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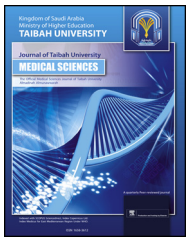

Original Article

Self-directed learning and clinical competence: The mediating role of the clinical learning environment

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الملخص

أهداف البحث: من الأهمية بمكان التعرف على العوامل التي تؤثر على الكفاءة السريرية لطلاب التمريض المتدربين. هدفت هذه الدراسة إلى تحديد آثار التعلم الموجه ذاتيا على الكفاءة السريرية لطلاب التمريض المتدربين مع الدور الوسيط لبيئة التعلم السريري.

طرق البحث: تم إجراء هذا البحث المقطعي على 300 طالب تمريض متدرب تم اختيارهم عن طريق أخذ العينات الملائمة، وتحليل البيانات باستخدام نهج "نمذجة المعادلة الهيكلية". تم جمع البيانات في مرحلة واحدة باستخدام ثلاث أدوات لمقياس جاهزية التعلم الموجه ذاتيا لتعليم التمريض، وقياس بيئة التعليم، واستبيان الكفاءة السريرية. بالإضافة إلى ذلك، تم إجراء تحليل البيانات باستخدام المربعات الصغرى الجزئية وبعد تقييم البيانات من حيث القياس والنماذج الهيكلية.

النتائج: أظهرت النتائج أن 20.5٪ من التباين في الكفاءة السريرية يمكن تفسيره من خلال بيئات التعلم ذاتية التوجيه والسريرية. كان للتعلم الموجه ذاتيا تأثير إيجابي وكبير على الكفاءة السريرية (معامل المسار = 0.14، فاصل الثقة 95٪: 0.02 - 0.26) ، وعلى بيئة التعلم السريري أيضا (معامل المسار = 0.41). تم الإبلاغ عن وجود علاقة بين بيئة التعلم السريري والكفاءة السريرية (معامل المسار = 0.38). كان التأثير غير المباشر للتعلم الموجه ذاتيا على الكفاءة السريرية إيجابيا ومعنويا (معامل المسار = 0.11). التعلم الموجه ذاتيا له تأثير كلي كبير على الكفاءة السريرية (معامل المسار = 0.30).

الاستنتاجات: وفقا لنتائج الدراسة، يوصى بأن ينظر مديرو تعليم ومعلمو التمريض في بعض الخطط لتعزيز التعلم الموجه ذاتيا بين طلاب التمريض وتحسين بيئة التعلم السريري.

الكلمات المفتاحية: تعليم التمريض؛ الكفاءة السريرية؛ التعلم الموجه ذاتيا

Abstract

Introduction: Recognizing the factors affecting clinical competence among internship nursing students is crucial. This study was aimed at determining the effects of self-directed learning on internship nursing students' clinical competence under the mediating role of the clinical learning environment.

Methods: This cross-sectional research was performed on 300 internship nursing students selected by convenience sampling with a structural equation modeling (SEM) approach. Data were collected in one stage with three tools: the Self-Directed Learning Readiness Scale for Nursing Education, Education Environment Measure, and Clinical Competence Questionnaire. Data analysis was performed in SPSS version 21 and Smart-PLS version 3 with partial least squares-SEM. Measurement and structural model data were assessed with a significance threshold of $p < 0.05$.

Results: A total of 20.5 % of the variance in clinical competence was explained by self-directed and clinical learning environments. Self-directed learning had a significant positive effect on clinical competence (path coefficient = 0.14, 95 % CI: 0.02, 0.26; p = 0.027), and on the clinical learning environment (path coefficient = 0.41, 95 % CI: 0.31, 0.52; $p < 0.001$). A relationship was observed between the clinical learning environment and clinical competence (path coefficient = 0.38, 95 % CI:

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0.25, 0.50; $p < 0.001$). The indirect effect of self-directed learning on clinical competence was positive and significant (path coefficient = 0.11, 95 % CI: 0.07, 0.17; $p < 0.001$). Self-directed learning had a significant total effect on clinical competence (path coefficient = 0.30, 95 % CI: 0.19, 0.40; $p < 0.001$).

Conclusions: According to the results, we recommend that nursing education managers and instructors consider plans to enhance self-directed learning among nursing students and improve the clinical learning environment.

