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Self-efficacy as a mediator in the relationship between clinical learning environment and core nursing competence of intern nursing students: A multicenter cross-sectional study

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Self-efficacy as a mediator in the relationship between clinical learning environment and core nursing competence of intern nursing students: A multicenter cross-sectional study

Yunxia Pu[a,1], Hongmei Xie[b,c,1], Lan Fu[b,c], Xiaoxia Zhang[d], Ting Long[e], Xiaotian Su[b,c], Xiaojuan Feng[b,c], Xianqiong Feng[f],*

[a] Department of Targeting Therapy & Immunology, Cancer Center, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

[b] Division of Breast Surgery, Department of General Surgery, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

[C] Breast Center, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[d] Division of Head & Neck Tumor Multimodality Treatment, Cancer Center, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

[e] Outpatient Department, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[f] Department of Nursing, West China Hospital, Sichuan University/ West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

[1] These authors contributed equally to this study.

* Corresponding Author:

No. 37 GuoXue Xiang, Department of Nursing, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

Phone number: 18980601700

Email address: fengxianqiong66@126.com

ABSTRACT

Objective: The aim of this study was to examine the relationships between Chinese intern nursing students' self-efficacy, the clinical learning environment, and core nursing competence. In addition, self-efficacy was investigated as a mediator in the association between the clinical learning environment and core nursing competence.

Design: This study used a cross-sectional, descriptive research design.

Setting: Fifteen nursing colleges and universities in China were the setting for the study.

Participants: The participants were 552 nursing student interns.

Primary and secondary outcome measures: The participants completed measures of general self-efficacy and nursing student core competencies.

Results: Participants' mean scores indicated they were satisfied with the clinical learning environment, their self-efficacy was at a medium-high level, and their core competence was at the upper intermediate level. Core nursing competence was positively correlated with self-efficacy and the clinical learning environment. Self-efficacy partially mediated the association between perception of the clinical learning environment and core competence level, accounting for 45.88% of the overall effect.

Conclusions: Self-efficacy played a role in explaining the beneficial association between the clinical learning environment and core nursing competence among Chinese intern nursing students. These findings suggest that nursing managers and educators should initially promote nursing students' self-efficacy to increase their confidence in overcoming clinical obstacles, and subsequently cultivate their core nursing competence.

Keywords: nursing students; core competence; self-efficacy; clinical learning environment; mediation analysis

ARTICAL SUMMARY

Strengths and limitations of this study

- The study included a large sample of nursing students from 15 nursing universities in China.
- We used convenience sampling and the participants were primarily full-time undergraduate students whose internship was at a tertiary Grade A hospital. Thereffore, the results may not be

representative of Chinese intern nursing students with different educational backgrounds working at different types of hospitals.

INTRODUCTION

Nurses are the largest goup of health care professionals worldwide and fulfill a key role in providing ethical, effective, and safe healthcare services tailored to the needs of the population [1]. The World Health Organization [2] reported that the education and training of new nurses, including intern nursing students, is a major concern of the nursing profession. Competency-based education is used extensively in the nursing profession because it can teach nurses to deliver high quality care to satisfy the expanding demands for healthcare worldwide [3]. Therefore, ensuring that nursing students learn solid professional skills to facilitate nursing industry development is critical.

As core nursing competence is the most important ability nursing professionals must acquire, nursing educators should focus on cultivating this set of skills [4]. In 2003, the International Council of Nurses defined nurses' core competence as "the special knowledge, skills, judgment and personal characteristics required by nurses to provide safe and ethical nursing services" [5]. Although different countries require different components and standards of core nursing competence, they all emphasize that it is a necessary ability for nursing work [6-8].

Clinical practice is an indispensable training component for nursing students. The nursing regulations in China require nurses applying for registration as nurse practitioners to undergo at least eight months of clinical internship in a teaching or general hospital [9]. Meanwhile, the latest regulations of the European Union state that nursing education must include at least 2,300 hours of clinical learning in different environments [10]. Clinical learning should enable students to integrate their theoretical knowledge with actual clinical situations, acquire professional competence, and become qualified nurses [11]. The clinical learning environment comprises all of the components that interact in the clinical setting and influence nursing students' learning. It is where nursing students learn nursing skills, socialize their roles, and develop a sense of professional responsibility for nursing [12]. The quality of the clinical learning environment (e.g., the physical environment, teaching personnel, and other health care experts) can affect nursing students' professional attitudes, level of nursing knowledge, behavioral skills, and ability to solve clinical problems [13]. Therefore, the clinical environment can be instrumental in cultivating core competence in intern nursing students.

Efforts to cultivate core nursing competence among nursing students should also focus on their self-efficacy, which refers to their subjective judgment of their ability to perform a certain task [14]. Bandura's [15] social cognition theory posits that self-efficacy can be a motivating factor and may affect one's sense of agency. The stronger a person's sense of self-efficacy, the greater their confidence in overcoming difficulties [16].

Investigating the status and influencing variables of nursing students' core competence is also critical to support the growth of their nursing careers. A survey of 1,796 nursing students graduating from six countries, including Germany, Finland, and Ireland, showed that their nursing abilities were generally good [17]. According to research on the core competence of Chinese nursing internship students, undergraduate nursing students possessed core competence at or above an intermediate level [18,19], whereas Chinese intern nursing students (including undergraduate, junior college, and technical secondary school students) were at an intermediate [20] or below intermediate level [21]. These findings suggest that relative to nursing students from other nations, Chinese nursing students must further develop their core nursing competence.

Research has demonstrated a positive correlation between the clinical competence of nursing students and both their self-efficacy and the clinical learning environment [22,23]. Self-efficacy alone has also been found to have a positive correlation with the clinical learning environment [24].

Previous research has focused more on the independent relationships among these variables, as opposed to hypothesizing a mediation model. To clarify the relationships between these factors, the present study aimed to accomplish the following objectives: (1) assess the perceptions of intern nursing students in China regarding the clinical learning environment, self-efficacy, and core nursing competence; (2) investigate the interconnections among self-efficacy, the clinical learning environment, and core competence; and (3) investigate the mediating role of self-efficacy in the relationship between the clinical learning environment and core nursing competence.

Bandura's [25] triadic reciprocal determinism theory was the theoretical foundation of the current investigation. Bandura postulated that the environment, behavior, and individual personal factors interact to exert mutual influence (Figure 1). This study used the self-efficacy of nursing students as the individual personal factor, core nursing competence as the behavior, and the clinical learning environment as the environment. Drawing upon prior investigations and Bandura's theoretical framework, we proposed the following two hypotheses (Figure 2):

H1: Core nursing competence is positively related to both self-efficacy and the clinical learning environment.

H2: Self-efficacy mediates the association between the clinical learning environment and core nursing competence.

[Insert Figure 1 here]

[Insert Figure 2 here]

METHODS

Participants

A total of 552 intern nursing students engaged in clinical learning were selected through convenience sampling from 15 nursing universities located in the southwestern region of China. Only nursing students (i.e., those enrolled in technical secondary schools, junior colleges, or undergraduate programs) were eligible to participate in the study. Students provided informed consent prior to their voluntary participation in the study. Intern nursing students whose clinical rotations were prematurely terminated due to personal or medical obligations were excluded from the study. According to Preacher and Kelley [26], to estimate a sufficient number of parameters, the number of participants for path analysis should be 10–20 times greater. To account for a 20% margin of error in the questionnaires and 30 variables (including demographic, core competency, self-efficacy, and clinical learning environment variables), a sample size of 375–750 participants was necessary for this study.

Sociodemographic Information Questionnaire

A sociodemographic questionnaire was developed for use in this study. The questionnaire asked participants to provide information on their age, gender, education level, professional interests, home location, length of clinical practice, classification of their hospital, whether they serve as a class leader, and whether they were an only child.

Competency Inventory for Nursing Students

The Competency Inventory for Nursing Students (CINS), which was designed by Hsu and Hsieh [27] to comprehensively assess the fundamental abilities of nursing students, was subsequently translated into Chinese by Ruixue et al. [28]. The CINS includes 38 items in six dimensions: care,

ethics and responsibility, general clinical skills, critical thinking and reasoning ability, lifelong learning, and clinical biomedical science. The responses to the items are provided on a 5-point Likert scale ranging from 1 = "completely incompetent" to 5 = "completely competent." The total scores range from 38 to 190, with high scores indicating a high level of student nursing competence. The Chinese version of the CINS demonstrated good internal consistency, reliability, and stability, with Cronbach's alpha values ranging from 0.83 to 0.95 for each subscale and 0.97 for the total scale [28]. In this investigation, Cronbach's alpha for the total scale was 0.95.

General Self-Efficacy Scale

The Chinese adaptation of the General Self-Efficacy Scale (GSES), created by Zhang and Schwarzer [29], was used to assess general self-efficacy. The GSES is a self-report instrument consisting of 10 items that are rated on a 4-point Likert scale ranging from 1 = "completely incorrect" to 4 = "completely correct." The cumulative score of all 10 items represents the total score; a high score indicates a high level of general self-efficacy. The Chinese version of the GSES has been used extensively in China and has highly reliable with a Cronbach's alpha of 0.87 [30]. The Cronbach's alpha in this investigation was 0.90.

Environment Evaluation Scale for Clinical Nursing Internship

The Environment Evaluation Scale for Clinical Nursing Internship, developed by Hu et al. [31], comprises 30 items divided into six dimensions: organizational support, teaching methods, teacher quality, learning opportunities, interpersonal relationships, and work atmosphere. The responses to the items are provided on a 5-point Likert scale ranging from 1 = "completely disagree" to 5 = "completely agree." The total score ranges from 30 to 150, with higher scores indicating a more robust clinical learning environment for nursing interns. The scale has demonstrated good internal consistency, reliability, and stability, with Cronbach's alpha values of 0.96 for the total scale and 0.84 to 0.95 for each subscale. In this investigation, Cronbach's alpha for the total scale was 0.96.

Procedures

The Medical Ethics Committee of the West China Hospital of Sichuan University approved this study (approval no. 2022-1903). The study adhered to the principles of informed consent and voluntary participation. The principal investigator generated a link to the questionnaire after entering it into the Questionnaire Star software program. Intern nursing students were provided with a link to the questionnaire, which they were able to access and complete through the WeChat social media

platform. To maintain the accuracy and comprehensiveness of responses, each item in the questionnaire required a response, and participation was restricted to a single attempt to complete the questionnaire from a given IP address. After completed questionnaires were collected and reviewed, invalid questionnaires were eliminated. A cohort of 580 intern nurses participated in the study; however, 28 participants submitted questionnaires determined to be invalid. As a result, 552 participants comprised the final sample, representing a valid return rate of 95.17%.

Data analysis

SPSS version 26.0 was used to analyze the data. Due to the normal distribution of data in this study, frequency, percentage, mean, and standard deviation were used to analyze the demographic characteristics of the participants. T-tests and ANOVA were used to examine the variations in fundamental nursing competence based on the characteristics of the nursing interns. Pearson's correlation coefficients were calculated to determine the relationships between the variables. Multiple linear stepwise regression was conducted to ascertain the factors substantially correlated with core nursing competence. The effects of self-efficacy and the clinical learning environment on core nursing competence were investigated using AMOS version 23.0 and structural equation modeling. Modification indices were used to fit the data. Furthermore, the mediating role of self-efficacy in the relationship between the clinical practice environment and core nursing competence was examined using bootstrap methods. The estimated effect was deemed significant if the 95% bootstrap confidence interval for the mediating effect did not include zero. Statistical significance was set at $P<0.05$.

Patient and public involvement

There was no patient or public involvement in this study.

RESULTS

Sociodemographic characteristics

A total of 552 intern nursing students aged 21.06 ($\pm$1.05) years were included in this study. Eighty (14.49%) participants were men and 472 (85.51%) were women. Regarding education level, 23 (4.17%) were technical secondary school students, 178 (32.24%) were junior college students, and 351 (63.59%) were undergraduate students (Table 1).

Table 1. Sociodemographic characteristics of the participants (N=552).

Variable	n	%	Variable	n	%
Gender			Home location		
Female	472	85.51	City	191	34.60
Male	80	14.49	Town	121	21.92
Education level			Rural area	240	43.48
Technical secondary school	23	4.17	From a one-child family		
Junior college	178	32.24	Yes	193	34.96
Undergraduate	351	63.59	No	359	65.04
Length of clinical practice			Professional interest (Do you like nursing?)		
<12 weeks	106	19.20	Yes	387	70.11
12–24 weeks	237	42.94	Neutral	139	25.18
25–36 weeks	145	26.27	No	26	4.71
>36 weeks	64	11.59	Whether served as a class leader		
Internship hospital level[a]			Yes	280	50.72
Tertiary grade A hospitals	499	90.40	No	272	49.28
Tertiary grade B hospitals	28	5.07			
Others	25	4.53			

[a] Hospitals are classified according to the Hospital Classification Management Standards. The hospitals are divided into three levels, and each level is divided into grades A, B, and C. Tertiary hospitals are added with special grades. Therefore, hospitals in China are divided into three levels and 10 grades. Tertiary Grade A hospitals offer the most comprehensive medical services, followed by tertiary Grade B hospitals.

