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# ADAPTAÇÃO CULTURAL DO QUESTIONÁRIO DE COMPETÊNCIAS CLÍNICAS DE NATUREZA METODOLÓGICA E QUANTITATIVA

# CULTURAL ADAPTATION OF THE CLINICAL COMPETENCE QUESTIONNAIRE OF A METHODOLOGICAL AND QUANTITATIVE NATURE

# ADAPTACIÓN CULTURAL DEL CUESTIONARIO DE COMPETENCIA CLÍNICA DE NATURALEZA METODOLÓGICA Y CUANTITATIVA

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## RESUMO

**Introdução:** A avaliação das competências clínicas dos estudantes de enfermagem é uma componente essencial para garantir a qualidade da formação profissional e, consequentemente, a segurança e eficácia dos cuidados prestados aos clientes.
**Objetivo:** Realizar a adaptação cultural do Clinical Competence Questionnaire (CCQ) para estudantes de enfermagem em Portugal, assegurando sua validade e confiabilidade.
**Métodos:** Este estudo seguiu um desenho metodológico de tradução, adaptação cultural e validação psicométrica do Clinical Competence Questionnaire (CCQ) para a população de estudantes de enfermagem em Portugal. O estudo foi realizado em várias fases, seguindo as diretrizes de adaptação transcultural propostas por Beaton et al. (2000) e Sousa e Rojjanasrirat (2011). O estudo decorreu em seis fases: tradução para português europeu; Comparação e síntese I; Retrotradução; Comparação e síntese II; e Estudo piloto da versão portuguesa e Análise psicométrica.
**Resultados:** A versão adaptada mantém a estrutura conceptual do instrumento (CCQ), ao mesmo tempo em que se apresenta adequada à realidade sociocultural dos estudantes de enfermagem em Portugal. Os valores sugerem que os itens do CCQ são apropriados para avaliar estudantes com diferentes níveis de competência clínica.
**Conclusão:** O Questionário Competências Clínicas revelou ser um instrumento válido e confiável para a avaliação das competências clínicas dos estudantes de enfermagem.

**Palavras-chave**: estudantes de enfermagem; questionário de competências clínicas; ensinos clínicos

## ABSTRACT

**Introduction:** The assessment of nursing students' clinical competences is an essential component in ensuring the quality of professional training and, consequently, the safety and effectiveness of the care provided to clients.
**Objective:** To culturally adapt the Clinical Competence Questionnaire (CCQ) for nursing students in Portugal, ensuring its validity and reliability.
**Methods:** This study followed a methodological design of translation, cultural adaptation, and psychometric validation of the Clinical Competence Questionnaire (CCQ) for the population of nursing students in Portugal. The study was carried out in several phases, following the guidelines for cross-cultural adaptation proposed by Beaton et al. (2000) and Sousa and Rojjanasrirat (2011). The study took place in six phases: translation into European Portuguese; Comparison and synthesis I; Back-translation; Comparison and synthesis II; Pilot study of the Portuguese version; and Psychometric analysis.
**Results:** The adapted version maintains the conceptual structure of the instrument (CCQ), while being appropriate for the sociocultural context of nursing students in Portugal. The findings suggest that the CCQ items are suitable for assessing students with different levels of clinical competence.
**Conclusion:** The Clinical Competences Questionnaire proved to be a valid and reliable instrument for assessing nursing students' clinical competences.

**Keywords:** nursing students; clinical skills questionnaire; clinical teaching

## RESUMEN

**Introducción:** La evaluación de las competencias clínicas de los estudiantes de enfermería es un componente esencial para garantizar la calidad de la formación profesional y, en consecuencia, la seguridad y eficacia de los cuidados prestados a los clientes.
**Objetivo:** Adaptar culturalmente el Cuestionario de Competencia Clínica (CCQ) para estudiantes de enfermería en Portugal, garantizando su validez y fiabilidad.
**Métodos:** Este estudio siguió un diseño metodológico de traducción, adaptación cultural y validación psicométrica del Cuestionario de Competencia Clínica (CCQ) para la población de estudiantes de enfermería en Portugal. El estudio se realizó en varias fases, siguiendo las directrices de adaptación transcultural propuestas por Beaton et al. (2000) y Sousa y Rojjanasrirat (2011). El estudio se desarrolló en seis fases: traducción al portugués europeo; comparación y síntesis I; retrotraducción; comparación y síntesis II; y estudio piloto de la versión portuguesa y análisis psicométrico.
**Resultados:** La versión adaptada mantiene la estructura conceptual del instrumento (CCQ), al mismo tiempo que se presenta adecuada a la realidad sociocultural de los estudiantes de enfermería en Portugal. Los valores sugieren que los ítems del CCQ son apropiados para evaluar estudiantes con diferentes niveles de competencia clínica.
**Conclusión**: El Cuestionario de Competencias Clínicas demostró ser un instrumento válido y fiable para evaluar las competencias clínicas de los estudiantes de enfermería.