Keywords: Clinical competence; Nursing education; Self-directed learning

Introduction

The education and clinical competence (CC) of nurses, who compose the largest health workforce and have roles in complicated decisions and delegation of care, are important factors for improving patient outcomes.[1] The term "competence" is derived from the Latin word "competentia" and is interpreted as capability and permission. Later, the term "competence" and its use were defined in the nursing field by Benner (1984), wherein nursing competence was recognized as the ability to perform a task such that favorable results are achieved.[2] CC refers to the clinical capabilities required by nurses in a clinical environment to successfully perform tasks, on the basis of knowledge, techniques, attitudes, and performance.[3]

Given that the end goal of nursing education is to train competent nurses and ensure the provision of high levels of patient care, the most important goal of clinical education in nursing is to improve nursing students' practical skills and clinical qualifications.[4] CC development for optimal nursing performance occurs throughout the nursing education process.[5] Clinical practice provides opportunities for nursing students to learn in different care settings and receive proper direction to promote CC development.[6]

Internship in clinical education occurs in the last year of nursing education and is an important approach used to close the gap between theoretical and practical knowledge. The program was first used in the late 19th century in the United States to prepare medical students for clinical practice after graduation and to establish maturity in these individuals.[7] Iran's undergraduate nursing education program is a 4-year course that ends with an internship program. In this program, every year includes two semesters. In the first semester, students learn the theoretical foundations of basic nursing skills in the classroom and practice these skills in the clinical skills center. Along with theory courses, internships in clinical positions start from the second semester, and nursing students undergo clinical training under the direct supervision of a nursing instructor (from their faculty). The theoretical requirements of nursing education are completed by the end of the third academic year (sixth semester) and in the fourth year (seventh and eighth semesters); students complete the internship course independently under the direct supervision of supervisors and clinical staff, and the indirect supervision of supervisors in the form of internships in most clinical departments.[8]

The goal of the internship is to equip students with the necessary professional skills, prepare them for becoming competent nurses, and enable them to use theoretical knowledge in practice. The program helps nursing students work as actual nurses to improve their clinical skills and achieve CC.[8] Nonetheless, various factors affect CC acquisition, including the educational environment in the ward, the supervisory relationship between students and instructors, and the preparation for performance based on nursing education.[9]

Conceptual framework of the hypothesized model

A major goal of all nursing education programs is to provide high-quality learning experiences that result in CC growth in nursing students.[10] In general, CC includes knowledge comprehension; clinical, technical, and communication skills; and the ability to solve problems through clinical judgment.[10] On the basis of the literature, the internship program helps nursing interns demonstrate leadership skills in problem-solving, prioritization, decision-making, task delegation, and accountability by trainers.[11] Furthermore, because self-directed learners take responsibility for their own learning needs and goals, thus aiding in their acquisition of professional competencies in nursing,[12] self-directed learning (SDL) is a necessary and effective strategy for nursing students' learning during clinical courses.[13]

SDL is defined as "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes."[14] SDL enables individuals to self-assess their learning needs, frame their learning objectives, find resources, implement their learning strategy, and evaluate their learning outcomes.[3] Thus, SDL helps trainees control their learning experiences by using various cognitive or metacognitive strategies that lead to their active participation in the learning process.[12] SDL has been verified to promote nurses' professional development by enabling them to broaden their theory base and increase the quality of clinical nursing.[15]

Many faculty members are drawn to the SDL approach, because of its ability to develop independent learning skills; foster accountability, responsiveness, and decisiveness, which are important features throughout the nursing profession; and improve nursing students' adjustment to the clinical environment. Accordingly, SDL is a necessary and effective approach for nursing students in the clinical period.[13]

Overall, improvement of the learning environment helps students gain a sense of motivation and participation, and can help develop self-learning.[16] SDL enables nursing students to develop independent learning skills, accountability, responsibility, assertiveness, and essential qualities throughout their careers, thereby allowing them to adapt to the clinical learning environment (CLE).[13] The CLE refers to a clinical workplace in which students in health professions complete their clinical work as part of their education.[17] This environment includes other students and influences professional development in the clinical setting. Clinical practice occurs via interactions among students, instructors, staff, patients, and environments.[6] The CLE combines several physical, psychological, emotional, and organizational factors affecting students' learning and how they confront their environment.[18] Thus, the CLE plays a fundamental role in the growth of students' professional identities and competencies.[19]

Literature review

Many nursing researchers have studied the factors affecting students' CC, to address this issue in undergraduate nursing students.[20] For instance, Yang and Jiang have conducted a study evaluating the relationship between SDL and CC in nursing undergraduates.[21] Similarly, Choi and Jeong have assessed the effect of SDL readiness on nursing CC.[22] Moreover, Alotaibi has sought to determine the relationship between SDL readiness and the academic performance of students under the mediating role of understanding learning environment needs.[23] In addition, Hwang and Oh have studied the relationship between SDL and problem-solving ability, under the mediating roles of academic self-efficacy and self-regulated learning among nursing students.[24] Another study has evaluated the relationship between the CLE and students' competence levels.[16] Finally, Yu et al. have assessed the relationship between the CC of graduated nursing students and the CLE.[20]

Given the importance of assessing factors affecting students' CC, on the basis of the studies described above, the current research was aimed at determining the effect of SDL on internship nursing students' CC under the mediating role of the CLE. Considering studies by Alotaibi,[23] Yu et al.,[20] and Visiers-Jiménez et al.,[16] we tested the following hypotheses in the current research:

H1: SDL directly affects CC.
H2: SDL directly affects the CLE.
H3: CLE directly affects CC.
H4: SDL indirectly affects CC.
H5: SDL generally affects CC.

