

RESEARCH

Open Access



Psychometric evaluation of the Chinese version of the Nursing Student Contributions to Clinical Settings scale and analysis of factors influencing nurses' perceptions of nursing students' contributions: a cross-sectional study

Kaiyan Xu¹, Huijuan Tong^{2*}, Chunyan Zhang¹, Feng Qiu³ and Yaoyao Liu¹

Abstract

Background Most medical organizations accept many nursing students each year who gain clinical practice skills under the supervision of clinical nurses. However, there are no assessment tools to measure the contributions nursing students make to the clinical setting during clinical practicum. This study aimed to translate the 'Nursing Student Contributions to Clinical Settings' scale into Chinese and test its reliability and validity from the perspective of Chinese clinical nurses. And to explore whether nurses' personal and professional characteristics are related to nurses' perception of nursing students' contributions to the clinical settings.

Methods The original scale was translated into Chinese following the Brislin translation model. A convenience sample of 935 clinical nurses was selected from January to March 2024 for the survey. The content validity of the scale was assessed by expert consultation and content validity index. Exploratory factor analysis and confirmatory factor analysis were performed to assess the construct validity of the scale. The reliability of the scale was measured using internal consistency, split-half reliability, and test-retest reliability. The measurement quality of the scales was assessed according to the CONsensus-based Standards for the selection of health Measurement INSTRuments. One-way analysis of variance was used to identify variables related to students' contributions.

Results The content validity index of the scale was 0.983. Exploratory factor analysis supported a one-factor structure, and the cumulative variance contribution was 71.177%. Confirmatory factor analysis showed that the model fit indicators were all within the acceptable range. The McDonald's Omega coefficient and Cronbach's alpha coefficient for the scale were 0.983. Nurses perceive that nursing students' contribution to the clinical settings is influenced by nurses' personal characteristics, professional characteristics, and the hospital environment.

Conclusion The Chinese version of the Nursing Student Contributions to Clinical Settings scale has good reliability and validity and can effectively and reliably measure the contributions of Chinese nursing students to clinical settings.

Keywords Clinical settings, Education, Nurses, Nursing students, Reliability, Validity

*Correspondence:

Huijuan Tong
thj_9921@163.com

Full list of author information is available at the end of the article



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Background

Clinical practice competencies are core competencies that nursing schools must cultivate in their nursing students (NS) [1]. Practical teaching of NS in clinical settings is the focus of professional competence acquisition. Clinical nursing practice teaching enables students to combine nursing theory with the actual nursing settings, which is conducive to improving NS' clinical practice ability and a profound comprehension of the connotation of the nursing profession. In many countries, a bachelor of NS must complete a certain period of clinical practice before graduation [2, 3]. Therefore, most registered nurses assume the role of a teacher while performing their duties, including setting learning objectives for NS, teaching clinical skills and clinical thought, providing constructive feedback, and conducting NS-centered assessments [4], which plays a non-negligible teaching role [5]. At the same time, NS shows different contributions in this process.

For NS who are new to clinical practice, the transition from theory to practice is a challenging process. Being novices, they are often vulnerable and need more support and understanding from experienced nurses [6, 7]. Benner's novice to expert mode and Duchscher's transition shock model and stages of transition theory (role change from NS to registered nurse) explain the transition from the theoretical knowledge learning stage to practice [8]. Benner emphasized the difference between practical knowledge ('knowing how') and theoretical knowledge ('knowing that'), arguing that knowledge is embedded in technique, which develops progressively through experience and clinical exposure [9, 10]. Duchscher agreed and proposed a theory of transition (doing-being-knowing) [11]. In the early 'doing' stage, there is a significant gap between the ideals and the reality of the NS [12]; in the 'being' stage, they are adapting to their new roles and their knowledge and skills are increasing significantly [12]; and in the 'knowing' stage, they can assist their colleagues in their work and develop new mechanisms for coping with problems [11]. Understanding this process helps experienced registered nurses to understand and facilitate the transition of NS during the first few months of clinical practice by providing them with tailored education and guidance [11]. Therefore, there is a need for a clearer understanding of registered nurses' perceptions of NS who are new to clinical practice and how best to integrate them into clinical practice to promote effective collaboration between nurses and NS, which will lead to a higher quality of care for patients.

The contribution of NS is defined as their impact on registered nurses' work hours, staff development, quality of care, registered nurses' personal satisfaction, and unit performance agreements and quality standards

during clinical practice [13]. According to reports, the total amount of nurses in China will reach 5.5 million by 2025, with 3.8 registered nurses per 1,000 population [14], while practicing nurses, as a reserve force for nursing, have a large number of NS going to hospitals every year for clinical practice. In this regard, a two-way relationship is created between the NS and the nurses, with the nurses teaching relevant skills to the NS, applying theoretical knowledge to clinical practice, and providing adequate support and encouragement to the NS [15], while the NS also makes valuable contributions to the individual nurses, patient care, clinical settings, and healthcare organizations during their clinical rotations [16, 17]. Most previous studies have explored this issue from the nurses' perspective. For example, one study found that registered nurses involved in teaching and mentoring perceived leading NS and providing them with learning opportunities as an additional component to their daily nursing duties and a source of stress [18]. This is because they need to spend more time and energy instructing and supervising NS, and they also have to worry about whether the performance of the NS will negatively affect the patients [19, 20], which creates an additional burden on the nurses [21]. There is also literature suggesting that nursing staff perceive NS as a threat to the development of their professional roles, believing that NS will take away their job opportunities, diminish their professional status, and lead to unemployment or loss of promotional opportunities [22]. However, some nurses believe that they help shape their future colleagues and enjoy the presence of students [5, 23], and studies have shown that NS makes a positive contribution to improving the clinical learning environment, increasing nurses' interest in learning, and engaging in students' professional development [18]. As a result, registered nurses hold differing views on the existence of the NS role, and the extent of NS' contributions has not been accurately measured [13].

Although NS worldwide spend a significant amount of time in hospitals completing their training, few studies have measured the contribution made by NS, except in the United States [24]. Especially in China, we found few studies reporting on this issue. Whether NS' contributions to clinical settings are positive or negative deserves further exploration. Understanding this phenomenon will help better design and manage professional programs and hospital teaching, and further promote the integration of clinical practice and nursing education [25]. Optimize the management process of clinical practice to reduce possible adverse effects during clinical training; consider whether NS are valuable resources for clinical institutions [26]. Therefore, it is appropriate to

evaluate this phenomenon using specific, objective, and reliable instruments and indices.

At the start of the twenty-first century, Grindel et al. developed a scale to quantify NS contributions to hospital settings in 2001 [16]. Some scholars have used this scale to measure the contributions made by NS in emergency, medical, surgery, and mental health departments in the United States [16, 17]. Later, the scale has been used in other studies [13, 22, 27], but it has never been formally validated. Moreover, the scale contains 54 items, which is an excessive and complex number of items and is not conducive to collecting the true thoughts of registered nurses. In response to this shortcoming, Fernández-Feito et al. developed the first Spanish acronym for the 'Nursing Student Contributions to Clinical Settings' scale (CEEEC, Spanish acronym for 'Contribuciones de los Estudiantes de Enfermería a los Entornos Clínicos') in 2021, based on Grindel as a validated and specialized tool for assessing the contributions of NS to clinical settings, and is available in English [28]. The scale contains 24 items that describe in detail the contributions that NS can make to the healthcare organization during clinical practice. In contrast to Grindel's scale, this scale is comprehensive, with moderate, simple, and easy-to-understand items, and has a high degree of feasibility for clinical application. The 24 items of the scale are attributed to the common factor structure, with a Cronbach's alpha coefficient of 0.95, and the structural model fit indices are within acceptable limits, with good reliability and validity [28], making it a simple and reliable measurement tool. However, further reliability and validity analyses are needed to determine whether the scale is directly applicable or appropriately adapted for application in the Chinese cultural context.

The technical title is a recognition and rating of nurses' professional competence. It has been found that nurses with high technical titles have a greater sense of professional respect [29]. A sense of professional respect is an individual's subjective perception and subjective judgment of their professional value [29]. Therefore, nurses with higher technical titles may have more respect and understanding for NS. Nurses' work experience and teaching experience may also influence nurses' perceptions of NS. Studies have shown that nurses with less work experience are more likely to appreciate students, and nurses with more than ten years of experience find students frustrating and time-consuming [17]. Studies showed that the higher the hospital level where they are located, the higher the work pressure of nurses and the lower their job satisfaction [30]. This may be because the higher the hospital level, the more difficult and critical patients are admitted, and the greater the intensity and difficulty of nursing work.