Descriptive statistics

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The clinical learning environment score was 123.02 (±19.62), the self-efficacy score was 29.71 (±5.25), and the core nursing competence score was 148.73 (±22.63). These scores indicated the participants were satisfied with the clinical learning environment, their self-efficacy was at a medium-high level, and their core competence was at the upper intermediate level (Table 2).

Table 2. Self-efficacy, clinical learning environment, and core nursing competence scores (N=552).

Variable	Score range	Mean±SD
Self-efficacy	10–40	29.71±5.25
Competency Inventory for Nursing Students	38–190	148.73±22.63
Clinical biomedical science	5–25	18.10±3.51
General clinical skills	6–30	22.55±3.97
Critical thinking and reasoning ability	3–15	10.96±2.16
Care	5–25	19.71±3.46
Ethics and responsibility	14–70	57.88±9.29
Lifelong learning	5–25	19.51±3.38
Clinical learning environment	30–150	123.02±19.62
Teaching methods	5–25	20.57±3.53
Teacher quality	5–25	20.97±3.48
Learning opportunities	5–25	20.12±3.66
Interpersonal relationships	5–25	20.57±3.41
Work atmosphere	5–25	20.58±3.46
Organizational support	5–25	20.18±3.73

Univariate and correlation analysis

Significant variations in core nursing competence were observed based on factors such as the duration of clinical experience, level of education, place of residence, and professional inclination (Table 3). Pearson correlation analysis revealed that self-efficacy was positively correlated with core nursing competence (r=0.597, P<0.001) and clinical learning environment (r=0.610, P<0.001), and

clinical learning environment was positively correlated with core nursing competence (r=0.549 P<0.001).

Table 3. Univariate analysis of core nursing competence by sociodemographic characteristics (N=552).

Characteristic	Core nursing competence			95% confidence interval	
	Mean	SD	F/t	Lower	Upper
Length of clinical practice			5.991**		
<12 weeks	142.82	28.13		137.40	148.23
12–24 weeks	147.72	21.26		145.00	150.44
25–36 weeks	151.15	22.11		147.52	154.78
>36 weeks	156.81	14.44		153.20	160.42
Education level			8.080**		
Tertiary	153.69	29.76		140.82	166.56
Postsecondary	153.80	21.82		150.57	157.03
Full-time undergraduate	145.84	22.06		143.52	148.16
Home location					
City	150.95	26.59	4.166*	147.16	154.75
Town	151.47	19.47		147.96	154.97
Rural area	145.59	20.27		143.01	148.17
Professional interest			10.303**		
Yes	151.50	22.42		149.26	153.74
Neutral	142.81	19.58		139.52	146.09
No	139.19	31.71		126.38	152.00

Only significant results are listed. *P<0.05, **P<0.001.

Regression analysis

Predictors of the core nursing competence were identified by performing multiple linear regression analyses. The independent variables, namely self-efficacy, clinical learning environment, professional interest, length of clinical practice, education level, and home location, were found to be significant in the univariate analyses. After accounting for the influence of the other variables, the clinical learning environment (β=0.362, P<0.001), length of clinical practice (β=0.131, P<0.001), and self-efficacy (β=0.406, P<0.001) emerged as significant predictors of core nursing competence. These factors accounted for 48.6% of the variance (Table 4).

Table 4. Regression analysis predicting core nursing competence (N=552).

Variable	B	SE	β	t	P
Self-efficacy	1.752	0.157	0.406	11.119	<0.001
Clinical learning environment	0.418	0.042	0.362	9.877	<0.001
Length of clinical practice	3.261	0.762	0.131	4.275	<0.001

Note: R^2=0.488; adjusted R^2=0.486; F=174.433.

The mediating effect of self-efficacy

The dependent variable was core nursing competence, the mediating variable was self-efficacy, and the independent variable was clinical learning environment (Figure 3). As a result of the initial inadequate fit of the model, this study used two modification indices corrections. Following the revision, the fit indices were as follows: X^2/df = 3.887, goodness of fit = 0.945, comparative fit index = 0.912, Tucker-Lewis index = 0.955, and root mean square error of approximation = 0.030. The fit of the model fell within a permissible range.

The findings from the AMOS analysis demonstrated that a direct and positive relationship existed between self-efficacy, the clinical learning environment, and core nursing competence (Table 5[a]). A 95% confidence interval (CI) was applied to the test of significance for the mediating effect

after 5,000 samples of the original data were replicated using the bootstrap method. The mediating effect is significant if zero is not included in the CI. The results indicated self-efficacy partially mediated the relationship between the clinical learning environment and core nursing competence. The total effect of the clinical internship environment on core competence was 0.497 (P<0.01, 95% CI=0.396–0.592). The direct effect was 0.270 (P<0.01, 95% CI=0.184–0.350) and the mediating effect was 0.228 (P<0.001, 95% CI=0.175–0.296), accounting for 45.88% of the total effect (Table 5[b]).

[Insert Figure 3 here]

Table 5(a). Path inspection.

Path	Unstandardized regression coefficient	Standardized regression coefficient	SE	Critical ratio	P
Clinical learning environment → self-efficacy	0.847	0.555	0.057	14.832	<0.001
Self-efficacy → core nursing competence	0.269	0.479	0.023	11.713	<0.001
Clinical learning environment → core nursing competence	0.270	0.315	0.035	7.737	<0.001

Table 5(b). Analysis of the mediating, direct, and total effects on core nursing competence.

Effect	Impact	SE	95% confidence interval		P	%
			Lower	Upper		
Mediating effect	0.228	0.030	0.175	0.296	<0.001	45.88
Direct effect	0.270	0.041	0.184	0.350	0.001	54.12
Total effect	0.497	0.050	0.396	0.592	0.001	

DISCUSSION

This study included intern nursing students with different educational backgrounds from 15 nursing colleges in Southwest China. The students were completing a nursing internship at tertiary A, tertiary B, and secondary A hospitals. The sample predominantly comprised undergraduate students and students at tertiary A practicing hospitals, indicating that the participants had high professional qualities. They were all new interns who participated in a standardized clinical internship for the first time. Although the internship duration followed a normal distribution, the nursing students were in different internship cycles. Similar to the male-to-female nurse-to-student ratio in China [32], the majority of the students were female. Consequently, the study sample provides a reasonable representation of intern nursing students in China.

Core nursing competence, self-efficacy, and the clinical learning environment of nursing students

In this study, the clinical learning environment score indicated that the nursing students were satisfied with the clinical learning environment. These findings align with those of Yuxuan et al. [33] and are marginally higher than those of Xiang et al. [16]. Among the dimensions, teacher quality received the highest score and learning opportunity the lowest, which is consistent with the findings of Jing et al. [34]. This result could be attributed to the fact that the majority of the study participants were educated in tertiary Grade A hospitals, which are renowned for their teaching capabilities. These hospitals can provide nursing students with a strong clinical learning experience because they have excellent hardware and software facilities, mature practical and teaching work, standardized management, orderly and well-organized clinical environments, and experienced clinical teachers. However, to avoid risk, teachers do not allow students to complete simple, mechanical, and repetitive nursing operations. In addition, patient trust in nursing students remains limited, resulting in few practical opportunities despite the students' strong technical capabilities [35]. Therefore, nursing students should be given more practical opportunities to operate independently while their clinical safety is guaranteed.

The self-efficacy score of the intern nursing students indicated a medium-high level of self-efficacy. This finding aligns with the results reported by nursing students in other countries, such as the Philippines, Spain, and Slovakia [36, 37]. However, it surpasses the level of confidence found in the study conducted by Li et al. [38], which targeted 836 Chinese intern nursing students. This

difference may be related to the nursing students' education level and clinical learning environments in the different studies, given that differences in self-efficacy can be related to the clinical context and patient population [39]. The proportion of undergraduate nursing students in this study exceeded 60%, which is higher than the proportion reported by Li et al. [38]. Compared with junior college and technical secondary school students, undergraduate nursing students have greater learning autonomy, more solid theoretical knowledge, and greater self-confidence in the face of difficulties; consequently, undergraduates tend to have greater self-efficacy. Furthermore, over 90% of the nursing students who participated in this study were affiliated with tertiary Grade A hospitals, which are renowned for their extensive clinical teaching experience and clinical learning environment that enhance students' self-efficacy [40]. To foster self-efficacy among nursing students, nursing educators and administrators should establish a positive clinical learning environment by offering a comprehensive, high-quality learning experience that promotes learning autonomy.

The core competence score of the nursing students in this study was at the upper intermediate level. This finding is marginally higher than the outcomes reported in other studies involving Chinese students [11, 41], but lower than the collective core competence level of nursing interns from six Asian countries [42]. Ethics and responsibility obtained the highest score, while clinical biomedical science and critical thinking and reasoning ability obtained the lowest scores. These findings are largely consistent with those of previous studies [11, 41].

The above variances may be due to the following reasons. First, in this study, most participants were undergraduate nursing students in tertiary Grade A hospitals. Students in Grade A hospitals would have a higher level of education and training than those in other hospitals, and the nursing students' professional quality would be higher. Therefore, the students' level of core nursing competence in the present study would be greater than that of students in other relevant studies in China. Second, according to a study by Grande et al. [42] on students' core nursing competence in other Asian countries, 80% of nursing students have a five-year learning cycle. In China, the learning period of undergraduate nursing students is four years, and that of junior college students is three years. The longer the learning cycle, the greater the likelihood that students have mastered their knowledge and, therefore, the greater their core nursing competence. Third, the highest score in the dimension of ethics and responsibility is possibly related to the emphasis placed on the patient-centered nursing model in China, and on the cultivation of ethics and a sense of responsibility in

nursing students. Thus, these results exemplify the success of the current focus on quality-oriented

education for nursing students. Fourth, the clinical biomedical science and critical thinking and

reasoning aptitude dimensions received low scores. Despite medical colleges and universities

recognizing the significance of fostering students' critical thinking skills, this is not consistently

reflected in instructional activities. The systematic assessment of learning is mostly limited to book

knowledge; consequently, students generally pay more attention to memorizing theoretical

knowledge than developing critical thinking skills [20]. The clinical biomedical sciences include

pathology, biology, and the physical examination and treatment of patients in clinical environments

[27]. As most of the participants in this study had experienced a short internship period, they had yet

to accumulate clinical experience in biomedical areas. According to the aforementioned results, the

fundamental nursing skills of Chinese nursing students have advanced compared to the level of

proficiency reported in previous studies. Nevertheless, further education and training are required to

develop students' proficiency in clinical biomedical science and critical thinking and reasoning.

Correlations and path analysis of the clinical learning environment, self-efficacy, and core
competence

A substantial positive correlation was identified in this study between the clinical learning

environment and core competence, indicating that a strong clinical learning environment for intern

nurses is associated with strong core competence in nursing students, which is consistent with the

findings of Liao and Liu [11]. Research has indicated that the effectiveness of instruction is

significantly influenced by the clinical learning environment. In other words, nursing students are

more likely to actively participate in the learning process when the clinical learning environment is

evaluated positively [43 ,44]. In addition to learning attitudes, the clinical learning environment

greatly affects nursing students' knowledge, behavioral skills, and problem-solving abilities [45].

Hence, establishing clinical environments conducive to learning is imperative to foster the

development of core nursing competence.

The present study revealed a positive correlation between self-efficacy and the clinical learning

environment, suggesting that a robust clinical learning environment is linked to higher self-efficacy.

This finding is consistent with the results reported by Xiang et al. [16]. This may occur because

nursing students gain self-efficacy through the support, resources, opportunities, and development

space provided by a positive clinical learning environment [46]. Such an environment also facilitates

the development of nursing students' confidence in their ability to manage problems that arise in nursing practice. Nursing educators and administrators can thus foster the development of self-efficacy among nursing students by providing a superior clinical learning environment.