Materials and Methods

Design

This cross-sectional study was performed to evaluate the effect of SDL on CC under the mediating role of CLE by using structural equation modeling (SEM) at Shahid Beheshti University of Medical Sciences (SBMU) in Tehran, Iran during 2020–2021, coinciding with the COVID-19 pandemic.

Participants and setting

The participants included nursing students undergoing the internship program in their 7th and 8th semesters at SBMU. The titles of clinical courses in the seventh semester of nursing education comprised medical-surgical nursing (eight credits) and critical care nursing (three credits). In addition, the titles of courses in the eighth semester comprised emergency nursing care (two credits), maternal health care (two credits), pediatric nursing (two credits), community nursing care (two credits), and nursing management (two credits). With the exception of community nursing care, the training for the rest of the clinical courses was provided in various departments of hospitals affiliated with SBMU.

SBMU accepts 220 applicants annually to study nursing in the national centralized annual examination for the fall and spring semesters (100–120 per semester) at the School of Nursing and Midwifery. Therefore, every year, 200–240 nursing students are in their last year of nursing education (i.e., the 7th and 8th semesters). For two consecutive years, 344 internship nursing students who were in their final year of study and were undergoing the nursing internship course at six general hospitals affiliated with SBMU entered this study, according to a convenience sampling method. The first researcher, who was neither acquainted with nor had an educational relationship with the participants, was referred to the various departments where the internship nursing students worked morning and evening shifts. Participants entered the study if they were willing to participate after receiving an introduction to the research and reviewing the ethical considerations. Internship nursing students were selected to join the study in the fall semesters of two consecutive years, each lasting approximately 1 month (2 months total). After elimination of participants with incomplete responses, a total of 300 internship nursing students were enrolled in the study. The tool completion rate was 87 %.

Of note, according to the SBMU educational rules for protecting students' health, the participants were prohibited from taking the internship nursing course in departments where health care was provided to patients with COVID-19.

Instruments

Demographic information questionnaire

In this study, a demographic characteristics questionnaire was used to assess five criteria: age, sex, mean grade point average, nursing work experience as a student job, and duration of employment.

SDL Readiness Scale for Nursing Education

The SDL Readiness Scale for Nursing Education measures the degree to which an individual has the characteristics, attitudes, preferences, and capabilities required for SDL. This instrument was selected because it estimates individual traits, whereas similar tools measure immediate feedback on actual abilities.[25]

The tool was first introduced by Fisher et al., in 2001 and contained 40 items. In 2010, Fisher and King conducted a psychometric assessment of the tool, which led to the extraction of a 29-item tool with three subscales of self-management (ten items), desire to learn (nine items), and self-control (ten items). The items are scored on a 5-point Likert scale from "completely agree" (score 5) to "completely disagree" (score 1). Items 2, 15, and 21 are scored in reverse.[26] The lowest and highest mean scores of the tool are 1 and 5, respectively. Notably, the reliability and validity of the Farsi version of the tool have been assessed by Fooladvand and Nadi in Iranian nursing and midwifery students, and all three subscales have been found to have high internal consistency coefficients. The Cronbach alpha of 0.94 confirmed the reliability of the tool.[27]

Undergraduate Clinical Education Environment Measure

The undergraduate Clinical Education Environment Measure was applied to measure the CLE. This instrument was selected because the results of a systematic review have indicated that similar tools have poor psychometric properties and methodological approaches.[28] This measure was first designed at Lund University in 2012, on the basis of theories of experiential learning and social participation. The tool encompasses 25 items and four subscales of preparedness for student entry (6 items); opportunities for learning in and through work, and quality supervision (11 items); workplace interaction patterns and student inclusion (6 items); and equal treatment (2 items). The items are scored on a 5-point Likert scale from "completely disagree" (score of 1) to "completely disagree" (score of 5). A higher score indicates higher educational environment quality.[29] In addition, the lowest and highest mean scores of the tool are 1 and 5, respectively.