Working in intensive departments such as intensive care units, nurses and NS take on more responsibility and work under more pressure [31]. Excessive pressure is prone to lead to negative emotions in nurses, and the accumulation of excessive times of emotional exhaustion can lead to a decrease in their motivation to work [32]. Compared with the staff outside the establishment, the staff within the establishment have better salary and stable work [33]. Therefore all of the above factors may influence nurses' perceptions of the contribution of NS. A good clinical work environment should include a positive, supportive relationship between the teacher and the student and a trusting work atmosphere in which the student can participate as a member of the care team [15]. Studies have shown that a good working environment is the basis for nurses to perform their tasks effectively, improve the quality of nursing services, and help to improve the professional quality of nurses [34]. A positive and supportive work environment can enhance the self-confidence of NS, make them more willing to participate in clinical learning and practice, and help improve clinical nursing skills [35]. McRobbie et al. believe clinical settings can affect NS' professional attitudes, nursing knowledge level, and clinical problem-solving skills [36]. Work satisfaction refers to an individual's satisfaction with the work he or she is engaged in, which is expressed as the individual's sense of fulfillment at work [37]. A study by a Chinese scholar showed that the nursing work environment was positively related to work satisfaction [38]. Nurses' work satisfaction has a positive effect on nurses' improving work motivation, meeting patients' needs, and realizing their value [6]. Clinical teaching behavior is a series of purposeful actions taken by clinical instructors to motivate students to translate theory into clinical practice and promote their rapid adaptation to work [39]. Clinical teachers are key determinants of the quality of clinical learning for NS. It has been found that clinical faculty with effective teaching behaviors can help new graduate nurses or NS to improve adaptability, confidence, work satisfaction, and retention [40, 41]. Therefore, it can be considered that the above variables may influence how nurses perceive the contribution of NS to clinical settings.

The purpose of this study was to translate and cross-culturally adapt the CEEEC scale into Chinese and to test the reliability and validity of its application among clinical nurses in China. Based on the preceding literature analysis, this study hypothesized that nurses' personal and professional characteristics are related to nurses' perceived NS contributions to the clinical settings. Therefore, we analyzed differences in CEEEC scores across nurses' personal and professional characteristics.

Methods

Study design and sample

This is a cross-sectional research conducted from January to March 2024. Clinical nurses from 5 hospitals (2 second-level hospitals and 3 third-level hospitals) in Jinzhou and Shenyang were selected as respondents by convenience sampling method. Each year, these hospitals recruit NS for clinical practice in various departments. The questionnaire was collected using the Chinese data collection platform "Questionnaire Star". This study collected 980 questionnaires in all; 45 invalid questionnaires were removed; 935 clinical nurses were included in the end, representing a valid recovery rate of 95.41%. Inclusion criteria: (1) age ≥ 18 years old (2) meet the conditions and qualifications of clinical nursing teaching in the sampled hospitals (3) engaged in clinical teaching of NS for half a year or more (4) willing to participate in this study after informed consent. Exclusion criteria: participants with incomplete questionnaire responses or obvious logical errors. To evaluate the scale's test-retest reliability two weeks later, fifty participants were randomly selected to provide their contact information. The study procedures followed the ethical standards of the Ethics Committee of Jinzhou Medical University (Grant Number: JZMULL2021009) and the ethical guidelines of the Declaration of Helsinki [42].

Translation procedure

We carried out our translation and validation work with Prof. Fernández-Feito's approval. The scale was translated and back-translated according to the Brislin translation model. First, two nursing graduate students who were proficient in both Chinese and English independently translated the English version of the CEEEC into two different Chinese versions. Then a third nursing graduate student who was not involved in the translation compared the differences between the two versions, and all the translators and researchers were convened to discuss and compare the differences, which were corrected, and finally, the first draft of the Chinese version was obtained. The first draft of the Chinese version was back-translated into two different English versions by two bilingual translators (one university English instructor and one doctor of nursing) who had not been exposed to the original scale, and another translator (a master's degree student majoring in English) without exposure to the original scale consolidated the two back-translated versions to form a back-translated version of the scale. Finally, all participants compared, discussed, and modified the first draft of the Chinese version, the back-translated scale, and the original scale in terms of semantics, concepts, and conventions of expression, to make the

content of the scale more in line with the Chinese language environment.

Cultural adaptation

Five clinical nursing experts and two nursing education experts were asked to assess the content of the Chinese version of the scale. After the researcher revised the relevant content according to the experts' opinions, thirty clinical nurses were chosen at random to conduct the scale's initial test. The final revision of the scale was carried out by combining the clinical nurses' understanding of the semantics and keywords when they filled out the scale, and their opinions and suggestions on the scale as a whole, to form the final Chinese version of the CEEEC. With the consent of the original authors, we have amended item 5 "Act as a reminder to update the work protocols" to "Act as a reminder to update the care programs". As this study is a survey of clinical nurses and NS, it would be more appropriate to change the words "work protocols" to "care programs" to make the content of the scale more relevant to this study and to enable the participants to comprehend and answer the questions more accurately.

Instruments

General information questionnaire

This included participants' age, education, marital status, technical title, work experience, teaching experience, department, appointment method, hospital level, and frequency of emotional exhaustion.

Nursing Student Contributions to Clinical Settings (CEEEEC)

The scale was developed by Prof. Fernández-Feito et al. in 2021 to measure the extent to which NS contributes to nursing practice during clinical training [28]. The scale contains 24 items in 1 dimension. A five-point Likert scale was used, with scores ranging from 0 to 4 on a scale from "strongly disagree" to "strongly agree," and a total score of 0 to 96, with higher total scores indicating a greater positive contribution of NS to clinical settings. The Cronbach's alpha coefficient for this scale was 0.94.

The Practice Environment Scale of the Nursing Work Index (PES-NWI)

The scale was developed by Prof. Lake in 2002 [43]. Chinese scholar Wang Li revised it in Chinese in 2011, and the Cronbach's alpha coefficient was 0.91, containing 5 dimensions and 31 items. A Likert 4-point scale was used, with a total score of 31 to 124, with higher scores indicating that nursing staff rated their work environment better. The Cronbach's alpha coefficient in this study was 0.978.

Clinical Teaching Behavior Inventory (CTBI-23)

The scale was developed and validated by Prof. Jane Lee-Hsieh et al. in 2006 with a Cronbach's alpha coefficient of 0.96 [44]. Chinese scholar Su Xi revised the Taiwanese version of CTBI-23 to form a simplified Chinese version in 2020. The scale can be used by new nurses and clinical instructors to evaluate clinical nursing teaching behaviors and contains 23 items in 6 dimensions. A Likert 5-point scale was used with a total score of 23 to 115, with higher scores indicating better clinical teaching behaviors. In this study, the Cronbach's alpha coefficient for this scale was 0.982.

Minnesota Satisfaction Questionnaire (MSQ)

The scale is a short version of the Minnesota Satisfaction Questionnaire developed by Weiss and other scholars in 1967 with a Cronbach's alpha coefficient of 0.849 [45]. It contains 3 subscales with a total of 20 items. A 5-point Likert scale was employed, with a total score ranging from 20 to 100. Higher scores indicate higher work satisfaction among nurses. The Cronbach's alpha coefficient for this scale in this study was 0.974.

Statistical analysis

Data were statistically analyzed using SPSS 27.0 and AMOS 24.0 software. Continuous variables were expressed as mean \pm standard deviation ($\bar{x} \pm s$), and categorical variables were expressed as frequency and composition ratio (%). The Chinese version of the CEEEC scores' differences between nurses' personal and professional characteristics was examined using a one-way analysis of variance (ANOVA). Post hoc multiple comparisons were performed using the Bonferroni test. Skewness and kurtosis were calculated for each item, and the data were regarded as following a normal distribution when the skewness and kurtosis were between -2 and +2 [46].

Item analysis

The scale's items were analyzed using correlation analysis and the Critical Ratio (CR) method. The CR method was used to rank the total scores of the Chinese version of the CEEEC scale from high to low, with the top 27% representing the high subgroup and the bottom 27% representing the low subgroup. The t-value from the independent samples t-test for the high and low subgroups was used as the decision value (CR) to assess the degree of differentiation of the items, and items with a CR of less than 3 and a non-statistically significant difference were removed [47]. Pearson correlation analysis was performed to calculate the correlation coefficients between each item and the total score, and when the correlation

coefficient r was more than 0.4, it showed that the items were highly homogeneous with the overall scale and were retained [48]. Cronbach's alpha coefficient was also calculated after deleting each item to evaluate whether the item could be retained.

Methodological examination and evaluation of the measurement quality of the Chinese version of CEEEC using the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) checklist

Validity analysis

Content validity We asked five clinical nursing experts and two nursing education experts to score each item on a 4-point scale (1–4 representing "not relevant", "weakly relevant", "strongly relevant", and "highly relevant" in order). The item-level content validity index (I-CVI), and average scale-level content validity index (S-CVI/Ave) were used to assess the scale's content validity [49]. Good content validity is indicated by $S-CVI/Ave \geq 0.9$, and $I-CVI \geq 0.78$ [50].