The relationship between the clinical learning environment and core nursing competence was partially mediated by self-efficacy; this suggests that self-efficacy could partially explain the association between the clinical learning environment and the core competence of nursing students. This relationship can be understood in terms of self-efficacy's influence on an individual's motivation [15] and confidence in overcoming difficulties [16]. Upon entering the clinical environment, student nurses face many mental and physical challenges. They may have difficulty applying the knowledge and experiences from classroom learning to the problems they encounter in the clinical setting. Consequently, students may have reactions such as withdrawal, avoidance, and burnout, which can result in low motivation for clinical and academic work that will manifest in their core competence. However, a strong clinical learning environment plays a positive role in stimulating the self-efficacy of nursing students, and the level of self-efficacy affects the learning attitude and clinical learning quality of nursing students [24], thereby affecting their core nursing competence. Therefore, to foster the growth of intern nursing students' fundamental nursing competence, it is critical to provide students with a robust clinical learning environment and opportunities that cultivate their self-efficacy for effectively navigating the diverse challenges of clinical practice.

Limitations

This study has certain limitations that should be addressed in future research. First, although the nursing students were recruited from different institutions in China, we used convenience sampling, and the participants were primarily full-time undergraduate students with internships at tertiary Grade A hospitals. Therefore, the results may not be representative of Chinese intern nursing students with different educational backgrounds working at different types of hospitals. In the future, multicenter, large sample, stratified random sampling can be conducted to improve sample representativeness. Moreover, the influencing factors included in this study were limited. Future studies should consider additional factors and mediators affecting the core nursing competence of intern nursing students.

CONCLUSIONS

This study found that Chinese nursing interns were satisfied with their clinical learning environment, they had a medium-high level of self-efficacy, and their core competence was at the upper intermediate level. Furthermore, self-efficacy partially mediated the relationship between the clinical learning environment and core nursing competence. To foster the development of fundamental nursing competence in students, nursing administrators and instructors must not only establish a conducive clinical learning environment, but also provide students with motivation and validation, bolster their assurance in clinical tasks, and enhance their sense of self-efficacy.

Declarations of interest

None.

Ethical Statement

The study received approval from the Medical Ethics Committee of the West China Hospital of Sichuan University (No. 2022-1903).

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Data and code availability

The data that support this study are available from the first author upon reasonable request.

Author Contributions

Pu Yunxia: Writing–Original Draft, Visualization, Project Administration, Data Curation; Xie Hongmei: Formal Analysis, Writing–Original Draft, Data Curation, Project Administration; Fu Lan: Project Administration, Supervision; Zhang Xiaoxia: Investigation, Funding Acquisition, Supervision; Long Ting: Investigation, Resources, Methodology; Su Xiaotian: Investigation, Resources, Methodology; Feng Xiaojuan: Investigation, Resources, Conceptualization; Feng Xianqiong: Writing–Review & Editing, Supervision. All the authors contributed to this work and have approved the submitted version.

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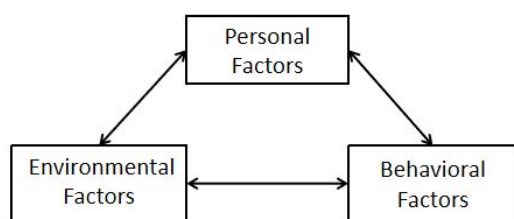56
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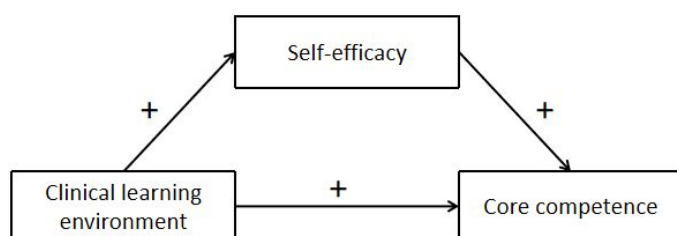
Figure 3. Bandura's triadic reciprocal determinism.
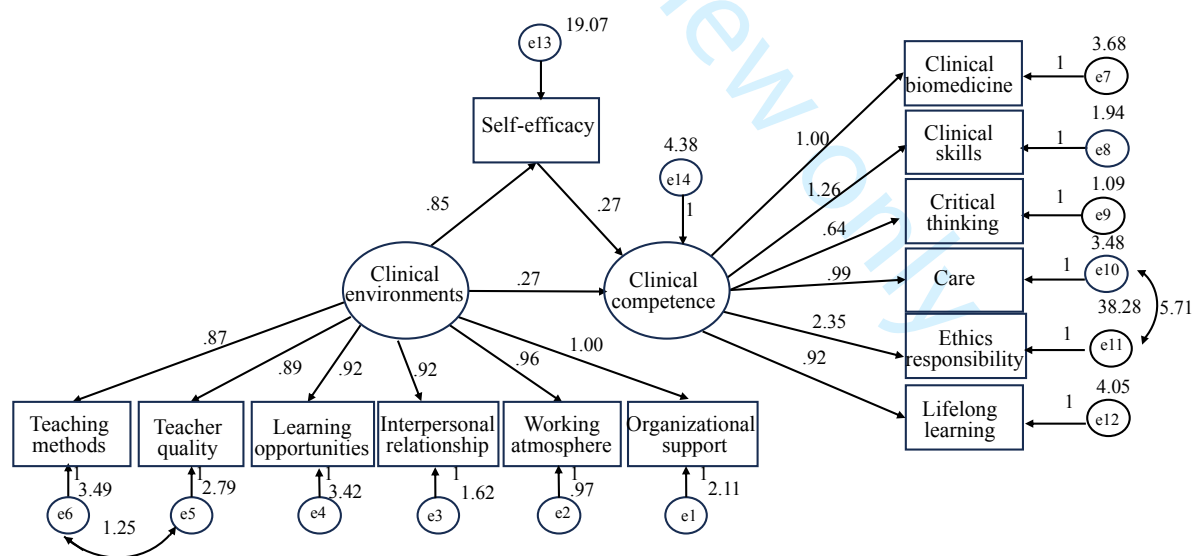
Figure 4. Hypothesized model.

Figure 3. Path model showing the mediating effect of self-efficacy in the relationship between the clinical learning environment and core nursing competence.

Figure 1 Bandura's triadic reciprocal determinism.

Figure 2 Hypothesized model.

Figure 3 Path model showing the mediating effect of self-efficacy in the relationship between the clinical learning environment and core nursing competence.

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Self-efficacy as a mediator in the relationship between clinical learning environment and core nursing competence of intern nursing students: A multicenter cross-sectional study

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Self-efficacy as a mediator in the relationship between clinical learning environment and core nursing competence of intern nursing students: A multicenter cross-sectional study

Yunxia Pu[a,g,1], Hongmei Xie[b,c,g,1], Lan Fu[b,c], Xiaoxia Zhang[d,g], Ting Long[e], Xiaotian Su[b,c], Xiaojuan Feng[b,c], Xianqiong Feng[f,g],*

[a] Department of Targeting Therapy & Immunology, Cancer Center, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[b] Department of General Surgery, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[c] Breast Disease Center, West China Hospital, Sichuan University , Chengdu, Sichuan Province, China

[d] Division of Head & Neck Tumor Multimodality Treatment, Cancer Center, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[e] Outpatient Department, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[f] Department of Nursing, West China Hospital, Sichuan University

[g] West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

[1] These authors contributed equally to this study.

* Corresponding Author:

No. 37 GuoXue Xiang, Department of Nursing, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

Phone number: 18980601700

Email address: fengxianqiong66@126.com

ABSTRACT

Objective: The aim of this study was to examine the relationships between Chinese intern nursing students' self-efficacy, the clinical learning environment, and core nursing competence. In addition, self-efficacy was investigated as a mediator in the association between the clinical learning environment and core nursing competence.

Design: This study used a cross-sectional, descriptive research design.

Setting: Fifteen nursing colleges and universities in China were the setting for the study.

Participants: The participants were 552 nursing student interns.

Primary and secondary outcome measures: The participants completed measures of general self-efficacy and nursing student core competencies.

Results: Participants' mean scores indicated they were satisfied with the clinical learning environment（123.02 ± 19.62）, their self-efficacy was at a medium-high level（29.71 ± 5.25）, and their core competence was at the upper intermediate level（148.73 ± 22.63）. Core nursing competence was positively correlated with self-efficacy and the clinical learning environment（r=0.597, P<0.001；r=0.549, P<0.001）. The clinical learning environment (β=0.362, P<0.001), duration of clinical practice (β=0.131, P<0.001), and self-efficacy (β=0.406, P<0.001) were identified as significant predictors of core nursing competence. Self-efficacy partially mediated the association between perception of the clinical learning environment and core competence level, accounting for 45.88% of the overall effect.

Conclusions: Self-efficacy played a role in explaining the beneficial association between the clinical learning environment and core nursing competence among Chinese intern nursing students. These findings suggest that nursing managers and educators should initially promote nursing students' self-efficacy to increase their confidence in overcoming clinical obstacles, and subsequently cultivate their core nursing competence.

Keywords: nursing students; core competence; self-efficacy; clinical learning environment; mediation analysis

ARTICAL SUMMARY

Strengths and limitations of this study

- The study included a large sample of nursing students from 15 nursing universities in China.

- We used convenience sampling and the participants were primarily full-time undergraduate students whose internship was at a tertiary Grade A hospital. Therefore, the results may not be representative of Chinese intern nursing students with different educational backgrounds working at different types of hospitals.

INTRODUCTION

Nurses are the largest group of health care professionals worldwide and fulfill a key role in providing ethical, effective, and safe healthcare services tailored to the needs of the population [1]. The World Health Organization [2] reported that the education and training of new nurses, including intern nursing students, is a major concern of the nursing profession. Competency-based education is used extensively in the nursing profession because it can teach nurses to deliver high quality care to satisfy the expanding demands for healthcare worldwide [3]. Nurses constitute the largest group of healthcare professionals worldwide and play a critical role in delivering ethical, effective, and safe healthcare services to meet population health needs. Therefore, ensuring that nursing students learn solid professional skills to facilitate nursing industry development is critical.

As core nursing competence is the most important ability nursing professionals must acquire, nursing educators should focus on cultivating this set of skills [4]. In 2003, the International Council of Nurses defined nurses' core competence as "the special knowledge, skills, judgment and personal characteristics required by nurses to provide safe and ethical nursing services" [5]. Although different countries require different components and standards of core nursing competence, they all emphasize that it is a necessary ability for nursing work [6-8]. As the future workforce of the nursing profession, the development of clinical intern nurses' professional competencies is crucial for the development of the nursing profession and enhancing the quality of nursing care.

Clinical practice is an indispensable training component for nursing students. The nursing regulations in China require nurses applying for registration as nurse practitioners to undergo at least eight months of clinical internship in a teaching or general hospital [9]. Meanwhile, the latest regulations of the European Union state that nursing education must include at least 2,300 hours of clinical learning in different environments [10]. Clinical learning should enable students to integrate their theoretical knowledge with actual clinical situations, acquire professional competence, and become qualified nurses [11]. The clinical learning environment comprises all of the components that interact in the clinical setting and influence nursing students' learning. It is where nursing

students learn nursing skills, socialize their roles, and develop a sense of professional responsibility for nursing [12]. The quality of the clinical learning environment (e.g., the physical environment, teaching personnel, and other health care experts) can affect nursing students' professional attitudes, level of nursing knowledge, behavioral skills, and ability to solve clinical problems [13]. Therefore, the clinical environment can be instrumental in cultivating core competence in intern nursing students.

Efforts to cultivate core nursing competence among nursing students should also focus on their self-efficacy, which refers to their subjective judgment of their ability to perform a certain task [14]. Bandura's [15] social cognition theory posits that self-efficacy can be a motivating factor and may affect one's sense of agency. The stronger a person's sense of self-efficacy, the greater their confidence in overcoming difficulties [16].

Investigating the status and influencing variables of nursing students' core competence is also critical to support the growth of their nursing careers. A survey of 1,796 nursing students graduating from six countries, including Germany, Finland, and Ireland, showed that their nursing abilities were generally good [17]. According to research on the core competence of Chinese nursing internship students, undergraduate nursing students possessed core competence at or above an intermediate level [18,19], whereas Chinese intern nursing students (including undergraduate, junior college, and technical secondary school students) were at an intermediate [20] or below intermediate level [21]. These findings suggest that relative to nursing students from other nations, Chinese nursing students must further develop their core nursing competence.

Research has demonstrated a positive correlation between the clinical competence of nursing students and both their self-efficacy and the clinical learning environment [22,23]. Self-efficacy alone has also been found to have a positive correlation with the clinical learning environment [24].

Previous research has focused more on the independent relationships among these variables, as opposed to hypothesizing a mediation model. To clarify the relationships between these factors, the present study aimed to accomplish the following objectives: (1) assess the perceptions of intern nursing students in China regarding the clinical learning environment, self-efficacy, and core nursing competence; (2) investigate the interconnections among self-efficacy, the clinical learning environment, and core competence; and (3) investigate the mediating role of self-efficacy in the relationship between the clinical learning environment and core nursing competence.