Abbasi et al. have performed a psychometric assessment of the Farsi version of the instrument and confirmed the tool's reliability, with Cronbach's alpha of 0.93. The construct validity of the tool has been evaluated with exploratory factor analysis and Pearson's correlations, and the four factors above have been extracted according to the original version. Therefore, the reliability and validity of the tool had been confirmed.[30]

Clinical Competence Questionnaire

The CC Questionnaire, which is used to measure CC in internship nursing students, was first developed by Cheng and Liou. The instrument includes 46 items and four subscales of nursing professional behaviors (16 items); skill competence: general performance (12 items); skill competence: core nursing skills (12 items); and skill competence: advanced nursing skills (6 items). The items are scored on a five-point Likert scale, as follows: "do not have a clue" (score 1), "know in theory but not confident at all in practice" (score 2), "know in theory, can perform some parts in practice independently, and need supervision to be readily available" (score 3), "know in theory, competent in practice, but need contactable sources of supervision" (score 4), and "know in theory, and competent in practice without any supervision" (score 5). In this tool, a higher score indicates greater CC.[31] Moreover, the lowest and highest mean scores of the tool are 1 and 5, respectively. This CC Questionnaire was first translated and psychometrically assessed in Iran in this research. After translation and verification of consistency between two translations, the tool was provided to ten faculty members of the nursing and midwifery school to assess qualitative validity and the need for questions with the content validity ratio formula. According to the suggested values of Lawshe's table and scores exceeding 0.64 for each question, all items were retained in the tool. Moreover, the relevance of the questions to the purpose of the questionnaire was also verified with the content validity index,[32] and the total mean was 0.99. Therefore, all questions were validated to be relevant.

At this stage, the internal consistency method (Cronbach's alpha) was used to confirm the reliability of the tools. All three tools were completed by 20 eligible internship nursing students who were not included in the research. The reliability of the Self-Directed Learning Readiness Scale for Nursing Education, Undergraduate Clinical Education Environment Measure, and CC Questionnaire was confirmed, with Cronbach's alpha of 0.92, 0.88, and 0.96, respectively.

Data collection

The data were collected at one stage at the place of access to internship nursing students, at various departments in hospitals affiliated with SBMU. The corresponding author of the study, who performed planning and supervision of internship nursing students, and directly interacted with them, collected the data with the help of the second researcher, over four academic semesters, during morning and night shifts. The tools were distributed among the students, who were asked to complete and return them as soon as possible.

Data analysis

In this study, partial least squares-SEM (PLS-SEM) was used to test the hypothetical research model. PLS-SEM is a regression technique that, in addition to exploring the linear relationship between several independent variables and one or more dependent variables, measures the relationship networks between structures, as well as the relationships between structures and their measures. The aim of model testing in SEM-PLS is to determine the fit of the measurement model and the structural model. Data analysis was performed after validation of the suitability of the two described fits. The measurement model examines the assumed relationships between indicators and latent structures, whereas the structural model evaluates the assumed paths between endogenous latent variables and exogenous latent variables.[33]

Measurement model

The following steps were used in the measurement model: indicator reliability, internal consistency reliability, convergent validity, and discriminant validity. The first step (indicator reliability) determined extent to which the variance of each indicator was explained by its construct and was performed by indicator loading. Indicators with values less than 0.4 should be removed, and indicators from 0.4 to 0.708 should be considered for removal only when the removal of the index leads to an increase in internal consistency reliability or convergent validity with values above the threshold.[33]

The two measures of composite reliability and Cronbach's alpha were used to assess internal consistency reliability, which indicated the relationships between variables. For both measures, values of 0.6–0.7, 0.7–0.9, and >0.9 were considered "acceptable," "satisfactory to good," and "problematic," respectively. Convergent validity, as a third step, was the extent to which the construct converged and explained the variance of its indicators. The metric used to evaluate convergent validity was the average variance extracted (AVE) for all indicators in each structure, and its minimum acceptable value is 0.5.[33]

Discriminant validity, in the fourth step, measured the degree of empirical differentiation of a construct from other constructs in the structural model. The concept can be assessed through three methods: Fornell-Larcker, cross-loading, and heterotrait-monotrait ratio of correlations (HTMT). In the Fornell-Larcker method, the square root of AVE is compared with the correlation of hidden variables, and its value should exceed the correlation of the construct with hidden variables.[33] In examining cross-loadings, discriminant validity was demonstrated when each indicator had a weak correlation with all other constructs except the construct theoretically associated with it. HTMT is defined as the mean value of the indicator correlations across constructs relative to the mean of the average correlations for the indicators measuring the same construct, and its value must be below 0.85; a value above 0.9 indicates a lack of discriminant validity in the path model.[34]