Construct validity Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to test the construct validity of the scale. A random number table method was used to randomly divide 935 participants into Sample 1 and Sample 2 for EFA ($n_1 = 467$) and CFA ($n_2 = 468$), respectively.

In Sample 1 ($n_1 = 467$), the factor ability of the correlation matrix was assessed using the Kaiser–Meyer–Olkin (KMO) value [51] and Bartlett's test of sphericity [52], and the data were considered suitable for factor analysis when the KMO was > 0.60 and Bartlett's test of sphericity was significant ($p < 0.05$). Principal Component Analysis (PCA) and Maximum Variance Orthogonal Rotation were used to assess the potential factor structure of the Chinese version of CEEEC [53]. Maximum variance orthogonal rotation is the most used orthogonal technique to minimize factor complexity while maximizing the variance of factor loading [54]. Finally, eigenvalues, cumulative variance contribution, and Scree plot were combined to extract factors [55].

In sample 2 ($n_2 = 468$), CFA was used to assess the goodness-of-fit of the structural model [56]. In this study, the degree of model fit was verified by chi-square (χ^2) and degrees of freedom (df), incremental fit index (IFI), comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and root mean square residual (RMR) [57]. The model was considered well-fitted when $\chi^2/df < 5$, TLI, CFI, and IFI > 0.90 .

[58], RMSEA and $RMR < 0.08$ [59]. Next, the average variance extracted (AVE) value was calculated using the standardized factor loadings, and the AVE value was used to evaluate the convergent validity of the model. When the AVE value is greater than 0.5, the convergent validity is good [60]. Finally, the discriminant validity of the model was judged based on the correlation coefficients and \sqrt{AVE} value of individual items output by AMOS 24.0. When the \sqrt{AVE} value is higher than the correlation coefficients between individual items, the discriminant validity of the model is good.

Reliability analysis

Internal consistency Split-half reliability, McDonald's Omega coefficient, and Cronbach's alpha coefficient were utilized to evaluate the scale's internal consistency. Split-half reliability was assessed using the odd–even split-half method, in which the scale items were split into two parts, odd and even, and the correlation coefficients between the two parts were computed using Spearman correlation analysis. McDonald's Omega coefficient is thought one of the greatest methods for calculating reliability [61, 62], ≥ 0.8 indicating good internal consistency [63]. Cronbach's alpha coefficient and fold half coefficient ≥ 0.70 are associated with good internal consistency [64].

Test–retest reliability The stability of the scale was assessed using test–retest reliability. Two weeks after the first completion of the scale, 50 participants were asked to complete the Chinese version of the CEEEC again. The correlation between the two tests was calculated using Spearman correlation analysis. A correlation coefficient greater than 0.75 indicated good test–retest reliability [65].

Measurement error

Measurement errors, including systematic and random errors, are not caused by true changes in the structure to be tested [66]. The minimum detectable change (SDC), which determines the threshold of clinical change beyond the measurement error, is calculated based on the standard error of the measurement (SEM) of test–retest reliability [67].

Hypotheses testing

A priori hypothesis was proposed before calculating the results [68]. We expected that the correlation coefficients between the scores of each item and the total score of the scale would be higher than 0.4 and that the

24 items would be attributed to the same common factor. The Cronbach's alpha coefficient and McDonald's Omega coefficient for the scale were greater than 0.7, and the test–retest reliability was greater than 0.75.

Interpretability

Interpretability is the degree to which one can assign qualitative meaning to quantitative scores [69]. Interpretability includes both ceiling and floor effects, and a “ceiling effect” or “floor effect” is considered to exist if more than 15 percent of respondents reach the highest or lowest possible score, respectively [70]. If there is a ceiling or floor effect, extreme items are likely to be missing from the upper or lower end of the scale, indicating limited content validity. As a result, it is not possible to distinguish between the highest and lowest-scoring patients, thus reducing reliability. In addition, the responsiveness of the scale is limited by the inability to measure change in these patients.

Results

General information

The age range of 935 clinical nurses was 18~56 years, with an average age of 33.84 ± 6.95 years; the work experience span ranged from 1 to 37 years, with a mean of 12.11 ± 7.49 years; 87.0% of the study participants were from hospitals affiliated with medical schools. Other information is described in Table 1. The two items with the highest scores in the Chinese version of CEEEC were item 23, “Enable nurses to carry out their teaching role” and item 14, “Become future nurses who know the hospital”. Therefore, the clinical nurses in this study believed that the most important contributions of NS to the clinical environment were in both the nursing profession and the healthcare organization. Table 2 shows the mean scores, skewness, and kurtosis values for each CEEEC item in the Chinese version.

Item analysis

The critical values of the Chinese version of the CEEEC total score for the high and low subgroups were 72 (352, 37.65%) and 56 (258, 27.59%), respectively, and the difference between the items in the high and low subgroups was significant ($P < 0.001$). The CR values ranged from 23.23 to 37.93, which were all greater than 3, suggesting that the items were well discriminated and able to discriminate between different participants' response degrees. The correlation coefficients between the individual item scores and the scale's overall score varied from 0.772 to 0.877 ($P < 0.001$), which were all more than 0.4 [71], and the total Cronbach's alpha coefficient did not rise as a result of the removal of any one item. Therefore all items were retained (Table 3).

Table 1 Characteristics of participants (N=935)

Variable	Total (N%)
Age	
<30 years	196(21%)
30-44 years	656(70.2%)
≥45 years	83(8.9%)
Education	
Junior college students	135(14.4%)
Undergraduates	761(81.4%)
Postgraduates	39(4.2%)
Marital status	
Unmarried	222(23.7%)
Married	701(75.0%)
Divorced or widowed	12(1.3%)
Technical title	
Nurse	127(13.6%)
Nurse Practitioner	335(35.8%)
Charge Nurse	409(43.7%)
Deputy Chief Nurse or above	64(6.8%)
Working experience	
<10 years	317(33.9%)
10-29 years	571(61.1%)
≥30 years	47(5.0%)
Teaching experience	
<5 years	275(29.4%)
5-14 years	504(53.9%)
15-24 years	112(12.0%)
≥25 years	44(4.7%)
Department	
Internal Medicine service	391(41.8%)
Surgical services	256(27.4%)
Intensive care units	58(6.2%)
Emergency services	38(4.1%)
Operating room	51(5.5%)
Other services	141(15.1%)
Appointment method	
Contract system	640(68.4%)
Personnel agency	35(3.7%)
Authorized strength	260(27.8%)
Hospital level	
City hospital	72(7.7%)
Provincial hospital	50(5.3%)
Hospital affiliated with medical university	813(87.0%)
Frequency of emotional exhaustion	
Never or seldom (<1 day/month)	210(22.5%)
Occasionally (1-4 days/month)	480(51.3%)
Frequently (>4 days/month)	245(26.2%)

Validity analysis

Content validity

Seven experts evaluated the content validity of the scale. The results showed that the Chinese version of the CEEEC scale had an I-CVI of 0.86~1 and an S-CVI/Ave of 0.983.

Construct validity

Exploratory factor analysis (EFA) The factorizability of the 24-item matrix in Sample 1 ($n_1=467$) was first checked, and the results showed that the KMO value was 0.980 and Bartlett's test of sphericity was significant ($\chi^2=13,038.338$, $P<0.001$), which indicated that the variables were sufficiently correlated to be suitable for factor extraction. PCA was used to identify the number of possible factors, and the results showed that one common factor with eigenvalue>1 was extracted in total, with a cumulative variance contribution of 71.177%. The factor loadings of the items on this dimension ranged from 0.757 to 0.871 and were all greater than 0.40. Finally, the rotated component matrix could not be obtained because only one component was extracted. The results are further confirmed by the fact that the decreasing trend of the scree plot starts to weaken after point two (Fig. 1).

Confirmatory factor analysis(CFA) To test the EFA-derived model, CFA was performed on sample 2 ($n_2=468$). The one-factor structural model fit indices were all within acceptable ranges, with a χ^2/df of 3.500, an IFI of 0.957, a CFI of 0.957, a TLI of 0.952, an RMR of 0.017, and an RMSEA of 0.073. Based on the Modification Indices (MI), six corrections were made to the initial model, in the order of e2 and e9, e5 and e8, e6 and e18, e10 and e11, e11 and e12, and e13 and e14. The standardized path analysis is Fig. 2 shown.

Convergent validity and discriminant validity The model's AVE value was 0.718, which exceeded the minimum acceptable value of 0.5, suggesting that the model showed good convergent validity. The $\sqrt{\text{AVE}}$ value was 0.847, and the correlation coefficients of each item in the AMOS output were 0.577 to 0.876, $p<0.001$. $\sqrt{\text{The AVE}}$ value was not greater than the correlation coefficients of all the items, and the discriminant validity of the scale did not meet the standard.