Bandura's [25] triadic reciprocal determinism theory was the theoretical foundation of the current investigation. Bandura postulated that the environment, behavior, and individual personal factors interact to exert mutual influence (Figure 1). This study used the self-efficacy of nursing students as the individual personal factor, core nursing competence as the behavior, and the clinical learning environment as the environment. Drawing upon prior investigations and Bandura's theoretical framework, we proposed the following two hypotheses (Figure 2):

H1: Core nursing competence is positively related to both self-efficacy and the clinical learning environment.

H2: Self-efficacy mediates the association between the clinical learning environment and core nursing competence.

[Insert Figure 1 here]

[Insert Figure 2 here]

METHODS

Participants

From December 2022 to March 2023, clinical nursing students from 15 medical schools in China were recruited as research participants. Inclusion criteria: Only nursing students enrolled in technical secondary schools, junior colleges, or undergraduate programs were eligible to participate. All participants provided informed consent prior to their voluntary participation in the study. Exclusion criteria: (1) Nursing students with physical or mental health conditions that prevented them from completing the questionnaire; and (2) internship nursing students who had not successfully completed clinical practice or were subject to sanctions, including those who failed to comply with hospital practice regulations.

According to Preacher and Kelley [26], to estimate a sufficient number of parameters, the number of participants for path analysis should be 10–20 times greater. To account for a 20% margin of error in the questionnaires and 30 variables (including demographic, core competency, self-efficacy, and clinical learning environment variables), a sample size of 375–750 participants was necessary for this study.

Sociodemographic Information Questionnaire

A sociodemographic questionnaire was developed for use in this study. The questionnaire asked participants to provide information on their age, gender, education level, professional interests, home location, length of clinical practice, classification of their hospital, whether they serve as a class leader, and whether they were an only child.

Competency Inventory for Nursing Students

The Competency Inventory for Nursing Students (CINS), which was designed by Hsu and Hsieh [27] to comprehensively assess the fundamental abilities of nursing students, was subsequently translated into Chinese by Ruixue et al. [28]. The CINS includes 38 items in six dimensions: care, ethics and responsibility, general clinical skills, critical thinking and reasoning ability, lifelong learning, and clinical biomedical science. The responses to the items are provided on a 5-point Likert scale ranging from 1 = "completely incompetent" to 5 = "completely competent." The total scores range from 38 to 190, with high scores indicating a high level of student nursing competence. The Chinese version of the CINS demonstrated good internal consistency, reliability, and stability, with Cronbach's alpha values ranging from 0.83 to 0.95 for each subscale and 0.97 for the total scale [28]. In this investigation, Cronbach's alpha for the total scale was 0.95.

General Self-Efficacy Scale

The Chinese adaptation of the General Self-Efficacy Scale (GSES), created by Zhang and Schwarzer [29], was used to assess general self-efficacy. The GSES is a self-report instrument consisting of 10 items that are rated on a 4-point Likert scale ranging from 1 = "completely incorrect" to 4 = "completely correct." The cumulative score of all 10 items represents the total score; a high score indicates a high level of general self-efficacy. The Chinese version of the GSES has been used extensively in China and has highly reliable with a Cronbach's alpha of 0.87 [30]. The Cronbach's alpha in this investigation was 0.90.

Environment Evaluation Scale for Clinical Nursing Internship

The Environment Evaluation Scale for Clinical Nursing Internship, developed by Hu et al. [31], comprises 30 items divided into six dimensions: organizational support, teaching methods, teacher quality, learning opportunities, interpersonal relationships, and work atmosphere. The responses to the items are provided on a 5-point Likert scale ranging from 1 = "completely disagree" to 5 = "completely agree." The total score ranges from 30 to 150, with higher scores indicating a more robust clinical learning environment for nursing interns. The scale has demonstrated good internal

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consistency, reliability, and stability, with Cronbach's alpha values of 0.96 for the total scale and 0.84 to 0.95 for each subscale. In this investigation, Cronbach's alpha for the total scale was 0.96.

Procedures

The Medical Ethics Committee of the West China Hospital of Sichuan University approved this study (approval no. 2022-1903). The study adhered to the principles of informed consent and voluntary participation. The researchers first contacted the instructors responsible for overseeing students' internships at the university's school of nursing and affiliated hospitals. They provided a detailed explanation of the study's purpose, content and questionnaire completion process. Subsequently, questionnaires were distributed randomly to clinical internship nurses from institutions such as Chengdu University, Ya'an Vocational and Technical College, North Sichuan Medical College, and Hubei Three Gorges Vocational and Technical College. The questionnaire was administered through the Questionnaire Star software, and the unified guidance language was used in the questionnaire to explain the study's purpose, completion method and informed consent process. Participants submitted the questionnaire anonymously upon completion.

To maintain the accuracy and comprehensiveness of responses, each item in the questionnaire required a response, and participation was restricted to a single attempt to complete the questionnaire from a given IP address. After completed questionnaires were collected and reviewed, invalid questionnaires were eliminated. A cohort of 580 intern nurses participated in the study; however, 28 questionnaires were deemed invalid. Consequently, the final sample consisted of 552 participants, resulting in a valid response rate of 95.17%.

Data analysis

SPSS version 26.0 was used to analyze the data. Due to the normal distribution of data in this study, frequency, percentage, mean, and standard deviation were used to analyze the demographic characteristics of the participants. T-tests and ANOVA were used to examine the variations in fundamental nursing competence based on the characteristics of the nursing interns. Pearson's correlation coefficients were calculated to determine the relationships between the variables. Multiple linear stepwise regression was conducted to ascertain the factors substantially correlated with core nursing competence. The effects of self-efficacy and the clinical learning environment on core nursing competence were investigated using AMOS version 23.0 and structural equation modeling. Modification indices were used to fit the data. Furthermore, the mediating role of self-

efficacy in the relationship between the clinical practice environment and core nursing competence was examined using bootstrap methods. The estimated effect was deemed significant if the 95% bootstrap confidence interval for the mediating effect did not include zero. Statistical significance was set at P<0.05.

Patient and public involvement

There was no patient or public involvement in this study.

RESULTS

Sociodemographic characteristics

A total of 552 intern nursing students（mean age: 21.06 ±1.05 years) participated in this study. Of these, 80 (14.49%) were men, and 472 (85.51%) were women. Regarding education level, 23 (4.17%) were enrolled in technical secondary schools, 178 (32.24%) in junior colleges, and 351 (63.59%) in undergraduate programs (Table 1).

Table 1. Sociodemographic characteristics of the participants (N=552).

Variable	n	%	Variable	n	%
Gender			Home location		
Female	472	85.51	City	191	34.60
Male	80	14.49	Town	121	21.92
Education level			Rural area	240	43.48
Technical secondary school	23	4.17	From a one-child family		
Junior college	178	32.24	Yes	193	34.96
Undergraduate	351	63.59	No	359	65.04
Length of clinical practice			Professional interest (Do you like nursing?)		
<12 weeks	106	19.20	Yes	387	70.11
12–24 weeks	237	42.94	Neutral	139	25.18
25–36 weeks	145	26.27	No	26	4.71
>36 weeks	64	11.59	Whether served as a class leader		

Variable	n	%	Variable	n	%
Internship hospital level[a]			Yes	280	50.72
Tertiary grade A hospitals	499	90.40	No	272	49.28
Tertiary grade B hospitals	28	5.07			
Others	25	4.53			

[a] Hospitals are classified according to the Hospital Classification Management Standards. The hospitals are divided into three levels, and each level is divided into grades A, B, and C. Tertiary hospitals are added with special grades. Therefore, hospitals in China are divided into three levels and 10 grades. Tertiary Grade A hospitals offer the most comprehensive medical services, followed by tertiary Grade B hospitals.

Descriptive statistics

The clinical learning environment score was 123.02 ±19.62, the self-efficacy score was 29.71 ±5.25, and the core nursing competence score was 148.73 ±22.63. These scores indicated the participants were satisfied with the clinical learning environment, their self-efficacy was at a medium-high level, and their core competence was at the upper intermediate level (Table 2).

Table 2. Self-efficacy, clinical learning environment, and core nursing competence scores (N=552).

Variable	Score range	Mean±SD
Self-efficacy	10–40	29.71±5.25
Competency Inventory for Nursing Students	38–190	148.73±22.63
Clinical biomedical science	5–25	18.10±3.51
General clinical skills	6–30	22.55±3.97
Critical thinking and reasoning ability	3–15	10.96±2.16
Care	5–25	19.71±3.46
Ethics and responsibility	14–70	57.88±9.29
Lifelong learning	5–25	19.51±3.38
Clinical learning environment	30–150	123.02±19.62
Teaching methods	5–25	20.57±3.53
Teacher quality	5–25	20.97±3.48

Variable	Score range	Mean±SD
Learning opportunities	5–25	20.12±3.66
Interpersonal relationships	5–25	20.57±3.41
Work atmosphere	5–25	20.58±3.46
Organizational support	5–25	20.18±3.73

Univariate and correlation analysis

Significant variations in core nursing competence were observed based on factors such as the duration of clinical experience, level of education, place of residence, and professional inclination (Table 3). Pearson correlation analysis revealed that self-efficacy was positively correlated with core nursing competence ($r=0.597$, $P<0.001$) and clinical learning environment ($r=0.610$, $P<0.001$), and clinical learning environment was positively correlated with core nursing competence ($r=0.549$ $P<0.001$).

Table 3. Univariate analysis of core nursing competence by sociodemographic characteristics (N=552).

Characteristic	Core nursing competence			95% confidence interval	
	Mean	SD	F/t	Lower	Upper
Length of clinical practice			5.991**		
<12 weeks	142.82	28.13		137.40	148.23
12–24 weeks	147.72	21.26		145.00	150.44
25–36 weeks	151.15	22.11		147.52	154.78
>36 weeks	156.81	14.44		153.20	160.42
Education level			8.080**		
Tertiary	153.69	29.76		140.82	166.56
Postsecondary	153.80	21.82		150.57	157.03

Characteristic	Core nursing competence				95% confidence interval	
	Mean	SD	F/t		Lower	Upper
Full-time undergraduate	145.84	22.06			143.52	148.16
Home location						
City	150.95	26.59	4.166*		147.16	154.75
Town	151.47	19.47			147.96	154.97
Rural area	145.59	20.27			143.01	148.17
Professional interest			10.303**			
Yes	151.50	22.42			149.26	153.74
Neutral	142.81	19.58			139.52	146.09
No	139.19	31.71			126.38	152.00

Only significant results are listed. *$P<0.05$, **$P<0.001$.

Regression analysis

Predictors of the core nursing competence were identified by performing multiple linear regression analyses. The independent variables, namely self-efficacy, clinical learning environment, professional interest, length of clinical practice, education level, and home location, were found to be significant in the univariate analyses. After accounting for the influence of the other variables, the clinical learning environment ($\beta=0.362$, $P<0.001$), length of clinical practice ($\beta=0.131$, $P<0.001$), and self-efficacy ($\beta=0.406$, $P<0.001$) emerged as significant predictors of core nursing competence. These factors accounted for 48.6% of the variance (Table 4).

Table 4. Regression analysis predicting core nursing competence (N=552).

Variable	B	SE	β	t	P
Self-efficacy	1.752	0.157	0.406	11.119	<0.001
Clinical learning environment	0.418	0.042	0.362	9.877	<0.001

Length of clinical practice	3.261	0.762	0.131	4.275	<0.001

Note: R^2=0.488; adjusted R^2=0.486; F=174.433.

The mediating effect of self-efficacy

The dependent variable was core nursing competence, the mediating variable was self-efficacy, and the independent variable was clinical learning environment (Figure 3). As a result of the initial inadequate fit of the model, this study used two modification indices corrections. Following the revision, the fit indices were as follows: X^2/df = 3.887, goodness of fit = 0.945, comparative fit index = 0.912, Tucker-Lewis index = 0.955, and root mean square error of approximation = 0.030. The fit of the model fell within a permissible range.

The findings from the AMOS analysis demonstrated that a direct and positive relationship existed between self-efficacy, the clinical learning environment, and core nursing competence (Table 5[a]). A 95% confidence interval (CI) was applied to the test of significance for the mediating effect after 5,000 samples of the original data were replicated using the bootstrap method. The mediating effect is significant if zero is not included in the CI. The results indicated self-efficacy partially mediated the relationship between the clinical learning environment and core nursing competence. The total effect of the clinical internship environment on core competence was 0.497 (*P*<0.01, 95% CI=0.396–0.592). The direct effect was 0.270 (*P*<0.01, 95% CI=0.184–0.350) and the mediating effect was 0.228 (*P*<0.001, 95% CI=0.175–0.296), accounting for 45.88% of the total effect (Table 5[b]).