Structural model

The structural model in PLS-SEM was evaluated according to the significance and relevance of path coefficients, and the model's explanatory and predictive power. Significance assessment was performed by calculation of the t-value for the path coefficients. The path coefficients are normally between −1 and +1: coefficients near −1 indicate strong negative relationships, whereas coefficients near +1 indicate strong positive relationships. The next step was the coefficient of determination (R^2) associated with endogenous constructs. In general, R^2 ranges from 0 to 1, and higher values indicate higher explanatory power.[33] Given that analysis with the SEM method assumes normality of the data, the normality of the data was first assessed with the Kolmogorov–Smirnov test. In addition, data analysis was performed in SPSS version 21 to describe demographic characteristics, and assess the main variables in terms of mean and standard deviation. Smart-PLS was applied for path analysis of the research variables.

Table 1: Descriptive statistics of participants.

Variables	Frequency (%)
Sex	
Female	166 (55.3)
Male	134 (44.7)
Semester	
Seven	70 (23.3)
Eight	230 (76.7)
Student nursing work experience	
Yes	120 (40.0)
No	180 (60.0)

Table 2: Indicator reliability, construct reliability, and convergent validity testing results.

Construct	Item	Standardized factor loading	Internal consistency validity		Average variance extracted (AVE)
			Composite reliability	Cronbach's alpha	
CC	CC17	0.81	0.94	0.94	0.51
	CC18	0.79			
	CC19	0.70			
	CC20	0.72			
	CC21	0.74			
	CC23	0.78			
	CC24	0.76			
	CC25	0.71			
	CC26	0.70			
	CC27	0.77			
	CC28	0.72			
	CC30	0.64			
	CC31	0.63			
	CC32	0.65			
	CC37	0.60			
	CC39	0.63			
CLE	CLE1	0.75	0.96	0.96	0.52
	CLE2	0.67			
	CLE3	0.78			
	CLE4	0.76			
	CLE5	0.75			
	CLE6	0.73			
	CLE7	0.66			
	CLE8	0.63			
	CLE9	0.67			
	CLE10	0.75			
	CLE11	0.75			
	CLE12	0.77			
	CLE13	0.81			
	CLE14	0.76			
	CLE15	0.77			
	CLE16	0.76			
	CLE17	0.77			
	CLE18	0.74			
	CLE19	0.70			
	CLE20	0.68			
	CLE21	0.72			
	CLE22	0.61			
	CLE23	0.63			
	CLE24	0.62			
	CLE25	0.76			
SDL	SDL1	0.68	0.94	0.93	0.51
	SDL2	0.72			
	SDL5	0.74			
	SDL8	0.75			
	SDL9	0.73			
	SDL10	0.72			
	SDL11	0.71			
	SDL12	0.71			
	SDL13	0.69			
	SDL19	0.68			
	SDL20	0.72			
	SDL25	0.75			
	SDL26	0.66			
	SDL27	0.66			
	SDL28	0.75			

CC, clinical competence; CLE, clinical learning environment; SDL, self-directed learning.

Table 3: Descriptive statistics, correlation matrix, and square roots of AVE (Fornell and Larcker criterion).

Construct	Mean	SD	CC (1)	CLE (2)	SDL (3)
CC (1)	4.27	0.61	0.71		
CLE (2)	2.83	0.90	0.44	0.72	
SDL (3)	4.22	0.55	0.30	0.41	0.71

CC, clinical competence; CLE, clinical learning environment; SDL, self-directed learning.

Results

Demographic characteristics

As shown in Table 1, the study included 300 participants (166 women and 134 men) with a mean age of 23.33 ± 2.10 years. Ninety-seven percent of the students were in semesters seven (20.3 %) and eight (76.7 %). The students had a

Table 4: Loadings and cross-loadings of the items.