Table 2 Mean (SD) scores, kurtosis, and skewness values for each CEEEC item in the Chinese version ($N=935$)

Items in the Chinese version of CEEEC	Mean (SD)	Skewness	Kurtosis
(1)Help to lighten the workload	2.85(0.73)	-0.465	0.633
(2)Stimulate staff to work according to scientific evidence	2.86(0.73)	-0.608	0.814
(3)Generate satisfaction in nurses by participating in the professional development of students	2.87(0.74)	-0.600	0.651
(4)Increase communication with patients and families	2.65(0.81)	-0.195	-0.318
(5)Act as a reminder to update the care programs	2.70(0.82)	-0.459	0.037
(6)Enhance the learning environment of the health centre	2.70(0.80)	-0.295	-0.230
(7)Provide a break in the care of demanding patients	2.53(0.88)	-0.264	-0.397
(8)Encourage staff to update their knowledge	2.81(0.76)	-0.635	0.796
(9)Promote interest in research among nurses	2.78(0.78)	-0.525	0.296
(10)Increase patient and family satisfaction	2.51(0.84)	-0.128	-0.486
(11)Provide comprehensive care to patients	2.49(0.87)	-0.107	-0.545
(12)Represent a responsibility for nurses	2.59(0.82)	-0.280	-0.260
(13)Constitute a link between the healthcare centre and the university	2.89(0.68)	-0.592	1.431
(14)Become future nurses who know the healthcare centre	2.90(0.68)	-0.645	1.570
(15)Encourage the development of empathy among staff	2.82(0.75)	-0.508	0.544
(16)Contribute to the recognition of the nursing profession	2.71(0.78)	-0.350	0.027
(17)Intellectually stimulate staff with different or innovative perspectives	2.73(0.76)	-0.324	-0.036
(18)Improve the work environment	2.62(0.85)	-0.236	-0.489
(19)Participate in interdisciplinary collaborative work	2.60(0.85)	-0.213	-0.461
(20)Improve the reputation of the institution	2.58(0.83)	-0.176	-0.343
(21)Are helpful for the development of technological skills among staff	2.80(0.75)	-0.463	0.321
(22)Collaborate in the integration and teaching of other students	2.71(0.78)	-0.427	0.040
(23)Enable nurses to carry out their teaching role	2.94(0.64)	-0.350	0.729
(24)Monitor the patient's status more frequently	2.63(0.83)	-0.280	-0.332

Reliability analysis

Internal consistency reliability

The Chinese version of the CEEEC showed that McDonald's Omega coefficient was 0.983, Cronbach's alpha coefficient was 0.983, and the fold half coefficient was 0.968, which indicated that the scale had good internal consistency.

Test-retest reliability

Fifty participants were asked to complete the scale again after two weeks. Between the two tests, the Spearman correlation coefficient was 0.864, $p < 0.001$, higher than 0.75, indicating that the Chinese version of the CEEEC has good long-term stability.

Hypotheses testing

As we expected, the correlation coefficients between the scores of the items and the total score of the scale were higher than 0.4, and 24 items were attributed to the same common factor. The Cronbach's alpha coefficient and McDonald's Omega coefficient for the scale were greater than 0.7, and the test-retest reliability was greater than 0.75.

Interpretability

In this study, no patients reported a worst score of 0, and only 65 (7.0%) patients reported a best score of 96; therefore, there were no ceiling and floor effects, and the scale had high reliability.

Analysis of differences in nurses' personal and professional characteristics in the Chinese version of CEEEC scores

The mean score of the Chinese version of the CEEEC for the 935 clinical nurses in this study was 65.28 ± 15.95 , which was higher than the mean score of the original scale of 54.7 ± 202.16 . The original authors categorized the total scores of the CEEEC scale as a very negative contribution for scores of 0–23.9, a negative contribution for scores of 24–47.9, a positive contribution for scores of 48–71.9, and a very positive contribution for scores of ≥ 72 . It means that this study is in agreement with the original author's findings both concluded that NS' contribution to the clinical settings is at a positive level and within the same range. For the continuous variables PES-NWI, CTBI-23, and MSQ scale total scores, we selected quartile (25th percentile, 50th percentile, and 75th

Table 3 Item analysis for the Chinese version of the CEEEC (N=935)

Item	High-score group (n=352)		Low-score group (n=258)		CR	r	P-value	Cronbach's alpha if item deleted
	Mean	SD	Mean	SD				
1	3.41	0.51	2.22	0.68	23.64	0.772	<0.001	0.983
2	3.41	0.50	2.15	0.70	25.93	0.824	<0.001	0.982
3	3.43	0.50	2.16	0.71	24.62	0.843	<0.001	0.982
4	3.35	0.49	1.80	0.57	36.05	0.846	<0.001	0.982
5	3.35	0.49	1.85	0.69	29.84	0.854	<0.001	0.982
6	3.36	0.50	1.88	0.63	32.44	0.843	<0.001	0.982
7	3.29	0.48	1.57	0.63	36.89	0.872	<0.001	0.982
8	3.37	0.48	2.04	0.70	27.60	0.841	<0.001	0.982
9	3.38	0.50	2.01	0.71	28.13	0.843	<0.001	0.982
10	3.28	0.47	1.65	0.60	36.08	0.855	<0.001	0.982
11	3.29	0.49	1.59	0.60	37.49	0.871	<0.001	0.982
12	3.26	0.50	1.78	0.67	29.88	0.820	<0.001	0.982
13	3.38	0.49	2.23	0.65	25.07	0.839	<0.001	0.982
14	3.39	0.49	2.25	0.67	23.23	0.836	<0.001	0.982
15	3.40	0.49	2.02	0.64	29.24	0.863	<0.001	0.982
16	3.34	0.50	1.86	0.58	32.84	0.865	<0.001	0.982
17	3.33	0.49	1.93	0.59	30.98	0.856	<0.001	0.982
18	3.36	0.51	1.70	0.61	35.45	0.867	<0.001	0.982
19	3.35	0.50	1.68	0.58	37.39	0.876	<0.001	0.982
20	3.31	0.50	1.69	0.55	37.93	0.877	<0.001	0.982
21	3.38	0.50	2.04	0.66	28.60	0.847	<0.001	0.982
22	3.33	0.48	1.85	0.62	33.07	0.861	<0.001	0.982
23	3.41	0.49	2.30	0.57	25.80	0.849	<0.001	0.982
24	3.33	0.51	1.77	0.64	32.25	0.854	<0.001	0.982

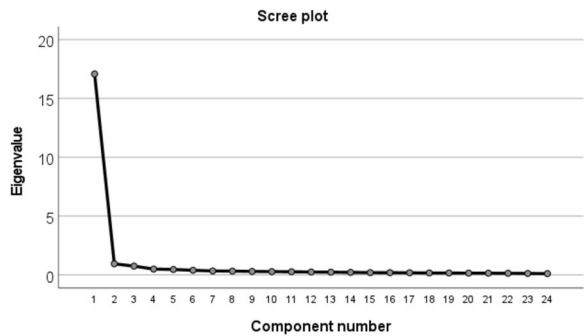


Fig. 1 Scree plot of exploratory factor analysis for the Chinese version of CEEEC ($n_1 = 467$)

percentile) values for categorization. The PES-NWI scale cut-off points were 88, 93, and 104, the CTBI-23 scale cut-off points were 90, 92, and 110, and the MSQ scale cut-off points were 76, 80, and 90. The results of one-way ANOVA showed statistically significant differences in the Chinese version of the CEEEC scores in terms of

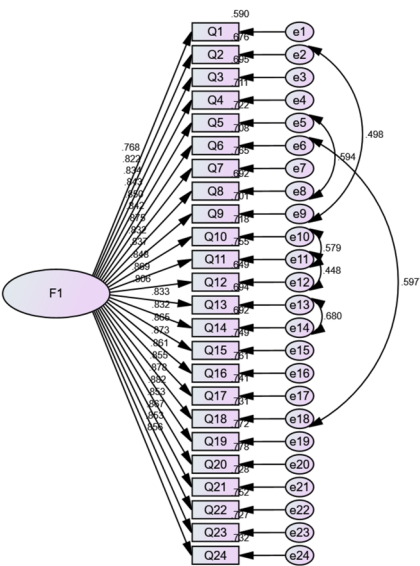


Fig. 2 Standardized one-factor structural model for the Chinese version of CEEEC ($n_2 = 468$)

technical title, working experience, teaching experience, department, appointment method, frequency of emotional exhaustion, working environment, clinical teaching behavior, and work satisfaction. Only the hospital level had no statistically significant effect on the Chinese version of the CEEEC score. Table 4 presents the particular results.

Discussion

This study was the first attempt to introduce the CEEEC scale to China, explore the psychometric properties of the Chinese version of the CEEEC, and provide a valid measurement tool for assessing the contribution of Chinese NS to clinical settings. This study agreed with the original authors' study that NS' contribution to the clinical settings was at a positive level, especially in terms of the nursing profession and healthcare organization. We also confirmed that clinical nurses' technical title, working experience, teaching experience, department, appointment method, frequency of emotional exhaustion, nursing work environment, nurses' work satisfaction, and clinical teaching behaviors affect how nurses evaluate NS' contributions to the clinical settings.