[Insert Figure 3 here]

Table 5(a). Path inspection.

Path	Unstandardized regression coefficient	Standardized regression coefficient	SE	Critical ratio	P
Clinical learning environment → self-efficacy	0.847	0.555	0.057	14.832	<0.001

Path	Unstandardized regression coefficient	Standardized regression coefficient	SE	Critical ratio	P
Self-efficacy → core nursing competence	0.269	0.479	0.023	11.713	<0.001
Clinical learning environment → core nursing competence	0.270	0.315	0.035	7.737	<0.001

Table 5(b). Analysis of the mediating, direct, and total effects on core nursing competence.

Effect	Impact	SE	95% confidence interval		P	%
			Lower	Upper		
Mediating effect	0.228	0.030	0.175	0.296	<0.001	45.88
Direct effect	0.270	0.041	0.184	0.350	0.001	54.12
Total effect	0.497	0.050	0.396	0.592	0.001	

DISCUSSION

This study included intern nursing students with different educational backgrounds from 15 nursing colleges in Southwest China. The students were completing a nursing internship at tertiary A, tertiary B, and secondary A hospitals. The sample predominantly comprised undergraduate students and students at tertiary A practicing hospitals, indicating that the participants had high professional qualities. They were all new interns who participated in a standardized clinical internship for the first time. Although the internship duration followed a normal distribution, the nursing students were in different internship cycles. Similar to the male-to-female nurse-to-student ratio in China [32], the majority of the students were female. Consequently, the study sample provides a reasonable representation of intern nursing students in China.

Core nursing competence, self-efficacy, and the clinical learning environment of nursing students

In this study, the clinical learning environment score indicated that the nursing students were satisfied with the clinical learning environment. These findings align with those of Yuxuan et al. [33] and are marginally higher than those of Xiang et al. [16]. Among the dimensions, teacher quality received the highest score and learning opportunity the lowest, which is consistent with the findings of Jing et al. [34]. This result could be attributed to the fact that the majority of the study participants were educated in tertiary Grade A hospitals, which are renowned for their teaching capabilities. These hospitals can provide nursing students with a strong clinical learning experience because they have excellent hardware and software facilities, mature practical and teaching work, standardized management, orderly and well-organized clinical environments, and experienced clinical teachers. However, to avoid risk, teachers do not allow students to complete simple, mechanical, and repetitive nursing operations. In addition, patient trust in nursing students remains limited, resulting in few practical opportunities despite the students' strong technical capabilities [35]. Therefore, nursing students should be given more practical opportunities to operate independently while their clinical safety is guaranteed.

The self-efficacy score of the intern nursing students indicated a medium-high level of self-efficacy. This finding aligns with the results reported by nursing students in other countries, such as the Philippines, Spain, and Slovakia [36, 37]. However, it surpasses the level of confidence found in the study conducted by Li et al. [38], which targeted 836 Chinese intern nursing students. This difference may be related to the nursing students' education level and clinical learning environments in the different studies, given that differences in self-efficacy can be related to the clinical context and patient population [39]. The proportion of undergraduate nursing students in this study exceeded 60%, which is higher than the proportion reported by Li et al. [38]. Compared with junior college and technical secondary school students, undergraduate nursing students have greater learning autonomy, more solid theoretical knowledge, and greater self-confidence in the face of difficulties; consequently, undergraduates tend to have greater self-efficacy. Furthermore, over 90% of the nursing students who participated in this study were affiliated with tertiary Grade A hospitals, which are renowned for their extensive clinical teaching experience and clinical learning environment that enhance students' self-efficacy [40]. To foster self-efficacy among nursing students, nursing educators and administrators should establish a positive clinical learning environment by offering a comprehensive, high-quality learning experience that promotes learning autonomy.

The core competence score of the nursing students in this study was at the upper intermediate level. This finding is marginally higher than the outcomes reported in other studies involving Chinese students [11, 41], but lower than the collective core competence level of nursing interns from six Asian countries [42]. Ethics and responsibility obtained the highest score, while clinical biomedical science and critical thinking and reasoning ability obtained the lowest scores. These findings are largely consistent with those of previous studies [11, 41].

The above variances may be due to the following reasons. First, in this study, most participants were undergraduate nursing students in tertiary Grade A hospitals. Students in Grade A hospitals would have a higher level of education and training than those in other hospitals, and the nursing students' professional quality would be higher. Therefore, the students' level of core nursing competence in the present study would be greater than that of students in other relevant studies in China. Second, according to a study by Grande et al. [42] on students' core nursing competence in other Asian countries, 80% of nursing students have a five-year learning cycle. In China, the learning period of undergraduate nursing students is four years, and that of junior college students is three years. The longer the learning cycle, the greater the likelihood that students have mastered their knowledge and, therefore, the greater their core nursing competence. Third, the highest score in the dimension of ethics and responsibility is possibly related to the emphasis placed on the patient-centered nursing model in China, and on the cultivation of ethics and a sense of responsibility in nursing students. Thus, these results exemplify the success of the current focus on quality-oriented education for nursing students. Fourth, the clinical biomedical science and critical thinking and reasoning aptitude dimensions received low scores. Despite medical colleges and universities recognizing the significance of fostering students' critical thinking skills, this is not consistently reflected in instructional activities. The systematic assessment of learning is mostly limited to book knowledge; consequently, students generally pay more attention to memorizing theoretical knowledge than developing critical thinking skills [20]. The clinical biomedical sciences include pathology, biology, and the physical examination and treatment of patients in clinical environments [27]. As most of the participants in this study had experienced a short internship period, they had yet to accumulate clinical experience in biomedical areas. According to the aforementioned results, the fundamental nursing skills of Chinese nursing students have advanced compared to the level of

proficiency reported in previous studies. Nevertheless, further education and training are required to develop students' proficiency in clinical biomedical science and critical thinking and reasoning.

Correlations and path analysis of the clinical learning environment, self-efficacy, and core competence

A substantial positive correlation was identified in this study between the clinical learning environment and core competence, indicating that a strong clinical learning environment for intern nurses is associated with strong core competence in nursing students, which is consistent with the findings of Liao and Liu [11]. Research has indicated that the effectiveness of instruction is significantly influenced by the clinical learning environment. In other words, nursing students are more likely to actively participate in the learning process when the clinical learning environment is evaluated positively [43 ,44]. In addition to learning attitudes, the clinical learning environment greatly affects nursing students' knowledge, behavioral skills, and problem-solving abilities [45]. Hence, establishing clinical environments conducive to learning is imperative to foster the development of core nursing competence.

The present study revealed a positive correlation between self-efficacy and the clinical learning environment, suggesting that a robust clinical learning environment is linked to higher self-efficacy. This finding is consistent with the results reported by Xiang et al. [16]. This may occur because nursing students gain self-efficacy through the support, resources, opportunities, and development space provided by a positive clinical learning environment [46]. Such an environment also facilitates the development of nursing students' confidence in their ability to manage problems that arise in nursing practice. Nursing educators and administrators can thus foster the development of self-efficacy among nursing students by providing a superior clinical learning environment.

The relationship between the clinical learning environment and core nursing competence was partially mediated by self-efficacy; this suggests that self-efficacy could partially explain the association between the clinical learning environment and the core competence of nursing students. This relationship can be understood in terms of self-efficacy's influence on an individual's motivation [15] and confidence in overcoming difficulties [16]. Upon entering the clinical environment, student nurses face many mental and physical challenges. They may have difficulty applying the knowledge and experiences from classroom learning to the problems they encounter in the clinical setting. Consequently, students may have reactions such as withdrawal, avoidance, and

burnout, which can result in low motivation for clinical and academic work that will manifest in their core competence. However, a strong clinical learning environment plays a positive role in stimulating the self-efficacy of nursing students, and the level of self-efficacy affects the learning attitude and clinical learning quality of nursing students [24], thereby affecting their core nursing competence. Therefore, to foster the growth of intern nursing students' fundamental nursing competence, it is critical to provide students with a robust clinical learning environment and opportunities that cultivate their self-efficacy for effectively navigating the diverse challenges of clinical practice.

Limitations

This study has certain limitations that should be addressed in future research. First, although the nursing students were recruited from different institutions in China, we used convenience sampling, and the participants were primarily full-time undergraduate students with internships at tertiary Grade A hospitals. Therefore, the results may not be representative of Chinese intern nursing students with different educational backgrounds working at different types of hospitals. In the future, multicenter, large sample, stratified random sampling can be conducted to improve sample representativeness. Moreover, the influencing factors included in this study were limited. Future studies should consider additional factors and mediators affecting the core nursing competence of intern nursing students.

CONCLUSIONS

This study found that Chinese nursing interns were satisfied with their clinical learning environment, they had a medium-high level of self-efficacy, and their core competence was at the upper intermediate level. Furthermore, self-efficacy partially mediated the relationship between the clinical learning environment and core nursing competence. To foster the development of fundamental nursing competence in students, nursing administrators and instructors must not only establish a conducive clinical learning environment, but also provide students with motivation and validation, bolster their assurance in clinical tasks, and enhance their sense of self-efficacy.

Declarations of interest

None.

Ethical Statement

The study received approval from the Medical Ethics Committee of the West China Hospital of Sichuan University (No. 2022-1903).

Data and code availability

The data that support this study are available from the first author upon reasonable request.

Author Contributions

Pu Yunxia: Writing–Original Draft, Visualization, Project Administration, Data Curation; Xie Hongmei: Formal Analysis, Writing–Original Draft, Data Curation, Project Administration; Fu Lan: Project Administration, Supervision; Zhang Xiaoxia: Collection, Funding Acquisition, Supervision, and Decision to Submit the article for publication; Long Ting: Investigation, Resources, Methodology; Su Xiaotian: Investigation, Resources, Methodology; Feng Xiaojuan: Investigation, Resources, Conceptualization; Feng Xianqiong: Writing–Review & Editing, Supervision. All the authors contributed to this work and have approved the submitted version. Feng Xianqiong is the guarantor.

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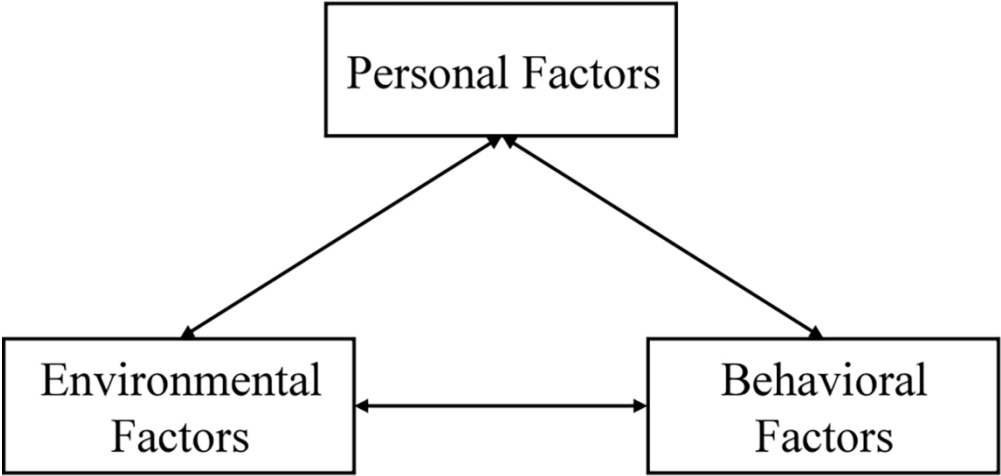
Figure Captions

Figure 3. Bandura's triadic reciprocal determinism.
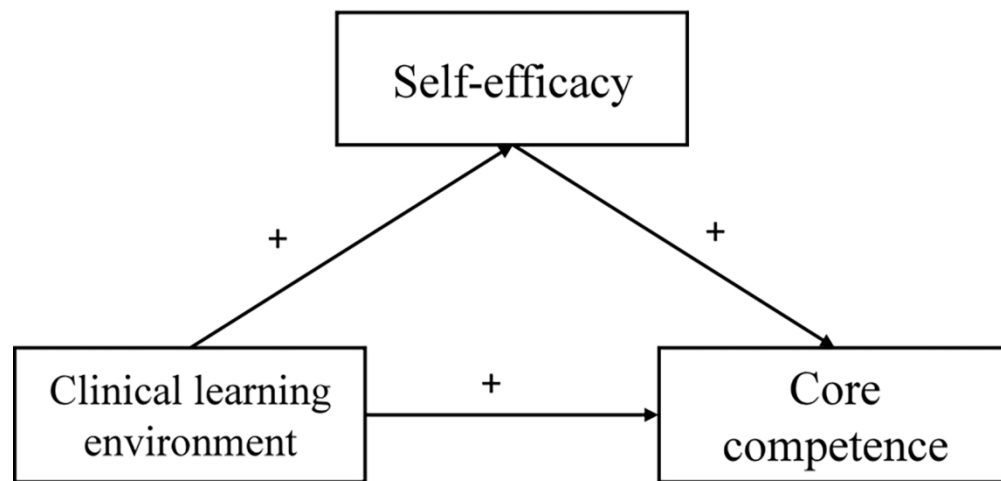
Figure 4. Hypothesized model.

