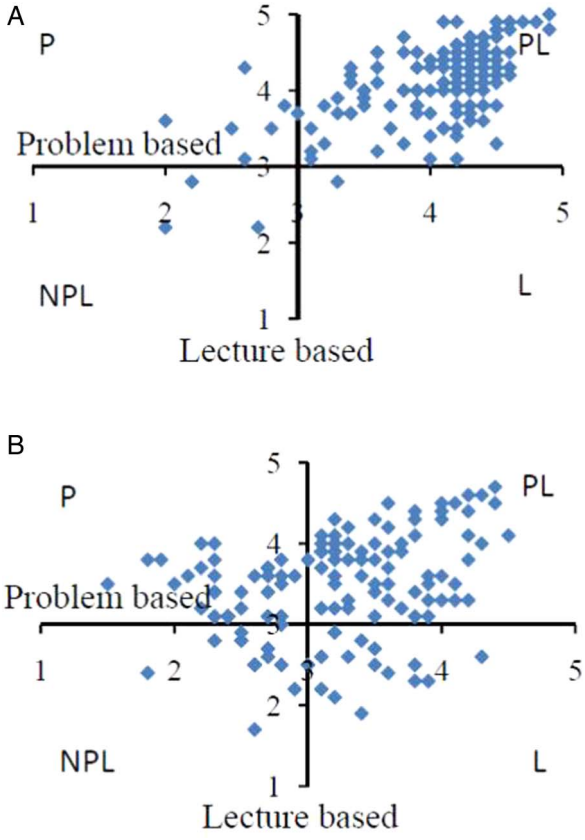

Figure 1 The preferences of students with respect to the learning environment (A) and their perceptions of the problem-based Fundamental Nursing curriculum (B) on 5-point Likert scales. The scores that represent the preferences and perceptions of the students with respect to the learning environment were plotted into the four quadrants of the (X, Y) model. The upper-right quadrant represents a combined problem-based and lecture-based (PL-hybrid) learning environment; the upper-left quadrant represents a lecture-based (L) learning environment; the lower-right quadrant represents a problem-based (P) learning environment; and the lower-left quadrant represents a learning environment that is neither problem-based nor lecture-based (NPL).

The preferred-perceived fit (PCF) method

A learning environment that did not match the preferred environment of the students might have had a substantial effect on performance, even if the PCS score was low. Therefore, we developed the PCF method to confirm the results of the PCS method analysis. Students whose scores for Pr-LEI and Pc-LEI were in the same quadrant were assigned to the 'preferred environment aligned with perceived learning environment by the PCF method' (PrAPc_PCF) group. Students whose Pr-LEI and Pc-LEI scores were in different quadrants were assigned to the 'preferred environment discordant with perceived learning environment by the PCF method' (PrDPc_PCF) group.

Data analysis

We hypothesised that the learning achievements and attitudes of the students would be better when they

perceived that the instructional activities were congruent with their preferences. We performed: (1) a univariate analysis of covariance (ANCOVA) on the post-test ANI and SENI results with the pretest results as the covariate; and (2) a two-tailed t test analysis of the results of FNLAT. We have reported the practical significance (effect magnitudes) along with the statistical significance of each test result. The post hoc least-significant-difference analysis was used because it is the most powerful post hoc multiple-comparison procedure for ANCOVA. Tests of the assumptions used for ANCOVA and inferential statistical analyses were performed using SPSS V.13.0 (Chicago, Illinois, USA).

RESULTS

A total of 124 first-year nursing students were recruited. The reliability coefficient (Cronbach's α) values for Pr-LEI in preinstruction, Pc-LEI in postinstruction, FNLAT, SENI and ANI with the 124 nursing students sample were estimated at 0.82, 0.86, 0.86, 0.92 and 0.90, respectively.

Students' perceptions of preferred and perceived learning environments

As figure 1A shows, in the preinstruction survey, most of the students preferred a PBL-LBL hybrid learning environment (most of the mean scores being in the upper-right quadrant at (X, Y)=(3.96, 4.04)), although a few students indicated a preference for a fully PBL or fully LBL environment. In terms of perceived learning experience, most students perceived the PBFN learning environment to be predominantly lecture-based (mean scores (X, Y)=(3.21, 3.47)), as shown in figure 1B.