The Chinese version of CEEEC has good psychometric properties

Firstly, the group reached a consensus on the applicability of the scale among Chinese clinical nurses, supporting its content validity. Secondly, the EFA results of this study demonstrated that the Chinese version of the CEEEC has a one-factor structure, which is identical to the structure of the original scale, retaining all 24 items. Díaz-Alonso validated the scale in a primary care setting and demonstrated results that were also consistent with our study [72]. It suggests that all the items of the CEEEC scale are intended to measure the same underlying variable and provide a more focused response to the NS' contributions to the clinical environment. The CFA results demonstrated that the model fit indicators were all within acceptable limits and the convergent validity of the scale performed well. However, it is worth noting that the discriminant validity of the scale did not meet the criteria, probably because the scale is a one-factor structure with some similarity in that all the items are intended to measure the same underlying variable. Nevertheless, in our initial items analysis work, all indicators met the criteria, and no items needed to be deleted, suggesting that the scale needs to be further validated in the future in a wider population. Finally, this study used Cronbach's alpha coefficient and McDonald's Omega coefficient to jointly assess the internal consistency of the scale, and the findings indicated that both Cronbach's alpha and McDonald's Omega coefficients were 0.983, with the

scale exhibiting a high level of internal consistency. The test–retest reliability of the scale was good, suggesting that the scale has great stability and can be reused among Chinese clinical nurses. The measurement quality of the Chinese version of CEEEC was evaluated according to the COSMIN guidelines and the results showed good results.

Analysis of factors influencing nurses' perceptions of nursing students' contributions to clinical settings

As expected, nurses' views of NS' contributions to the clinical settings were influenced by nurses' characteristics, professional traits, and the hospital environment. This study found that junior nurses were more likely to perceive NS as positively contributing to the clinical settings than more technically qualified staff, contrary to the initial hypothesis. The relatively young age of junior nurses and the small generation gap between them and NS are conducive to mutual communication and good interpersonal relationships, which could result in a better comprehension of the role of NS [13]. Nurses' working experience and teaching experience also influence their perceptions of NS' contributions. Traditionally, students have been encouraged to work with more senior nurses to learn more about nursing practice during clinical practice. However, the results were the opposite, as one study showed that nurses with no more than ten years of experience rated NS' contributions higher compared to nurses with ten or more years of experience [17]. This is quite in line with the findings of this investigation, which can also be interpreted to mean that nurses with fewer years of work experience have deeper memories of their personal student experiences and may hold higher levels of empathy for their students [13]. In our study, internal medicine nurses had higher CEEEC scores, which coincided with the findings of Fernández-Feito [26]. Intensive care nurses' occupational stress is high due to their long-term exposure to high-stress, high-intensity work environments [73], and the high number of surgical patients, intense and busy workloads, and frequent shift work in surgical health units have resulted in decreased quality of life and increased anxiety sensitivity among nurses [74]. All these factors are likely to contribute to more negative evaluations by intensive care and surgical nurses about the contribution of NS. There was no difference in the evaluation of the contributions of NS by nurses employed on a contract or authorized strength appointment method, while nurses employed on a personnel agency rated the contributions of NS more favorably. This is different from the results of our expected study, as the personnel agency system appeared late, some hospitals' personnel agency systems are not perfect and there are still many problems. For example,

Table 4 Comparisons of the Chinese version of CEEEC scores in nurses' personal and professional characteristics (N = 935)

Variable	N%	Mean (SD)	F	p-value	Pairwise differences
Technical title					
Nurse (1)	13.6	73.02 (17.76)	14.272	< 0.001	(1) > (2)(3)(4)
Nurse Practitioner (2)	35.8	65.69 (15.86)			
Charge Nurse (3)	43.7	63.14 (14.65)			
Deputy Chief Nurse or above (4)	6.8	61.48 (15.79)			
Working experience					
< 10 years (1)	33.9	68.92 (16.05)	13.120	< 0.001	(1) > (2)(3)
10–29 years (2)	61.1	63.57 (15.84)			
≥ 30 years (3)	5.0	61.62 (11.97)			
Teaching experience					
< 5 years (1)	29.4	68.90 (16.55)	9.054	< 0.001	(1) > (2)(3)
5–14 years (2)	53.9	64.46 (15.54)			
15–24 years (3)	12.0	60.29 (15.66)			
≥ 25 years (4)	4.7	64.82 (12.76)			
Department					
Internal Medicine service (1)	41.8	66.77(16.80)	2.736	0.018	(1) > (6)
Surgical services (2)	27.4	64.71(15.28)			
Intensive care units (3)	6.2	64.19(18.22)			
Emergency services (4)	4.1	67.47(14.41)			
Operating room (5)	5.5	66.96(15.94)			
Other services (6)	15.1	61.43(13.40)			
Appointment method					
Contract system (1)	68.4	65.51 (16.29)	5.373	0.005	(2) > (1)(3)
Personnel agency (2)	3.7	72.89 (14.57)			
Authorized strength (3)	27.8	63.70 (14.96)			
Hospital level					
City hospital (1)	7.7	65.93(13.72)	0.065	0.937	
Provincial hospital (2)	5.3	65.30(13.14)			
Hospital affiliated with medical university (3)	87.0	65.22(16.30)			
Frequency of emotional exhaustion					
Never or seldom (< 1 day/month) (1)	22.5	70.70(15.96)	19.185	< 0.001	(1) > (2) > (3)
Occasionally (1–4 days month) (2)	51.3	64.71(15.62)			
Frequently (> 4 days/month) (3)	26.2	61.75(15.42)			
Work environment					
≤ 88 points (1)	25.6	52.93(13.55)	157.935	< 0.001	(4) > (3) > (2) > (1)
89–93 points (2)	26.3	61.83(11.85)			
94–104 points (3)	23.2	69.19(11.40)			
≥ 105 points (4)	24.9	77.95(14.86)			
Clinical teaching behavior					
≤ 90 points (1)	26.8	54.69(14.44)	110.445	< 0.001	(4) > (3)(2) > (1)
91–92 points (2)	24.8	64.45(10.23)			
93–110 points (3)	23.9	65.55(11.37)			
≥ 111 points (4)	24.5	77.47(17.55)			
Work satisfaction					
≤ 76 points (1)	26.8	54.90(14.08)	77.004	< 0.001	(4) > (3)(2) > (1)
77–80 points (2)	26.8	65.55(11.44)			
81–90 points (3)	22.2	67.50(12.86)			
≥ 91 points (4)	24.2	74.48(18.13)			

the responsibilities in the work are not clear enough and the management methods are backward [75]. Therefore, before the study was conducted, we thought that personnel agency nurses would have a more negative evaluation of NS, and this finding should be confirmed in more surveys in the future. In addition, this study found that hospital level was not related to the scores on the CEEEC scale, more than half of our study participants were from hospitals affiliated with medical schools, and the percentage of nurses from other hospitals was too small to be representative. Therefore, in the future, it is necessary to collect more samples from hospitals that are not affiliated with medical schools to explore whether the contribution of NS is related to the level of the hospital.

In addition, several additional factors were linked to nurses' favorable perceptions of student contributions. The frequency of nurses' emotional exhaustion was negatively related to NS' contributions. Negative emotions affect nurses' professional judgment and indirectly influence nurses' perceptions of NS' contributions. Therefore, an organizational culture that provides nurses with a normal experience and expression of emotions, and an organizational environment that gives nurses sufficient time to digest their emotions can help to improve the relationship between nurses and NS, which in turn leads to a willingness to provide better nursing education to students [76]. Both nursing work environment and nurses' work satisfaction were positively correlated with the total CEEEC scale score, and optimizing the work environment of clinical practice can not only improve the quality of nursing services as well as patient satisfaction [77] but also deepen NS' knowledge and understanding of nursing professional knowledge and skills [78]. Also, Arkan's study showed that poor work environment made nurses' attitudes toward students negative [79]. The nursing work environment is positively related to work satisfaction [38]. Therefore, it can be considered that the nursing work environment and nurses' work satisfaction are highly correlated with nurses' perceptions of students' contributions. Teaching behaviors of clinical nursing teachers play an essential role in promoting student development [80], and studies have shown that effective teaching behaviors enhance students' motivation to learn, increase their interest in caring for patients, and maximize their clinical practice [81, 82]. Therefore, nurses who rated their clinical teaching behaviors highly were also positive about the contributions made by NS.

In summary, it is critical to understand and actively publicize the positive contributions of NS, as well as appropriately explore the factors associated with the contributions of NS. This will lead to healthcare organizations focusing more on training and providing

students with more opportunities for clinical practice, producing more quality people for the future of nursing.