Figure 3. Path model showing the mediating effect of self-efficacy in the relationship between the

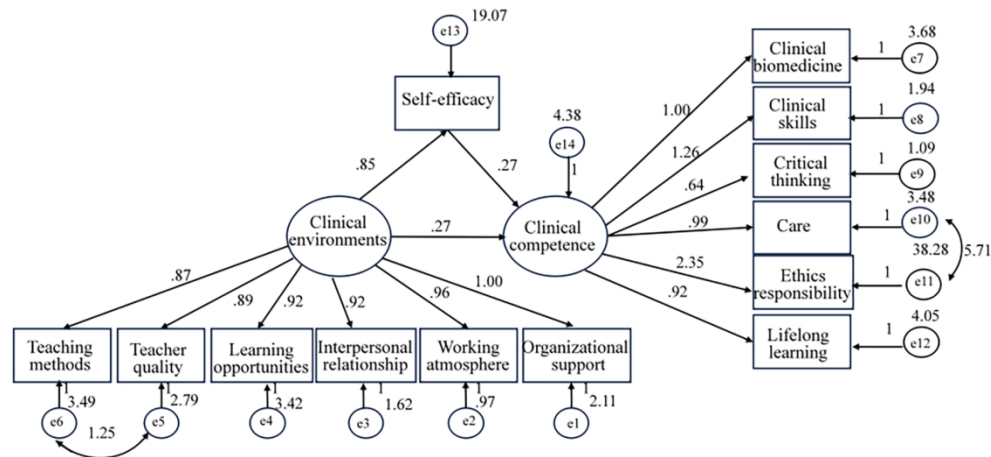clinical learning environment and core nursing competence.

Bandura's triadic reciprocal determinism

150x73mm (300 x 300 DPI)

Hypothesized model

150x73mm (300 x 300 DPI)

Path model showing the mediating effect of self-efficacy in the relationship between the clinical learning environment and core nursing competence

159x74mm (300 x 300 DPI)

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Self-efficacy as a mediator in the relationship between clinical learning environment and core nursing competence of intern nursing students: A multicenter cross-sectional study

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Self-efficacy as a mediator in the relationship between clinical learning environment and core nursing competence of intern nursing students: A multicenter cross-sectional study

Yunxia Pu[a,g,1], Hongmei Xie[b,c,g,1], Lan Fu[b,c], Xiaoxia Zhang[d,g], Ting Long[e], Xiaotian Su[b,c], Xiaojuan Feng[b,c], Xianqiong Feng[f,g],*

[a] Department of Targeting Therapy & Immunology, Cancer Center, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[b] Department of General Surgery, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[c] Breast Disease Center, West China Hospital, Sichuan University , Chengdu, Sichuan Province, China

[d] Division of Head & Neck Tumor Multimodality Treatment, Cancer Center, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[e] Outpatient Department, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China

[f] Department of Nursing, West China Hospital, Sichuan University

[g] West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

[1] These authors contributed equally to this study.

* Corresponding Author:

No. 37 GuoXue Xiang, Department of Nursing, West China Hospital, Sichuan University/West China School of Nursing, Sichuan University, Chengdu, Sichuan Province, China

Phone number: 18980601700

Email address: fengxianqiong66@126.com

ABSTRACT

Objective: The aim of this study was to examine the relationships between Chinese intern nursing students' self-efficacy, the clinical learning environment, and core nursing competence. In addition, self-efficacy was investigated as a mediator in the association between the clinical learning environment and core nursing competence.

Design: This study used a cross-sectional, descriptive research design.

Setting: Fifteen nursing colleges and universities in China were the setting for the study.

Participants: The participants were 552 nursing student interns.

Primary and secondary outcome measures: The participants completed measures of general self-efficacy and nursing student core competencies.

Results: Participants' mean scores indicated they were satisfied with the clinical learning environment（123.02 ± 19.62）, their self-efficacy was at a medium-high level（29.71 ± 5.25）, and their core competence was at the upper intermediate level（148.73 ± 22.63）. Core nursing competence was positively correlated with self-efficacy and the clinical learning environment（r=0.597, P<0.001；r=0.549, P<0.001）. The clinical learning environment (β=0.362, P<0.001), duration of clinical practice (β=0.131, P<0.001), and self-efficacy (β=0.406, P<0.001) were identified as significant predictors of core nursing competence. Self-efficacy partially mediated the association between perception of the clinical learning environment and core competence level, accounting for 45.88% of the overall effect.

Conclusions: Self-efficacy played a role in explaining the beneficial association between the clinical learning environment and core nursing competence among Chinese intern nursing students. These findings suggest that nursing managers and educators should initially promote nursing students' self-efficacy to increase their confidence in overcoming clinical obstacles, and subsequently cultivate their core nursing competence.

Keywords: nursing students; core competence; self-efficacy; clinical learning environment; mediation analysis

ARTICAL SUMMARY

Strengths and limitations of this study

- The study included a large sample of nursing students from 15 nursing universities in China.

- We used convenience sampling and the participants were primarily full-time undergraduate students whose internship was at a tertiary Grade A hospital. Therefore, the results may not be representative of Chinese intern nursing students with different educational backgrounds working at different types of hospitals.

INTRODUCTION

Nurses are the largest group of health care professionals worldwide and fulfill a key role in providing ethical, effective, and safe healthcare services tailored to the needs of the population [1]. The World Health Organization [2] reported that the education and training of new nurses, including intern nursing students, is a major concern of the nursing profession. Competency-based education is used extensively in the nursing profession because it can teach nurses to deliver high quality care to satisfy the expanding demands for healthcare worldwide [3]. Nurses constitute the largest group of healthcare professionals worldwide and play a critical role in delivering ethical, effective, and safe healthcare services to meet population health needs. Therefore, ensuring that nursing students learn solid professional skills to facilitate nursing industry development is critical.

As core nursing competence is the most important ability nursing professionals must acquire, nursing educators should focus on cultivating this set of skills [4]. In 2003, the International Council of Nurses defined nurses' core competence as "the special knowledge, skills, judgment and personal characteristics required by nurses to provide safe and ethical nursing services" [5]. Although different countries require different components and standards of core nursing competence, they all emphasize that it is a necessary ability for nursing work [6-8]. As the future workforce of the nursing profession, the development of clinical intern nurses' professional competencies is crucial for the development of the nursing profession and enhancing the quality of nursing care.

Clinical practice is an indispensable training component for nursing students. The nursing regulations in China require nurses applying for registration as nurse practitioners to undergo at least eight months of clinical internship in a teaching or general hospital [9]. Meanwhile, the latest regulations of the European Union state that nursing education must include at least 2,300 hours of clinical learning in different environments [10]. Clinical learning should enable students to integrate their theoretical knowledge with actual clinical situations, acquire professional competence, and become qualified nurses [11]. The clinical learning environment comprises all of the components that interact in the clinical setting and influence nursing students' learning. It is where nursing

students learn nursing skills, socialize their roles, and develop a sense of professional responsibility for nursing [12]. The quality of the clinical learning environment (e.g., the physical environment, teaching personnel, and other health care experts) can affect nursing students' professional attitudes, level of nursing knowledge, behavioral skills, and ability to solve clinical problems [13]. Therefore, the clinical environment can be instrumental in cultivating core competence in intern nursing students.

Efforts to cultivate core nursing competence among nursing students should also focus on their self-efficacy, which refers to their subjective judgment of their ability to perform a certain task [14]. Bandura's [15] social cognition theory posits that self-efficacy can be a motivating factor and may affect one's sense of agency. The stronger a person's sense of self-efficacy, the greater their confidence in overcoming difficulties [16].

Investigating the status and influencing variables of nursing students' core competence is also critical to support the growth of their nursing careers. A survey of 1,796 nursing students graduating from six countries, including Germany, Finland, and Ireland, showed that their nursing abilities were generally good [17]. According to research on the core competence of Chinese nursing internship students, undergraduate nursing students possessed core competence at or above an intermediate level [18,19], whereas Chinese intern nursing students (including undergraduate, junior college, and technical secondary school students) were at an intermediate [20] or below intermediate level [21]. These findings suggest that relative to nursing students from other nations, Chinese nursing students must further develop their core nursing competence.

Research has demonstrated a positive correlation between the clinical competence of nursing students and both their self-efficacy and the clinical learning environment [22,23]. Self-efficacy alone has also been found to have a positive correlation with the clinical learning environment [24].

Previous research has focused more on the independent relationships among these variables, as opposed to hypothesizing a mediation model. To clarify the relationships between these factors, the present study aimed to accomplish the following objectives: (1) assess the perceptions of intern nursing students in China regarding the clinical learning environment, self-efficacy, and core nursing competence; (2) investigate the interconnections among self-efficacy, the clinical learning environment, and core competence; and (3) investigate the mediating role of self-efficacy in the relationship between the clinical learning environment and core nursing competence.

Bandura's [25] triadic reciprocal determinism theory was the theoretical foundation of the current investigation. Bandura postulated that the environment, behavior, and individual personal factors interact to exert mutual influence (Figure 1). This study used the self-efficacy of nursing students as the individual personal factor, core nursing competence as the behavior, and the clinical learning environment as the environment. Drawing upon prior investigations and Bandura's theoretical framework, we proposed the following two hypotheses (Figure 2):

H1: Core nursing competence is positively related to both self-efficacy and the clinical learning environment.

H2: Self-efficacy mediates the association between the clinical learning environment and core nursing competence.

[Insert Figure 1 here]

[Insert Figure 2 here]

METHODS

Participants

This study employed a convenience sampling method to recruit clinical nursing students from 15 medical universities across China as participants between December 2022 and March 2023. Inclusion criteria: Only nursing students enrolled in technical secondary schools, junior colleges, or undergraduate programs were eligible to participate. All participants provided informed consent prior to their voluntary participation in the study. Exclusion criteria: (1) Nursing students with physical or mental health conditions that prevented them from completing the questionnaire; and (2) internship nursing students who had not successfully completed clinical practice or were subject to sanctions, including those who failed to comply with hospital practice regulations.

According to Preacher and Kelley [26], to estimate a sufficient number of parameters, the number of participants for path analysis should be 10–20 times greater. To account for a 20% margin of error in the questionnaires and 30 variables (including demographic, core competency, self-efficacy, and clinical learning environment variables), a sample size of 375–750 participants was necessary for this study.

Sociodemographic Information Questionnaire

A sociodemographic questionnaire was developed for use in this study. The questionnaire asked participants to provide information on their age, gender, education level, professional interests, home location, length of clinical practice, classification of their hospital, whether they serve as a class leader, and whether they were an only child.

Competency Inventory for Nursing Students

The Competency Inventory for Nursing Students (CINS), which was designed by Hsu and Hsieh [27] to comprehensively assess the fundamental abilities of nursing students, was subsequently translated into Chinese by Ruixue et al. [28]. The CINS includes 38 items in six dimensions: care, ethics and responsibility, general clinical skills, critical thinking and reasoning ability, lifelong learning, and clinical biomedical science. The responses to the items are provided on a 5-point Likert scale ranging from 1 = "completely incompetent" to 5 = "completely competent." The total scores range from 38 to 190, with high scores indicating a high level of student nursing competence. The Chinese version of the CINS demonstrated good internal consistency, reliability, and stability, with Cronbach's alpha values ranging from 0.83 to 0.95 for each subscale and 0.97 for the total scale [28]. In this investigation, Cronbach's alpha for the total scale was 0.95.

General Self-Efficacy Scale

The Chinese adaptation of the General Self-Efficacy Scale (GSES), created by Zhang and Schwarzer [29], was used to assess general self-efficacy. The GSES is a self-report instrument consisting of 10 items that are rated on a 4-point Likert scale ranging from 1 = "completely incorrect" to 4 = "completely correct." The cumulative score of all 10 items represents the total score; a high score indicates a high level of general self-efficacy. The Chinese version of the GSES has been used extensively in China and has highly reliable with a Cronbach's alpha of 0.87 [30]. The Cronbach's alpha in this investigation was 0.90.