Item	Clinical competence	Clinical learning environment	Self-directed learning
CC17	0.81	0.36	0.28
CC18	0.79	0.29	0.24
CC19	0.70	0.28	0.01
CC20	0.72	0.31	0.07
CC21	0.74	0.38	0.16
CC23	0.78	0.33	0.18
CC24	0.76	0.36	0.32
CC25	0.71	0.24	0.04
CC26	0.70	0.24	0.04
CC27	0.77	0.32	0.25
CC28	0.72	0.31	0.14
CC30	0.64	0.33	0.34
CC31	0.63	0.31	0.31
CC32	0.65	0.32	0.35
CC34	0.42	0.21	0.01
CC37	0.60	0.27	0.25
CC39	0.63	0.27	0.33
CLS1	0.31	0.75	0.37
CLS2	0.26	0.67	0.32
CLS3	0.27	0.78	0.29
CLS4	0.28	0.76	0.27
CLS5	0.28	0.75	0.29
CLS6	0.34	0.73	0.29
CLS7	0.24	0.66	0.28
CLS8	0.24	0.63	0.24
CLS9	0.30	0.67	0.27
CLS10	0.31	0.75	0.30
CLS11	0.27	0.75	0.26
CLS12	0.34	0.77	0.46
CLS13	0.36	0.81	0.27
CLS14	0.35	0.76	0.24
CLS15	0.37	0.77	0.28
CLS16	0.34	0.76	0.29
CLS17	0.32	0.77	0.31
CLS18	0.26	0.74	0.25
CLS19	0.31	0.70	0.30
CLS20	0.33	0.68	0.30
CLS21	0.38	0.72	0.44
CLS22	0.34	0.61	0.28
CLS23	0.34	0.63	0.26
CLS24	0.35	0.62	0.28
CLS25	0.34	0.76	0.28
SDL1	0.22	0.30	0.68
SDL2	0.17	0.33	0.72
SDL5	0.16	0.27	0.74
SDL8	0.18	0.36	0.75
SDL9	0.21	0.32	0.73
SDL10	0.21	0.31	0.72
SDL11	0.27	0.26	0.71
SDL12	0.28	0.25	0.71

(*continued on next page*)

Table 4 (*continued*)

Item	Clinical competence	Clinical learning environment	Self-directed learning
SDL13	0.28	0.24	0.69
SDL19	0.23	0.27	0.68
SDL20	0.17	0.30	0.72
SDL25	0.25	0.30	0.75
SDL26	0.18	0.30	0.66
SDL27	0.14	0.30	0.66
SDL28	0.20	0.31	0.75

CC, clinical competence; CLE, clinical learning environment; SDL, self-directed learning.

Table 5: The HTMT ratio.

Construct	CC	CLE	SDL
CC			
CLE	0.45		
SDL	0.32	0.44	

CC, clinical competence; CLE, clinical learning environment; SDL, self-directed learning.

mean grade point average of 16.92 ± 1.04. A total of 120 students had nursing work experience for 6.31 ± 6.34 months.

Measurement model

As shown in Table 2, all constructs had Cronbach's alpha values above 0.7, and the composite reliabilities exceeded 0.7, thus demonstrating internal consistent