Limitations

Several limitations exist in this study. First, all information in this study was self-reported, so reporting bias is inevitable. Second, although we collected sufficient relevant information about nurses' professional characteristics, we did not assess other factors that may influence nurses' perceived NS contributions, such as the study motivation of the mentored students and certain personal characteristics of the surveyed nurses. Finally, there was a high correlation between the individual items of the CEEEC scale. Therefore, the discriminant validity of the scale should be judged with caution and needs to be further validated in more extensive studies.

Conclusions

The Chinese version of the CEEEC scale has good psychometric properties and can validly and reliably measure clinical nurses' perceptions of the contribution of NS in the clinical environment. NS are the foundation of future healthcare careers and they spend a great deal of time training in clinical settings. Therefore, the role of NS should be emphasized and considered. In addition, optimizing the nursing work environment, enhancing clinical teaching behaviors, and improving nurses' work satisfaction will help nurses better recognize the positive impact of NS on the clinical environment. Appropriate exploration of the aforementioned relationships will help to enhance the integration of the nursing practice environment with the academic environment.

Appendix A

Table 5 Comparison of each item in the English version of CEEEC and the Chinese version of CEEEC

The original version of CEEEC	The Chinese version of CEEEC
(1)Help to lighten the workload	护生可以帮助护士减轻工作负荷
(2)Stimulate staff to work according to scientific evidence	护生可以促使医护人员遵循科学证据开展工作
(3)Generate satisfaction in nurses by participating in the professional development of students	护士可以通过参与护生的职业发展而产生满足感
(4)Increase communication with patients and families	护生可以加强护士与患者及其家属的沟通

The original version of CEEEC	The Chinese version of CEEEC
(5) Act as a reminder to update the work protocols	护生会提醒护士更新护理方案
(6) Enhance the learning environment of the health center	护生可以改善医院的学习环境
(7) Provide a break in the care of demanding patients	在护理要求苛刻的患者时, 护生可以为护士提供修整时间
(8) Encourage staff to update their knowledge	护生可以促使医护人员更新专业知识
(9) Promote interest in research among nurses	护生可以促使护士提高科研兴趣
(10) Increase patient and family satisfaction	护生可以提高患者和家属的满意度
(11) Provide comprehensive care to patients	护生会为患者提供全方位的照护
(12) Represent a responsibility for nurses	护生可以尽到作为护士的责任
(13) Constitute a link between the healthcare center and the university	护生可以成为医院和大学之间的纽带
(14) Become future nurses who know the healthcare center	护生未来会成为了解医院的护士
(15) Encourage the development of empathy among staff	护生可以促使医护人员发展同理心
(16) Contribute to the recognition of the nursing profession	护生有助于护理行业得到认可
(17) Intellectually stimulate staff with different or innovative perspectives	护生可以用不同的或创新的观点, 启发医护人员的思维
(18) Improve the work environment	护生可以改善工作环境
(19) Participate in interdisciplinary collaborative work	护生会参与到跨学科协作工作当中
(20) Improve the reputation of the institution	护生有助于提高医疗机构的声誉
(21) Are helpful for the development of technological skills among staff	护生有助于医护人员提升专业技能
(22) Collaborate in the integration and teaching of other students	护生会在整合和教学活动中与其他学生合作
(23) Enable nurses to carry out their teaching role	护生可以使护士发挥其教学作用
(24) Monitor the patient's status more frequently	护生可以更加密切地监测病人的状态

Abbreviations

CEEEC	Nursing Student Contributions to Clinical Settings
NS	Nursing students
PES-NWI	Practice Environment Scale of the Nursing Work Index
CTBI-23	Clinical Teaching Behavior Inventory
MSQ	Minnesota Satisfaction Questionnaire
EFA	Exploratory Factor Analysis
CFA	Confirmatory Factor Analysis
PCA	Principal Component Analysis
RMSEA	Root Mean Square Error of Approximation
RMR	Root Mean Square Residual
CFI	Comparative Fit Index
IFI	Incremental Fit Index
TLI	Tucker-Lewis Index
AVE	Average Variance Extracted

Acknowledgements

We would like to thank all the clinical nurses who participated in this study and thank Prof. Fernández-Feito for providing the tools and support for this study.

Authors' contributions

KX, CZ, FQ, and YL co-authored the paper, HT supervised the study, CZ completed the data collection, and KX, FQ, and YL completed the final manuscript revisions. All authors read and approved the final manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Availability of data and materials

Given that China holds a high level of confidentiality regarding the underlying information of individuals, the data used and/or analyzed in this study will not be made available to the general public. However, researchers may obtain these data from the corresponding author if they have a reasonable need to do so.

Declarations

Ethics approval and consent to participate

The study procedures followed the ethical standards of the Ethics Committee of Jinzhou Medical University (Grant Number: JZMULL2021009) and the ethical guidelines of the Declaration of Helsinki. All participants in this study were older than 16 years and had signed an informed consent form.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Author details

¹Department of Nursing, Jinzhou Medical University, No. 40, Section 3, Songpo Road, Linghe District, Jinzhou 121001, People's Republic of China. ²Shenyang Medical College, No. 146, Huanghe North Street, Yuhong District, Shenyang 110034, People's Republic of China. ³Department of Ophthalmology, Shenyang Fourth People's Hospital, No. 20, Huanghe South Street, Huanggu District, Shenyang 110031, People's Republic of China.

Received: 10 August 2024 Accepted: 30 September 2024

Published online: 08 October 2024

References

- Mannino JE, Lane M, Siegel V, et al. On-Campus Clinical: Preparing Prelicensure Nursing Students for a Safe Clinical Practice [J]. *Nurse Educ*. 2021;46(3):180–3. <https://doi.org/10.1097/nne.0000000000000864>.
- Lana-Pérez A, Caamaño-Isorna F, Baltasar-Bagué A, et al. [Public health competencies and contents of Nursing degree programs in Spanish universities] [J]. *Rev Esp Salud Publica*, 2018, 92. <http://www.semanticscholar.org/paper/110e07c43cf10ef0dfdf131590dca0a0ece9356>
- Gobbi M. Reference points for the design and delivery of degree programmes in nursing [J]. University of Deusto, 2011. <http://eprints.soton.ac.uk/342497/1/tuningnursingfinal%255B1%255D.pdf>
- Tuomikoski AM, Ruotsalainen H, Mikkonen K, et al. Nurses' experiences of their competence at mentoring nursing students during clinical practice: A systematic review of qualitative studies [J]. *Nurse Educ Today*. 2020;85:104258. <https://doi.org/10.1016/j.nedt.2019.104258>.
- Hanson S E, Macleod M L, Schiller C J. 'It's complicated': Staff nurse perceptions of their influence on nursing students' learning. A qualitative descriptive study [J]. *Nurse Educ Today*, 2018, 63: 76–80. <https://doi.org/10.1016/j.nedt.2018.01.017>
- Boamah S A, Read E A, Spence Laschinger H K. Factors influencing new graduate nurse burnout development, job satisfaction and patient care