Environment Evaluation Scale for Clinical Nursing Internship

The Environment Evaluation Scale for Clinical Nursing Internship, developed by Hu et al. [31], comprises 30 items divided into six dimensions: organizational support, teaching methods, teacher quality, learning opportunities, interpersonal relationships, and work atmosphere. The responses to the items are provided on a 5-point Likert scale ranging from 1 = "completely disagree" to 5 = "completely agree." The total score ranges from 30 to 150, with higher scores indicating a more robust clinical learning environment for nursing interns. The scale has demonstrated good internal

consistency, reliability, and stability, with Cronbach's alpha values of 0.96 for the total scale and 0.84 to 0.95 for each subscale. In this investigation, Cronbach's alpha for the total scale was 0.96.

Procedures

The Medical Ethics Committee of the West China Hospital of Sichuan University approved this study (approval no. 2022-1903). The study adhered to the principles of informed consent and voluntary participation. The researchers first contacted the instructors responsible for overseeing students' internships at the university's school of nursing and affiliated hospitals. They provided a detailed explanation of the study's purpose, content and questionnaire completion process. Subsequently, questionnaires were administered through convenience sampling to clinical placement nurses from 15 healthcare institutions such as Chengdu University, Chengdu Medical College, Chengdu University of Traditional Chinese Medicine, North Sichuan Medical College, Hubei Three Gorges Polytechnic, West China Health School, Leshan Vocational and Technical College, Panzhihua University, Sichuan Nursing Vocational College, Sichuan Vocational College of Health and Rehabilitation, Sichuan College of Traditional Chinese Medicine, Southwest Medical University, Ya'an Vocational and Technical College, Tianfu College of Southwest University of Finance and Economics, and Yunnan University of Traditional Chinese Medicine. The questionnaire was administered through the Questionnaire Star software, and the unified guidance language was used in the questionnaire to explain the study's purpose, completion method and informed consent process. Participants submitted the questionnaire anonymously upon completion.

To maintain the accuracy and comprehensiveness of responses, each item in the questionnaire required a response, and participation was restricted to a single attempt to complete the questionnaire from a given IP address. After completed questionnaires were collected and reviewed, invalid questionnaires were eliminated. A cohort of 580 intern nurses participated in the study; however, 28 questionnaires were deemed invalid. Consequently, the final sample consisted of 552 participants, resulting in a valid response rate of 95.17%.

Data analysis

SPSS version 26.0 was used to analyze the data. Due to the normal distribution of data in this study, frequency, percentage, mean, and standard deviation were used to analyze the demographic characteristics of the participants. T-tests and ANOVA were used to examine the variations in fundamental nursing competence based on the characteristics of the nursing interns. Pearson's

correlation coefficients were calculated to determine the relationships between the variables.

Multiple linear stepwise regression was conducted to ascertain the factors substantially correlated

with core nursing competence. The effects of self-efficacy and the clinical learning environment on

core nursing competence were investigated using AMOS version 23.0 and structural equation

modeling. Modification indices were used to fit the data. Furthermore, the mediating role of self-

efficacy in the relationship between the clinical practice environment and core nursing competence

was examined using bootstrap methods. The estimated effect was deemed significant if the 95%

bootstrap confidence interval for the mediating effect did not include zero. Statistical significance

was set at P<0.05.

Patient and public involvement

There was no patient or public involvement in this study.

RESULTS

Sociodemographic characteristics

A total of 552 intern nursing students（mean age: 21.06 ±1.05 years) participated in this study.

Of these, 80 (14.49%) were men, and 472 (85.51%) were women. Regarding education level, 23

(4.17%) were enrolled in technical secondary schools, 178 (32.24%) in junior colleges, and 351

(63.59%) in undergraduate programs (Table 1).

Table 1. Sociodemographic characteristics of the participants (N=552).

Variable	n	%	Variable	n	%
Gender			Home location		
Female	472	85.51	City	191	34.60
Male	80	14.49	Town	121	21.92
Education level			Rural area	240	43.48
Technical secondary school	23	4.17	From a one-child family		
Junior college	178	32.24	Yes	193	34.96
Undergraduate	351	63.59	No	359	65.04
Length of clinical practice			Professional interest (Do you like nursing?)		

Variable	n	%	Variable	n	%
<12 weeks	106	19.20	Yes	387	70.11
12–24 weeks	237	42.94	Neutral	139	25.18
25–36 weeks	145	26.27	No	26	4.71
>36 weeks	64	11.59	Whether served as a class leader		
Internship hospital level[a]			Yes	280	50.72
Tertiary grade A hospitals	499	90.40	No	272	49.28
Tertiary grade B hospitals	28	5.07			
Others	25	4.53			

[a] Hospitals are classified according to the Hospital Classification Management Standards. The hospitals are divided into three levels, and each level is divided into grades A, B, and C. Tertiary hospitals are added with special grades. Therefore, hospitals in China are divided into three levels and 10 grades. Tertiary Grade A hospitals offer the most comprehensive medical services, followed by tertiary Grade B hospitals.

Descriptive statistics

The clinical learning environment score was 123.02 ±19.62, the self-efficacy score was 29.71 ±5.25, and the core nursing competence score was 148.73 ±22.63. These scores indicated the participants were satisfied with the clinical learning environment, their self-efficacy was at a medium-high level, and their core competence was at the upper intermediate level (Table 2).

Table 2. Self-efficacy, clinical learning environment, and core nursing competence scores (N=552).

Variable	Score range	Mean±SD
Self-efficacy	10–40	29.71±5.25
Competency Inventory for Nursing Students	38–190	148.73±22.63
Clinical biomedical science	5–25	18.10±3.51
General clinical skills	6–30	22.55±3.97
Critical thinking and reasoning ability	3–15	10.96±2.16
Care	5–25	19.71±3.46

Variable	Score range	Mean±SD
Ethics and responsibility	14–70	57.88±9.29
Lifelong learning	5–25	19.51±3.38
Clinical learning environment	30–150	123.02±19.62
Teaching methods	5–25	20.57±3.53
Teacher quality	5–25	20.97±3.48
Learning opportunities	5–25	20.12±3.66
Interpersonal relationships	5–25	20.57±3.41
Work atmosphere	5–25	20.58±3.46
Organizational support	5–25	20.18±3.73

Univariate and correlation analysis

Significant variations in core nursing competence were observed based on factors such as the duration of clinical experience, level of education, place of residence, and professional inclination (Table 3). Pearson correlation analysis revealed that self-efficacy was positively correlated with core nursing competence ($r=0.597$, $P<0.001$) and clinical learning environment ($r=0.610$, $P<0.001$), and clinical learning environment was positively correlated with core nursing competence ($r=0.549$ $P<0.001$).

Table 3. Univariate analysis of core nursing competence by sociodemographic characteristics (N=552).

Characteristic	Core nursing competence			95% confidence interval	
	Mean	SD	F/t	Lower	Upper
Length of clinical practice			5.991**		
<12 weeks	142.82	28.13		137.40	148.23
12–24 weeks	147.72	21.26		145.00	150.44
25–36 weeks	151.15	22.11		147.52	154.78

Characteristic	Core nursing competence		F/t	95% confidence interval	
	Mean	SD		Lower	Upper
>36 weeks	156.81	14.44		153.20	160.42
Education level			8.080**		
Tertiary	153.69	29.76		140.82	166.56
Postsecondary	153.80	21.82		150.57	157.03
Full-time undergraduate	145.84	22.06		143.52	148.16
Home location					
City	150.95	26.59	4.166*	147.16	154.75
Town	151.47	19.47		147.96	154.97
Rural area	145.59	20.27		143.01	148.17
Professional interest			10.303**		
Yes	151.50	22.42		149.26	153.74
Neutral	142.81	19.58		139.52	146.09
No	139.19	31.71		126.38	152.00

Only significant results are listed. *$P<0.05$, **$P<0.001$.

Regression analysis

Predictors of the core nursing competence were identified by performing multiple linear regression analyses. The independent variables, namely self-efficacy, clinical learning environment, professional interest, length of clinical practice, education level, and home location, were found to be significant in the univariate analyses. After accounting for the influence of the other variables, the clinical learning environment ($\beta=0.362$, $P<0.001$), length of clinical practice ($\beta=0.131$, $P<0.001$), and self-efficacy ($\beta=0.406$, $P<0.001$) emerged as significant predictors of core nursing competence. These factors accounted for 48.6% of the variance (Table 4).

Table 4. Regression analysis predicting core nursing competence (N=552).

Variable	B	SE	β	t	P
Self-efficacy	1.752	0.157	0.406	11.119	<0.001
Clinical learning environment	0.418	0.042	0.362	9.877	<0.001
Length of clinical practice	3.261	0.762	0.131	4.275	<0.001

Note: R^2=0.488; adjusted R^2=0.486; F=174.433.

The mediating effect of self-efficacy

The dependent variable was core nursing competence, the mediating variable was self-efficacy, and the independent variable was clinical learning environment (Figure 3). As a result of the initial inadequate fit of the model, this study used two modification indices corrections. Following the revision, the fit indices were as follows: X^2/df = 3.887, goodness of fit = 0.945, comparative fit index = 0.912, Tucker-Lewis index = 0.955, and root mean square error of approximation = 0.030. The fit of the model fell within a permissible range.

The findings from the AMOS analysis demonstrated that a direct and positive relationship existed between self-efficacy, the clinical learning environment, and core nursing competence (Table 5[a]). A 95% confidence interval (CI) was applied to the test of significance for the mediating effect after 5,000 samples of the original data were replicated using the bootstrap method. The mediating effect is significant if zero is not included in the CI. The results indicated self-efficacy partially mediated the relationship between the clinical learning environment and core nursing competence. The total effect of the clinical internship environment on core competence was 0.497 (P<0.01, 95% CI=0.396–0.592). The direct effect was 0.270 (P<0.01, 95% CI=0.184–0.350) and the mediating effect was 0.228 (P<0.001, 95% CI=0.175–0.296), accounting for 45.88% of the total effect (Table 5[b]).

[Insert Figure 3 here]

Table 5(a). Path inspection.

Path	Unstandardized regression coefficient	Standardized regression coefficient	SE	Critical ratio	P
Clinical learning environment → self-efficacy	0.847	0.555	0.057	14.832	<0.001
Self-efficacy → core nursing competence	0.269	0.479	0.023	11.713	<0.001
Clinical learning environment → core nursing competence	0.270	0.315	0.035	7.737	<0.001

Table 5(b). Analysis of the mediating, direct, and total effects on core nursing competence.

Effect	Impact	SE	95% confidence interval		P	%
			Lower	Upper		
Mediating effect	0.228	0.030	0.175	0.296	<0.001	45.88
Direct effect	0.270	0.041	0.184	0.350	0.001	54.12
Total effect	0.497	0.050	0.396	0.592	0.001	

DISCUSSION

This study included intern nursing students with different educational backgrounds from 15 nursing colleges in Southwest China. The students were completing a nursing internship at tertiary A, tertiary B, and secondary A hospitals. The sample predominantly comprised undergraduate students and students at tertiary A practicing hospitals, indicating that the participants had high professional qualities. They were all new interns who participated in a standardized clinical internship for the first time. Although the internship duration followed a normal distribution, the nursing students were in different internship cycles. Similar to the male-to-female nurse-to-student ratio in China [32], the majority of the students were female. Consequently, the study sample provides a reasonable representation of intern nursing students in China.

Core nursing competence, self-efficacy, and the clinical learning environment of nursing students

In this study, the clinical learning environment score indicated that the nursing students were satisfied with the clinical learning environment. These findings align with those of Yuxuan et al. [33] and are marginally higher than those of Xiang et al. [16]. Among the dimensions, teacher quality received the highest score and learning opportunity the lowest, which is consistent with the findings of Jing et al. [34]. This result could be attributed to the fact that the majority of the study participants were educated in tertiary Grade A hospitals, which are renowned for their teaching capabilities. These hospitals can provide nursing students with a strong clinical learning experience because they have excellent hardware and software facilities, mature practical and teaching work, standardized management, orderly and well-organized clinical environments, and experienced clinical teachers. However, to avoid risk, teachers do not allow students to complete simple, mechanical, and repetitive nursing operations. In addition, patient trust in nursing students remains limited, resulting in few practical opportunities despite the students' strong technical capabilities [35]. Therefore, nursing students should be given more practical opportunities to operate independently while their clinical safety is guaranteed.