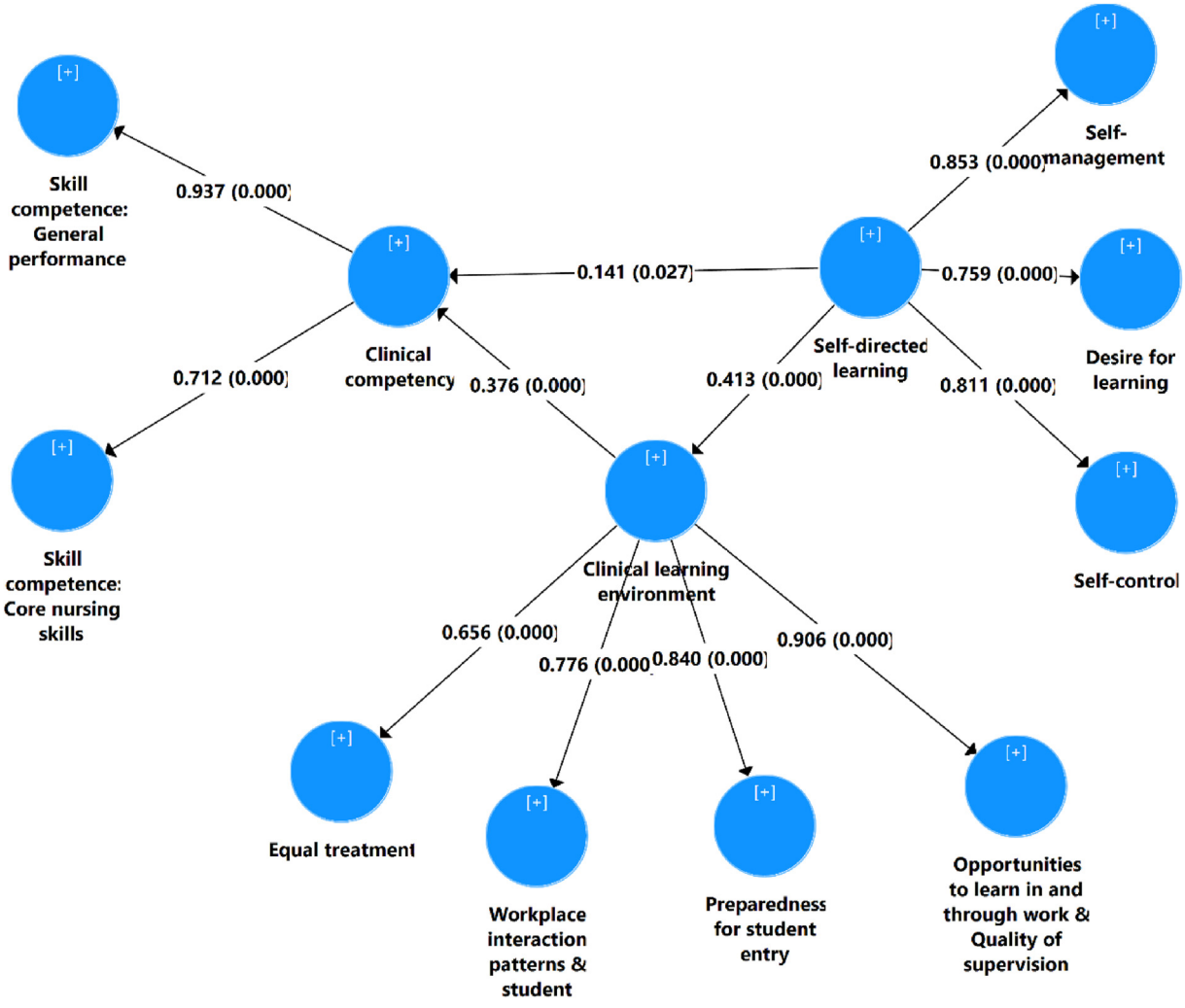

Figure 1: Structural model. Standardized coefficients (coefficient of determination and p-values).

Table 6: Hypothesis testing results of estimates and t-values.

Hypothesis	Path	Estimate (95 % CI)	t-value	p-value
Direct effect				
H1	SDL→CC	0.14 (0.02, 0.26)	2.22	0.027
H2	SDL→CLE	0.41 (0.31, 0.52)	7.46	<0.001
H3	CLE→CC	0.38 (0.25, 0.50)	5.95	<0.001
Indirect effect				
H4	SDL→CLE→CC	0.11 (0.07, 0.17)	4.44	<0.001
Total effect				
H5	SDL→CC	0.30 (0.19, 0.40)	5.31	<0.001

CC, clinical competence; CLE, clinical learning environment; SDL, self-directed learning.

reliability. The AVEs were above 0.5, thus indicating convergent validity.

The square root of the AVE (Fornell and Larcker criterion) was greater than its correlation with all other constructs (Table 3). As shown in Table 4, cross-loadings had higher loadings on the parent construct than on other constructs in the model, thereby indicating discriminant validity. The HTMT values were below 0.90 (Table 5). All three values described above demonstrated discriminant validity.

Structural model

The structural model is shown in Figure 1, with standardized coefficients (path coefficients and p-values) and R^2. According to R^2, 20.5 % of the variance in CC was explained by independent variables including SDL and the CLE. In addition, 17.0 % of the variance in the CLE was explained by SDL. The standardized effects of SDL and the CLE on CC were significant.

As shown in Table 6, SDL had a positive and significant effect on CC (path coefficient = 0.14, 95 % CI: 0.02, 0.26; $p = 0.027$). Thus, higher SDL scores were associated with higher CC scores, and H1 was accepted. SDL also had a significant effect on the CLE (path coefficient = 0.41, 95 % CI: 0.31, 0.52; $p < 0.001$); consequently, H2 was accepted. We observed that the CLE was associated with CC (path coefficient = 0.38, 95 % CI: 0.25, 0.50; $p < 0.001$). Accordingly, higher values of the CLE were associated with higher values of CC. Therefore, H3 was accepted. The indirect effect of SDL on CC was positive and significant (path coefficient = 0.11, 95 % CI: 0.07, 0.17; $p < 0.001$), and thus H4 was accepted. SLD had a significant total effect on CC (path coefficient = 0.30, 95 % CI: 0.19, 0.40; $p < 0.001$).

Discussion

The results of this study indicated that SDL affected CC and the CLE. In addition, we observed a relationship between the CLE and CC among internship nursing students. SDL also influenced CC by mediating the CLE.

The study's first hypothesis was confirmed, indicating that SDL directly affects CC. Other studies have yielded similar results. Yang and Jiang have shown that preparedness for SDL has a direct and robust association with nurses' competence.[21] Moreover, Alotaibi has demonstrated that preparedness for SDL positively affects nursing students' academic performance.[23] Similarly, Choi and Jeong have evaluated the relationship between SDL preparedness and last-year nursing students' nursing performance competence in China, and reported a direct relationship between the variables.[22] Furthermore, Peck et al. have reported the positive effects of self-directed modules on the acquisition of practical capabilities in physiotherapy students before graduation.[35] This finding may suggest that, in contrast to classroom settings, where the process and context of student learning are relatively structured and predictable, in a CLE, which is more dynamic and complex, SDL can further contribute to CC acquisition.