- quality: a time-lagged study [J]. *J Adv Nurs*, 2017, 73(5): 1182–95. <https://doi.org/10.1111/jan.13215>
7. Regan S, Wong C, Laschinger HK, et al. Starting Out: qualitative perspectives of new graduate nurses and nurse leaders on transition to practice [J]. *J Nurs Manag*. 2017;25(4):246–55. <https://doi.org/10.1111/jonm.12456>.
 8. Murray M, Sundin D, Cope V. Benner's model and Duchscher's theory: Providing the framework for understanding new graduate nurses' transition to practice [J]. *Nurse Educ Pract*. 2019;34:199–203. <https://doi.org/10.1016/j.nepr.2018.12.003>.
 9. Chen CH. From novice to expert [J]. *Am J Nurs*. 1982;82(3):402–7. <https://doi.org/10.2307/3462928>.
 10. Benner P. From Novice To Expert: Excellence and Power in Clinical Nursing Practice [J]. *Am J Nurs*. 1984;84(12):1480. <https://doi.org/10.1097/00000446-198412000-00025>.
 11. Duchscher J B. A process of becoming: the stages of new nursing graduate professional role transition [J]. *J Contin Educ Nurs*, 2008, 39(10): 441–50; quiz 51–2, 80. <https://doi.org/10.3928/00220124-20081001-03>
 12. Duchscher JEB. Out in the real world: newly graduated nurses in acute-care speak out [J]. *J Nurs Adm*. 2001;31(9):426–39. <https://doi.org/10.1097/00005110-200109000-00009>.
 13. Morrison TL, Brennaman L. What do nursing students contribute to clinical practice? The perceptions of working nurses [J]. *Appl Nurs Res*. 2016;32:30–5. <https://doi.org/10.1016/j.apnr.2016.03.009>.
 14. Zhang WQ, Tang W, Hu FH, et al. Impact of the National Nursing Development Plan on nursing human resources in China: An interrupted time series analysis for 1978–2021 [J]. *Int J Nurs Stud*. 2023;148:104612. <https://doi.org/10.1016/j.ijnurstu.2023.104612>.
 15. Mikkonen K, Tomietto M, Tuomikoski AM, et al. Mentors' competence in mentoring nursing students in clinical practice: Detecting profiles to enhance mentoring practices [J]. *Nurs Open*. 2022;9(1):593–603. <https://doi.org/10.1002/nop.2.1103>.
 16. Grindel C G, Bateman A L, Patsdaughter C A, et al. Student contributions to clinical agencies: a comparison of adult health and psychiatric staff nurses' perceptions [J]. *Nurs Health Care Perspect*, 2001, 22(4): 197–202. <https://www.researchgate.net/publication/7392607>
 17. Grindel C G, Patsdaughter C A, Medici G, et al. Adult-health/medical-surgical nurses' perceptions of students' contributions to clinical agencies [J]. *Medsurg Nurs*, 2003, 12(2): 117–23. <http://www.semanticscholar.org/paper/90156c452cd8241781bb7594372236cfd318ff4e>
 18. Anderson C, Moxham L, Broadbent M. Recognition for registered nurses supporting students on clinical placement: a grounded theory study [J]. *Australian journal of advanced nursing : a quarterly publication of the Royal Australian Nursing Federation, The*, 2020, (3). <https://doi.org/10.37464/2020.373.98>
 19. Kemper, Natalie J. Win-win strategies help relieve preceptor burden [J]. *Nursing Management*, 2007, 38(2): 10. <https://doi.org/10.1097/00006247-200702000-00004>
 20. Warren AL, Denham SA. Relationships between formalized preceptor orientation and student outcomes [J]. *Teaching & Learning in Nursing*. 2010;5(1):4–11. <https://doi.org/10.1016/j.teln.2009.02.003>.
 21. Omansky GL. Staff nurses' experiences as preceptors and mentors: an integrative review [J]. *J Nurs Manag*. 2010;18(6):697–703. <https://doi.org/10.1111/j.1365-2834.2010.01145.x>.
 22. Matsumura G, Callister L C, Palmer S, et al. Staff nurse perceptions of the contributions of students to clinical agencies [J]. *Nurs Educ Perspect*, 2004, 25(6): 297–303. <https://pubmed.ncbi.nlm.nih.gov/15675378/>
 23. Halcomb EJ, Peters K, McInnes S. Practice nurses experiences of mentoring undergraduate nursing students in Australian general practice [J]. *Nurse Educ Today*. 2012;32(5):524–8. <https://doi.org/10.1016/j.nedt.2011.08.012>.
 24. Visiers-Jiménez L, Palese A, Brugnolli A, et al. Nursing students' self-directed learning abilities and related factors at graduation: A multi-country cross-sectional study [J]. *Nurs Open*, 2022, 9(3): 1688–99. <https://doi.org/10.1002/nop.2.1193>
 25. Thompson CJ. Research Priorities for Nursing Education: Application to Clinical Nurse Specialist Education [J]. *Clin Nurse Spec*. 2017;31(5):285–8. <https://doi.org/10.1097/nur.0000000000000317>.
 26. Fernández-Feito A, Válcárcel-Álvarez Y, Andina-Díaz E, et al. Contribution of nursing students to clinical settings: A multi center cross sectional study [J]. *Nurse Educ Pract*, 2023, 68: 103601. <https://doi.org/10.1016/j.nepr.2023.103601>
 27. Slaughter-Smith C, Helms JE, Burris R. Nursing staff perceptions of student contributions in clinical settings [J]. *J Nurs Educ*. 2012;51(1):54–7. <https://doi.org/10.3928/01484834-20111130-02>.
 28. Fernández-Feito A, García-Cueto E, Díaz-Alonso J, et al. Contribution of students to nursing practice settings during clinical training: Design and validation of a questionnaire [J]. *J Adv Nurs*, 2021, 77(9): 3940–51. <https://doi.org/10.1111/jan.14891>
 29. Hailu FB, Kassahun CW, Kerie MW. Perceived Nurse-Physician Communication in Patient Care and Associated Factors in Public Hospitals of Jimma Zone, South West Ethiopia: Cross Sectional Study [J]. *PLoS ONE*. 2016;11(9):e0162264. <https://doi.org/10.1371/journal.pone.0162264>.
 30. Moyle W, Skinner J, Rowe G, et al. Views of job satisfaction and dissatisfaction in Australian long-term care [J]. *J Clin Nurs*. 2003;12(2):168–76. <https://doi.org/10.1046/j.1365-2702.2003.00732.x>.
 31. Jneid C. How social self-efficacy and emotional self-efficacy moderate the relationship between occupational stress and knowledge hiding in Brazilian software industry [J]. *Evidence-based HRM: a Global Forum for Empirical Scholarship*. 2023;11(2):233–52. <https://doi.org/10.1108/EBHRM-03-2021-0040>.
 32. Zeng JF, Xiao AX, Ye JR, et al. Occupational burnout in nurses: a concept analysis [J]. *Frontiers of Nursing*. 2020;7(1):1–8. <https://doi.org/10.2478/fon-2020-0006>.
 33. Johnson HM, Irish W, Strassle PD, et al. Associations Between Career Satisfaction, Personal Life Factors, and Work-Life Integration Practices Among US Surgeons by Gender [J]. *JAMA Surg*. 2020;155(8):742–50. <https://doi.org/10.1001/jamasurg.2020.1332>.
 34. Sullivan Havens D, Warshawsky N E, Vasey J. RN work engagement in generational cohorts: the view from rural US hospitals [J]. *J Nurs Manag*, 2013, 21(7): 927–40. <https://doi.org/10.1111/jonm.12171>
 35. Arsat N, Chua BS, Wider W, et al. The Impact of Working Environment on Nurses' Caring Behavior in Sabah, Malaysia [J]. *Front Public Health*. 2022;10:858144. <https://doi.org/10.3389/fpubh.2022.858144>.
 36. McCabe BW. The improvement of instruction in the clinical area: a challenge waiting to be met [J]. *J Nurs Educ*. 1985;24(6):255–7. <https://doi.org/10.3928/0148-4834-19850601-11>.
 37. Bacha A M, Grassiotto ODA R, Gonçalves S P, et al. Job satisfaction of nursing staff in a university hospital [J]. *Rev Bras Enferm*, 2015, 68(6): 1130–8. <https://doi.org/10.1590/0034-7167.20156806191>
 38. Shao J, Tang L, Wang X, et al. Nursing work environment, value congruence and their relationships with nurses' work outcomes [J]. *J Nurs Manag*. 2018;26(8):1091–9. <https://doi.org/10.1111/jonm.12641>.
 39. Biffitt BB, Dachew BA, Tiruneh BT, et al. Effective Clinical Teaching Behaviors Views of Nursing Students and Nurse Educators at University of Gondar, Northwest Ethiopia: Cross-Sectional Institution Based Study [J]. *J Caring Sci*. 2018;7(3):119–23. <https://doi.org/10.15171/jcs.2018.019>.
 40. Haggerty C, Holloway K, Wilson D. How to grow our own: an evaluation of preceptorship in New Zealand graduate nurse programmes [J]. *Contemp Nurse*. 2013;43(2):162–71. <https://doi.org/10.5172/conu.2013.43.2.162>.
 41. Tsai YM, Lee-Hsieh J, Turton MA, et al. Nurse preceptor training needs assessment: views of preceptors and new graduate nurses [J]. *J Contin Educ Nurs*. 2014;45(11):497–505. <https://doi.org/10.3928/00220124-20141023-01>.
 42. Helsinki W M A D O. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects [J]. *Hiv Clinical Trials*, 2000, 2(4): 92–5. <https://doi.org/10.1310/GTFR-2DRX-M6YE-ELXR>
 43. Lake ET. Development of the practice environment scale of the Nursing Work Index [J]. *Res Nurs Health*. 2002;25(3):176–88. <https://doi.org/10.1002/nur.10032>.
 44. Lee-Hsieh J, O'Brien A, Liu CY, et al. The development and validation of the Clinical Teaching Behavior Inventory (CTBI-23): Nurse preceptors' and new graduate nurses' perceptions of precepting [J]. *Nurse Educ Today*. 2016;38:107–14. <https://doi.org/10.1016/j.nedt.2015.12.005>.
 45. Weiss D J, Dawis R V, England G W. Manual for the Minnesota Satisfaction Questionnaire, F, 1967 [C]. <https://www.researchgate.net/publication/232548044>
 46. Adawi M, Bragazzi NL, Argumosa-Villar L, et al. Translation and Validation of the Nomophobia Questionnaire in the Italian Language: Exploratory Factor Analysis [J]. *JMIR Mhealth Uhealth*. 2018;6(1):e24. <https://doi.org/10.2196/mhealth.9186>.