The effect of congruence between preferred and perceived learning environments on learning outcomes

PCS method

Learning achievement, self-efficacy in nursing, and attitudes towards nursing were better when the instructional activities and students' preferred learning environment were congruent. The PrAPc_PCS group performed significantly better in FNLAT than did the PrDPc_PCS group, as shown in table 2. The ANCOVA analysis showed a significant between-group difference in SENI scores (large effect size) and ANI scores (medium effect size using the eta square statistic (η^2=0.05)); (table 3).

PCF method

Seventy-three students had Pr-LEI and Pc-LEI scores in the same quadrant and were assigned to the PrAPc_PCF group, and 51 students had Pr-LEI and Pc-LEI scores in different quadrants and were assigned to the PrDPc_PCF group. The PrAPc_PCF group performed better in FNLAT than the PrDPc_PCF group (medium-to-large effect size). There were significant differences in SENI (medium effect size) and ANI (medium-to-large effect size) scores between the PrAPc_PCF and PrDPc_PCF groups. The findings supported the results obtained by the PCS method.

DISCUSSION

Preferences for learning environments

The results provide evidence that first-year nursing students in Taiwan prefer a hybrid of PBL and LBL. The academic pressure on students may account for this preference. In Taiwan, after junior high school, students who wish to enter college must take an annual national standardised test—the basic competency test—to enrol in a senior high school and the Entrance Examination for Colleges to enter tertiary study. On the basis of test results at each stage, only a certain percentage of the age group is allowed to progress to the next level of education.[27 28] To be prepared for these examinations, a student must work through many exercises and problems and, during the process, may regard the teacher as an important director in their preparation for the examinations as well as an authoritative provider of knowledge. As a result, students may develop a preference for an LBL (teacher-centred) strategy to acquire knowledge efficiently and effectively. Many studies across a wide range of cultures (eg, the USA, the UK and Asia) have reported that levels of examination stress are high in a large proportion of high school students.[29 30] Therefore, students at the high school and tertiary levels of education may prefer a hybrid learning environment; this may be a fundamental characteristic in many countries.

Table 2 Comparison of the effect of similarity between preferred and perceived learning environments on learning achievement

Dependent variables	Mean (SD)	t	p Value	Effect size (Cohen's d)
Preferred-perceived spaces (PCS) method				
PrAPc _PCS (n=62)	77.97 (6.69)	2.66	0.01*	0.48
PrDPc _PCS (n=62)	74.74 (6.81)			
Preferred-perceived fit (PCF) method				
PrAPc _PCF (n=73)	78.22 (6.40)	3.78	<0.01*	0.69
PrDPc _PCF (n=51)	73.68 (6.81)			

*p<0.05

Table 3 Adjusted post-test scores for learning outcome in the problem-based Fundamental Nursing curriculum with ANCOVA analysis

Dependent variables		Adjusted post-test scores	F	p Value	Effect size (f)
Preferred-perceived spaces (PCS) method					
SENI	PrAPc _PCS (*n*=62)	3.39 (0.25)	6.67	0.01	0.24
	PrDPc _PCS (*n*=62)	3.27 (0.25)			
ANI	PrAPc_PCS (*n*=62)	3.70 (0.22)*	22.15	<0.01	0.43
	PrDPc_PCS (*n*=62)	3.53 (0.22)			
Preferred-perceived fit (PCF) method					
SENI	PrAPc _PCF (*n*=73)	3.38 (0.25)	5.48	0.02	0.22
	PrDPc _PCF (*n*=51)	3.26 (0.26)			
ANI	PrAPc _PCF (*n*=73)	3.67 (0.23)	10.55	<0.01	0.30
	PrDPc _PCF (*n*=51)	3.54 (0.23)			

*Mean (SD) score on a five-point Likert scale
ANCOVA, analysis of covariance; ANI, Attitudes towards Nursing Inventory; PrAPc _PCF, preferred environment aligned with perceived learning environment by the PCF method; PrAPc _PCS, preferred environment aligned with perceived learning environment by the PCS method; PrDPc _PCF, preferred environment was discordant with perceived learning environment by the PCF method; PrDPc _PCS, preferred environment was discordant with perceived learning environment by the PCS method; SENI, Self-efficacy in nursing Instrument.