The results associated with the second hypothesis indicated the effect of SDL on the CLE. A literature review demonstrated that very limited studies have been conducted on the relationship between SDL and the CLE. In research by Alotaibi, similar results have been obtained through SEM, thus demonstrating positive effects of preparedness for SDL on nursing students' perception of the CLE.[23] According to a review study conducted to evaluate SDL in a clinical environment, SDL has yet to achieve its full potential in clinical environments.[36] This result may be justified because SDL's student-centered nature allows students autonomy and internal motivation for learning; consequently, use of SDL increases the potential benefits for nursing students in the CLE.

The third hypothesis was also confirmed: the results showed a relationship between the CLE and CC of internship nursing students. In line with our findings, Visiers-Jiménez et al. have demonstrated a positive relationship between the CLE and graduate nursing students' competence.[16] In a similar study conducted in China by Yu et al., the results illustrated a relationship between the CLE and CC.[20] Given that the CLE is an interactive network of all factors affecting the learning outcomes of nursing students in a clinical environment,[20] all factors existing in the clinical departments can affect CC among internship nursing students. This finding may suggest that the CLE, which compasses many factors, affects the CC of internship nursing students. Therefore, various elements of this environment should be manipulated to improve CC.

The results associated with the fourth and fifth hypotheses showed that SDL affects CC through mediating the CLE. The authors found only one study in their research, with results relatively similar to the present study. However, some studies have examined the relationships among several study

variables. Park et al. have demonstrated an association between SDL and nurses' competence, along with other factors, such as critical thinking disposition, position, and experience.[37] The results of another study have demonstrated that SDL increases nursing students' problem-solving ability by mediating academic self-efficacy.[24] A study in Korea has indicated that nursing students' SDL is positively associated with their clinical performance satisfaction.[38] Noh and Kim have evaluated the effects of SDL programs on nursing students' CC with blended coaching, and their results demonstrated the effectiveness of the intervention.[13] Another study in Iran has shown that self-learning modules help students enhance the quality of nursing CC.[39]

The last two results showing that SDL affects CC, and the CLE plays a mediating role, may suggest that SDL, as a form of student-centered learning, leads to identification of gaps in skills, diagnosing learning needs, setting of educational goals, and skill acquisition.[40] In addition, if the elements of the CLE, including the physical environment, teachers, students, staff, and the interactions among them, are correct, the CLE can strengthen the effect of SDL on CC.

Limitations

Some substantial limitations of the study were the number of tool items, use of self-reporting, and low motivation of the participants to complete the instruments, thus potentially affecting the results. Another limitation of the investigation was that the study coincided with the COVID-19 pandemic. Participants did not directly experience clinical work associated with COVID-19. However, perceived risk, psychological stress, and inadequate healthcare workers and equipment might have influenced SDL, CC, and the CLE. Therefore, we recommend that similar studies be conducted in Iran to obtain more valid results.

Conclusion

The findings of this study may be unique, valuable, and applicable, because of our focus on CC among internship nursing students, and because the nursing internship course is relatively new in Iran. Our findings revealed a positive relationship between SDL and greater CC among internship nursing students, and demonstrated that the CLE helped boost this relationship. Therefore, SDL and the CLE are two important factors for CC improvement in internship nursing students. We recommend that SDL reinforcement be considered in nursing educational programs, as well as theoretical and clinical courses, and before students' entry into internship programs. This framework would encourage nursing instructors to develop this type of learning and benefit from CC acquisition during the internship program. Moreover, we suggest that CLE improvement measures be taken; for instance, clinical spaces and wards should be considered for clinical education of internship nursing students, where educational facilities and an organizational culture with interactions based on education are provided to nursing students. Another measure might be empowering nursing instructors, mentors, and preceptors to properly interact with nursing students.

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Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

All procedures performed in this study were approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (IR.SBMU.PHARMACY.REC.1398.050), in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments or comparable standards. The participants were informed of the study aim and data collection process, and the voluntary nature of participation in the research. Informed consent was obtained from all study participants. The questionnaires were filled out anonymously through use of registration codes. Participants were informed that any reluctance to participate in the study would not affect their grades.

Author's contribution

PV contributed to the conceptualization, analysis and interpretation of data, and writing the manuscript. HA-M contributed to the data collection and manuscript editing. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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