47. Hosford CC, Siders WA. Felder-Soloman's Index of Learning Styles: internal consistency, temporal stability, and factor structure [J]. *Teach Learn Med.* 2010;22(4):298–303. <https://doi.org/10.1080/10401334.2010.512832>.
48. Cha ES, Kim KH, Erlen JA. Translation of scales in cross-cultural research: issues and techniques [J]. *J Adv Nurs.* 2007;58(4):386–95. <https://doi.org/10.1111/j.1365-2648.2007.04242.x>.
49. Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations [J]. *Res Nurs Health.* 2006;29(5):489–97. <https://doi.org/10.1002/nur.20147>.
50. Devon HA, Block ME, Moyle-Wright P, et al. A psychometric toolbox for testing validity and reliability [J]. *J Nurs Scholarsh.* 2007;39(2):155–64. <https://doi.org/10.1111/j.1547-5069.2007.00161.x>.
51. Kaiser HF. An Index of Factorial Simplicity [J]. *Psychometrika.* 1974;39(1):31–6. <https://doi.org/10.1007/BF02291575>.
52. Greenwood M. A note on the subdivision of χ^2 into components [J]. *Biometrika.* 1949, (1–2). <https://doi.org/10.1093/biomet/36.1-2.130>.
53. Heidari Z, Feizi A. Transcultural adaptation and validation of the Persian version of the breast cancer awareness measure (BCAM) questionnaire [J]. *Cancer Med.* 2018;7(10):5237–51. <https://doi.org/10.1002/cam4.1740>.
54. Yang Z, Chen F, Zhang Y, et al. Translation of the Chinese version of the Self-Care for Aspiration Pneumonia Prevention Scale and its validation among Chinese community dwelling elderly with risk of dysphasia [J]. *Nurs Open.* 2022;9(3):1902–11. <https://doi.org/10.1002/nop2.940>.
55. Williams B, Brown T, Onsmar A. Exploratory factor analysis: A five-step guide for novices [J]. *Australasian Journal of Paramedicine.* 2010;8(3):1–13. <https://doi.org/10.33151/ajp.8.3.93>.
56. Hair J F, Black W C, Babin B J, et al. *Multivariate Data Analysis: A Global Perspective* [M]. *Multivariate Data Analysis: A Global Perspective*, 2010. <https://www.researchgate.net/publication/237009923>
57. Garritz A. Instrument Development of the Affective Domain. *School and Corporate Applications* [J]. *Educación Química*, 2013, 24: 538–9. [https://doi.org/10.1016/S0187-893X\(13\)72525-4](https://doi.org/10.1016/S0187-893X(13)72525-4)
58. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives [J]. *Struct Equ Model.* 1999;6(1):1–55. <https://doi.org/10.1080/10705519909540118>.
59. Brown T A. *Confirmatory Factor Analysis for Applied Research* [J]. *guilford pubn*, 2006. <https://www.researchgate.net/publication/262232557>
60. Strauss ME, Smith GT. Construct validity: advances in theory and methodology [J]. *Annu Rev Clin Psychol.* 2009;5:1–25. <https://doi.org/10.1146/annurev.clinpsy.032408.153639>.
61. Trizano-Hermosilla I, Alvarado JM. Best Alternatives to Cronbach's Alpha Reliability in Realistic Conditions: Congeneric and Asymmetrical Measurements [J]. *Front Psychol.* 2016;7:769. <https://doi.org/10.3389/fpsyg.2016.00769>.
62. WILLIAM, REVELLERICHARD, E., et al. Coefficients Alpha, Beta, Omega, and the glb: Comments on Sijtsma [J]. *Psychometrika*, 2009. <https://doi.org/10.1007/s11336-008-9102-z>
63. Taylor JM. Coefficient Omega [J]. *J Nurs Educ.* 2021;60(8):429–30. <https://doi.org/10.3928/01484834-20210722-02>.
64. Cronbach L. Coefficient alpha and the internal structure of tests [J]. *Psychometrika*, 1951, (16–3). <http://hdl.handle.net/https://doi.org/10.1007/BF02310555>
65. Zaki R, Bulgiba A, Nordin N, et al. A systematic review of statistical methods used to test for reliability of medical instruments measuring continuous variables [J]. *Iran J Basic Med Sci.* 2013;16(6):803–7. <https://doi.org/10.22038/IJBMS.2013.998>.
66. Mokkink L B, Terwee C B, Patrick D L. The COSMIN checklist manual [J]. 2009. <http://www.mendeley.com/research/cosmin-checklist-manual/>
67. Terwee CB, Roorda LD, Knol DL, et al. Linking measurement error to minimal important change of patient-reported outcomes [J]. *J Clin Epidemiol.* 2009;62(10):1062–7. <https://doi.org/10.1016/j.jclinepi.2008.10.011>.
68. Mokkink LB, Terwee CB, Patrick DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes [J]. *J Clin Epidemiol.* 2010;63(7):737–45. <https://doi.org/10.1016/j.jclinepi.2010.02.006>.
69. Lohr KN, Aaronson NK, Alonso J, et al. Evaluating quality-of-life and health status instruments: development of scientific review criteria [J]. *Clin Ther.* 1996. [https://doi.org/10.1016/S0149-2918\(96\)80054-3](https://doi.org/10.1016/S0149-2918(96)80054-3).
70. Tarlov MHR. Individual-patient monitoring in clinical practice: are available health status surveys adequate? [J]. *Qual Life Res.* 1995;4(4):293–307. <https://doi.org/10.1007/BF01593882>.
71. Ferketich S. Focus on psychometrics. Aspects of item analysis [J]. *Research in Nursing & Health.* 1991;14(2). <https://doi.org/10.1002/nur.4770140211>
72. Díaz-Alonso J, Fernández-Feito A, João Forjaz M, et al. Contributions of nursing students during their clinical practice in primary care: Adaptation and validation of a scale [J]. *Nurse Educ Pract.* 2022;65:103496. <https://doi.org/10.1016/j.nepr.2022.103496>
73. Wang Y, Li L, Tan S, et al. Psychological stress and associated factors in caring for patients with delirium among intensive care unit nurses: A cross-sectional study [J]. *Aust Crit Care.* 2023;36(5):793–8. <https://doi.org/10.1016/j.aucc.2022.09.006>.
74. Özyürek P, Çevik C, Kılıç İ, et al. Effects of Day and Night Shifts on Stress, Anxiety, Quality of Life, and Oxidative Stress Parameters in Nurses [J]. *Flourance Nightingale J Nurs.* 2021;29(1):81–92. <https://doi.org/10.5152/fnjn.2021.19141>
75. Butler MG, Callahan CM. Human resource outsourcing: Market and operating performance effects of administrative HR functions [J]. *J Bus Res.* 2014. <https://doi.org/10.1016/j.jbusres.2012.09.026>.
76. Brighton LJ, Selman LE, Bristowe K, et al. Emotional labour in palliative and end-of-life care communication: A qualitative study with generalist palliative care providers [J]. *Patient Educ Couns.* 2019;102(3):494–502. <https://doi.org/10.1016/j.pec.2018.10.013>.
77. Aiken LH, Sermeus W, van den Heede K, et al. Patient safety, satisfaction, and quality of hospital care: cross sectional surveys of nurses and patients in 12 countries in Europe and the United States [J]. *BMJ.* 2012;344:e1717. <https://doi.org/10.1136/bmj.e1717>.
78. Visiers-Jiménez L, Suikkala A, Salminen L, et al. Clinical learning environment and graduating nursing students' competence: A multi-country cross-sectional study [J]. *Nurs Health Sci.* 2021;23(2):398–410. <https://doi.org/10.1111/nhs.12819>
79. Arkan B, Ordin Y, YILMAZ D. Undergraduate nursing students' experience related to their clinical learning environment and factors affecting to their clinical learning process [J]. *Nurse Educ Pract.* 2018;29:127–32. <https://doi.org/10.1016/j.nepr.2017.12.005>.
80. Ludin SM, Fathullah NM. Undergraduate nursing students' perceptions of the effectiveness of clinical teaching behaviours in Malaysia: A cross-sectional, correlational survey [J]. *Nurse Educ Today.* 2016;44:79–85. <https://doi.org/10.1016/j.nedt.2016.05.007>.
81. A. Alavi M S, N. Parvin M S. The View Point of Nursing and Midwifery Students about Characteristics of Effective Clinical Instructors [J]. *Scientific Journal of Hamadan Nursing & Midwifery Faculty*, 2012. <http://nmj.umsha.ac.ir/article-1-1032-en.html>
82. Johnson-Farmer B, Frenn M. Teaching Excellence: What Great Teachers Teach Us [J]. *J Prof Nurs.* 2009;25(5):267–72. <https://doi.org/10.1016/j.profnurs.2009.01.020>.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.