The self-efficacy score of the intern nursing students indicated a medium-high level of self-efficacy. This finding aligns with the results reported by nursing students in other countries, such as the Philippines, Spain, and Slovakia [36, 37]. However, it surpasses the level of confidence found in the study conducted by Li et al. [38], which targeted 836 Chinese intern nursing students. This difference may be related to the nursing students' education level and clinical learning environments in the different studies, given that differences in self-efficacy can be related to the clinical context and patient population [39]. The proportion of undergraduate nursing students in this study exceeded 60%, which is higher than the proportion reported by Li et al. [38]. Compared with junior college and technical secondary school students, undergraduate nursing students have greater learning autonomy, more solid theoretical knowledge, and greater self-confidence in the face of difficulties; consequently, undergraduates tend to have greater self-efficacy. Furthermore, over 90% of the nursing students who participated in this study were affiliated with tertiary Grade A hospitals, which are renowned for their extensive clinical teaching experience and clinical learning environment that enhance students' self-efficacy [40]. To foster self-efficacy among nursing students, nursing

educators and administrators should establish a positive clinical learning environment by offering a comprehensive, high-quality learning experience that promotes learning autonomy.

The core competence score of the nursing students in this study was at the upper intermediate level. This finding is marginally higher than the outcomes reported in other studies involving Chinese students [11, 41], but lower than the collective core competence level of nursing interns from six Asian countries [42]. Ethics and responsibility obtained the highest score, while clinical biomedical science and critical thinking and reasoning ability obtained the lowest scores. These findings are largely consistent with those of previous studies [11, 41].

The above variances may be due to the following reasons. First, in this study, most participants were undergraduate nursing students in tertiary Grade A hospitals. Students in Grade A hospitals would have a higher level of education and training than those in other hospitals, and the nursing students' professional quality would be higher. Therefore, the students' level of core nursing competence in the present study would be greater than that of students in other relevant studies in China. Second, according to a study by Grande et al. [42] on students' core nursing competence in other Asian countries, 80% of nursing students have a five-year learning cycle. In China, the learning period of undergraduate nursing students is four years, and that of junior college students is three years. The longer the learning cycle, the greater the likelihood that students have mastered their knowledge and, therefore, the greater their core nursing competence. Third, the highest score in the dimension of ethics and responsibility is possibly related to the emphasis placed on the patient-centered nursing model in China, and on the cultivation of ethics and a sense of responsibility in nursing students. Thus, these results exemplify the success of the current focus on quality-oriented education for nursing students. Fourth, the clinical biomedical science and critical thinking and reasoning aptitude dimensions received low scores. Despite medical colleges and universities recognizing the significance of fostering students' critical thinking skills, this is not consistently reflected in instructional activities. The systematic assessment of learning is mostly limited to book knowledge; consequently, students generally pay more attention to memorizing theoretical knowledge than developing critical thinking skills [20]. The clinical biomedical sciences include pathology, biology, and the physical examination and treatment of patients in clinical environments [27]. As most of the participants in this study had experienced a short internship period, they had yet to accumulate clinical experience in biomedical areas. According to the aforementioned results, the

fundamental nursing skills of Chinese nursing students have advanced compared to the level of proficiency reported in previous studies. Nevertheless, further education and training are required to develop students' proficiency in clinical biomedical science and critical thinking and reasoning.

Correlations and path analysis of the clinical learning environment, self-efficacy, and core competence

A substantial positive correlation was identified in this study between the clinical learning environment and core competence, indicating that a strong clinical learning environment for intern nurses is associated with strong core competence in nursing students, which is consistent with the findings of Liao and Liu [11]. Research has indicated that the effectiveness of instruction is significantly influenced by the clinical learning environment. In other words, nursing students are more likely to actively participate in the learning process when the clinical learning environment is evaluated positively [43 ,44]. In addition to learning attitudes, the clinical learning environment greatly affects nursing students' knowledge, behavioral skills, and problem-solving abilities [45]. Hence, establishing clinical environments conducive to learning is imperative to foster the development of core nursing competence.

The present study revealed a positive correlation between self-efficacy and the clinical learning environment, suggesting that a robust clinical learning environment is linked to higher self-efficacy. This finding is consistent with the results reported by Xiang et al. [16]. This may occur because nursing students gain self-efficacy through the support, resources, opportunities, and development space provided by a positive clinical learning environment [46]. Such an environment also facilitates the development of nursing students' confidence in their ability to manage problems that arise in nursing practice. Nursing educators and administrators can thus foster the development of self-efficacy among nursing students by providing a superior clinical learning environment.

The relationship between the clinical learning environment and core nursing competence was partially mediated by self-efficacy; this suggests that self-efficacy could partially explain the association between the clinical learning environment and the core competence of nursing students. This relationship can be understood in terms of self-efficacy's influence on an individual's motivation [15] and confidence in overcoming difficulties [16]. Upon entering the clinical environment, student nurses face many mental and physical challenges. They may have difficulty applying the knowledge and experiences from classroom learning to the problems they encounter in

the clinical setting. Consequently, students may have reactions such as withdrawal, avoidance, and burnout, which can result in low motivation for clinical and academic work that will manifest in their core competence. However, a strong clinical learning environment plays a positive role in stimulating the self-efficacy of nursing students, and the level of self-efficacy affects the learning attitude and clinical learning quality of nursing students [24], thereby affecting their core nursing competence. Therefore, to foster the growth of intern nursing students' fundamental nursing competence, it is critical to provide students with a robust clinical learning environment and opportunities that cultivate their self-efficacy for effectively navigating the diverse challenges of clinical practice.

Limitations

This study has certain limitations that should be addressed in future research. First, although the nursing students were recruited from different institutions in China, we used convenience sampling, and the participants were primarily full-time undergraduate students with internships at tertiary Grade A hospitals. Therefore, the results may not be representative of Chinese intern nursing students with different educational backgrounds working at different types of hospitals. In the future, multicenter, large sample, stratified random sampling can be conducted to improve sample representativeness. Second, the influencing factors included in this study were limited. Future studies should consider additional factors and mediators affecting the core nursing competence of intern nursing students. Third, while the cross-sectional design effectively captures variable associations at a specific timepoint, it inherently limits temporal causal inference. Future research could adopt longitudinal designs to enhance methodological rigour. Furthermore, although standardized scales were administered in the survey, reliance on self-reported data may introduce social desirability bias and interpretation discrepancies. These limitations could be mitigated in future research through sample size expansion and external validation via objective metrics.

CONCLUSIONS

This study found that Chinese nursing interns were satisfied with their clinical learning environment, they had a medium-high level of self-efficacy, and their core competence was at the upper intermediate level. Furthermore, self-efficacy partially mediated the relationship between the clinical learning environment and core nursing competence. To foster the development of fundamental nursing competence in students, nursing administrators and instructors must not only

establish a conducive clinical learning environment, but also provide students with motivation and validation, bolster their assurance in clinical tasks, and enhance their sense of self-efficacy.

Declarations of interest

None.

Ethical Statement

The study received approval from the Medical Ethics Committee of the West China Hospital of Sichuan University (No. 2022-1903).

Funding

Data and code availability

The data that support this study are available from the first author upon reasonable request.

Author Contributions

Pu Yunxia: Writing–Original Draft, Visualization, Project Administration, Data Curation; Xie Hongmei: Formal Analysis, Writing–Original Draft, Data Curation, Project Administration; Fu Lan: Project Administration, Supervision; Zhang Xiaoxia: Collection, Funding Acquisition, Supervision, and Decision to Submit the article for publication; Long Ting: Investigation, Resources, Methodology; Su Xiaotian: Investigation, Resources, Methodology; Feng Xiaojuan: Investigation, Resources, Conceptualization; Feng Xianqiong: Writing–Review & Editing, Supervision. All the authors contributed to this work and have approved the submitted version. Feng Xianqiong is the guarantor.

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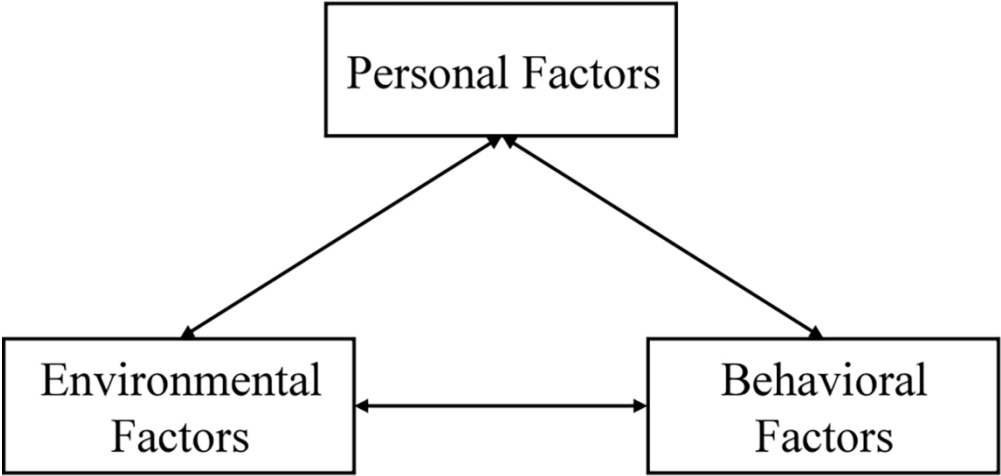
Figure Captions

Figure 3. Bandura's triadic reciprocal determinism.
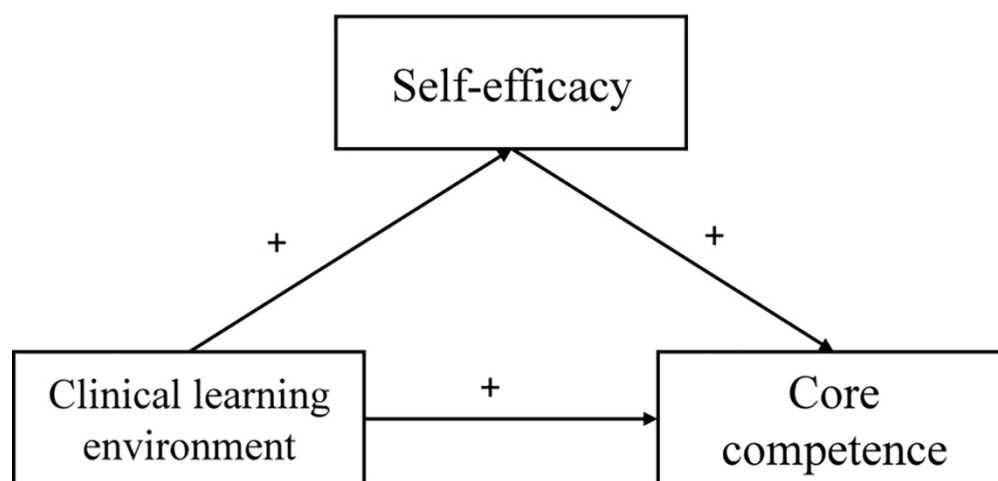
Figure 4. Hypothesized model.

Figure 3. Path model showing the mediating effect of self-efficacy in the relationship between the clinical learning environment and core nursing competence.

Personal Factors

Environmental Factors
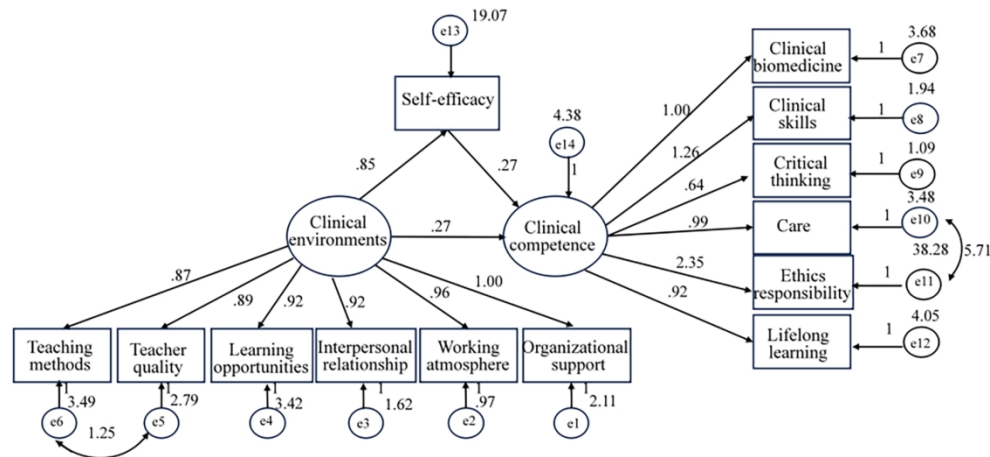
Behavioral Factors

Bandura's triadic reciprocal determinism

150x73mm (300 x 300 DPI)

Hypothesized model

150x73mm (300 x 300 DPI)

Path model showing the mediating effect of self-efficacy in the relationship between the clinical learning environment and core nursing competence

159x74mm (300 x 300 DPI)