Discrepancies between the teaching strategy and perceptions of students

The Fundamental Nursing curriculum emphasised PBL. However, a discrepancy between the intended teaching strategy and the perceptions of the students was observed. The mean scores on the PBL and LBL subscales of Pc-LEI were (X, Y)=(3.21, 3.46), as shown in figure 1, possibly reflecting inadequacies in the in-service professional development of nursing teachers.

For example, the students reported in the postinstruction interview that they "were required to discuss, think about, and share ideas in a limited amount of time," "could not think about and discuss each item in detail," and "felt striking pressure that they might not be able to think in sufficient depth to fulfill the expectations of the teacher." The students did not perceive the activities and approaches as PBL because they thought that the activities were controlled by the teachers and their major concern was how to meet expectations. This phenomenon was supported by the responses to Pc-LEI items in the problem-based subscale, such as, "My actual experience in the Fundamental Nursing curriculum was that I had ample opportunity to express the content and direction of my thoughts and to communicate extensively with fellow students" (perceived: 2.8). Therefore, even when PBL activities were used, the class might have perceived them, in part, as LBL activities.

Policies for preservice and in-service teacher education have been well established for K–12 teachers, but such policies rarely exist for medical educators.[31–33] This might be because the focus of teachers in higher education, including medicine, tends to be on research and they might not receive formal training in instruction.[34] Traditional PBL tutor-training courses generally consist of separate courses in subject matter (content) and guiding or teaching methods (pedagogy). How to bridge the gap between the content and pedagogical aspects of teacher preparation by developing cohesive knowledge has been a crucial issue.[31 35] Science education has highlighted the importance of pedagogical content knowledge in professional development, which envisions that teachers will try to blend professional knowledge and pedagogical knowledge into understandable content that is adaptable to learners' characteristics and learning environments. In order to develop successful instructional tools and learning environments for nursing, researchers and teachers in the area of nursing education should determine how to improve the professional development of PBL teachers.

Possible effects of perceptions of preferred and perceived learning environments on learning outcomes

In our study, fundamental nursing knowledge, self-efficacy in nursing, and attitudes towards nursing were significantly enhanced when students perceived the method of instruction to be congruent with their preferred learning environment. This echoes our argument that students' perceptions of their current learning environment are a strong predictor of learning outcomes at university.[13 36] A learning environment that is congruent with students' preferences provides an opportunity to improve outcomes. Aligning the method of instruction with the preferred learning environment of the students or decreasing the gap between preferred and perceived learning environments might help students to improve their performance further.

The following strategies would thus improve PBL. First, teachers need to examine students' preferences for the learning environment and familiarise themselves with PBL before providing them with PBL instruction. As students become more familiar with the PBL style, they may change their preference and achieve better results.[37] Second, teachers need to consider how students perceive the learning environment. They may need to continually adjust their instruction to help students engage in PBL activities, become familiar with the practice of inquiry, and thus achieve satisfaction and a sense of achievement from learning.

This study has some limitations, and some improvements could be made. For example, how the educators ensure that the learning environment provided is consistent with what was planned is always critical. As well as clarifying students' PBL, it is important to investigate the difference between the students' perception of the learning environment and the teachers' intention, and explore the effect of the congruence. In this study, we did observe a discrepancy between the intended teaching strategy by the teacher and the perceptions of the students. However, since the instructor's intention (or perception) for the learning environment was not measured at the experimental (quantitative) level, the current study cannot establish a connection between these factors. A revised Pc-LEI could serve as a measurement of the instructor's intention (or perception) of the learning environment. For example, the item "My actual experience in the Fundamental Nursing curriculum was that the teacher chose essential concepts and knowledge to teach in the class" in Pc-LEI can be revised to "In teaching Fundamental Nursing curriculum, the teacher chose essential concepts and knowledge to teach in the class. My intention was…" for assessing teachers' intentions before instruction. In subsequent studies, it would be of interest to investigate this issue by intentionally recruiting a representative sample.

In conclusion, the results of this study showed that most of the participants preferred to learn in a classroom environment that combined problem-based and lecture-based instructional approaches. Learning outcomes were enhanced when the instructional activities used were congruent with preferred learning environments.

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Contributors T-KY, C-YC designed the study, T-KY, H-MH researched the data, T-KY, H-MH performed the statistical analyses, and T-KY wrote the manuscript. All authors contributed to the discussion, WPC, C-YC edited the manuscript, and all authors gave final approval of the version to be submitted and any revised version. WPC and C-YC are the guarantors.

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