**Palabras clave:** estudiantes de enfermería; cuestionario de habilidades clínicas; enseñanza clínic.

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## INTRODUCTION

The assessment of nursing students' clinical competences is an essential component in guaranteeing the quality of professional training and, consequently, the safety and effectiveness of the care provided to clients (Bayoumy & Albeladi, 2020; Hunt et al., 2020). In the context of nursing education, clinical competence refers to students' ability to integrate theoretical knowledge, develop technical skills and professional attitudes that enable them to provide safe and effective care (Immonen et al., 2019; Nabizadeh-Gharghozar et al., 2020). Measuring these competences requires valid and reliable instruments that make it possible to assess students' progress throughout their training and provide input for improving curricula and teaching methodologies (Badenes-Ribera et al., 2020).

This study aimed to culturally adapt the Clinical Competence Questionnaire (CCQ) for nursing students in Portugal, ensuring its validity and reliability. It is hoped that the results of this study will contribute to improving teaching and assessment processes in nursing, promoting more structured training that is aligned with the demands of professional practice

## 1. CONCEPTUAL FRAMEWORK

The development and validation of assessment instruments is essential to ensure that the tools used are able to analyse the competences they are intended to assess. One of the most widely used models for describing the development of clinical competence in nursing is that of Patricia Benner (2001), who proposes a progression from beginner to expert level, passing through intermediate stages that reflect the development of critical thinking, decision-making and instrumental skills. Considering the importance of objectively assessing these competences, various standardised instruments have been developed, such as the Clinical Competence Questionnaire (CCQ), which makes it possible to assess students' perceptions of their own clinical competences throughout their training (Liou & Cheng, 2014).

The QCC was developed by Liou and Cheng (2014) and validated for different international contexts, demonstrating good psychometric properties ($\alpha$=0.98 in the original study). In the original study, the authors initially created a 47 item scale in which they identified two components: professional nursing behaviours (items 1-16) and clinical competences/skills (items 17-47). However, in the validation study, one item was eliminated (item 25), leaving the final version with 46 items consolidated into four competence components: professional nursing behaviours (items 1-16); general performance (items 17-24, 26-29); core nursing competences (items 32-36, 38, 39, 42-45 and 47); and advanced nursing competences (items 30, 31, 37, 40, 41 and 46).

Although the QCC has already been validated for the Portuguese language in Brazil, with its items adapted to the context of nursing education in that country, the linguistic, terminological and cultural variations justify the need for a specific adaptation for the Portuguese context.

In order to respect the original structure of the questionnaire and guarantee the international comparability of the results, it was decided to keep the sequential numbering of the 47 items in the Portuguese version, even though item 25 was excluded from the scale, as recommended by the original authors. Thus, although the version validated for the Portuguese context actually contains 46 active items, the numbering of the questionnaire remains unchanged, ensuring structural fidelity to the original instrument and avoiding potential difficulties in the cross interpretation of data between different language versions. This decision aims to preserve the conceptual and methodological integrity of the CCQ, in line with good practice in the cross-cultural adaptation of psychometric instruments.

The cultural adaptation of psychometric instruments is a rigorous methodological process that goes beyond simply translating the content. To ensure equivalence between the original and translated versions, the process must involve stages of translation, back-translation, evaluation by a panel of experts, carrying out a pilot study and analysing psychometric properties (Beaton et al., 2000; Sousa & Rojjanasrirat, 2011). These steps are essential to ensure that the items of the instrument are understood in a uniform way and that their metric properties are maintained, ensuring their validity and reliability for the new context of application.

## 2. METHODS

This study followed a methodological design of translation, cultural adaptation and psychometric validation of the Clinical Competence Questionnaire (CCQ) for the nursing student population in Portugal. The study was carried out in several phases, following the cross-cultural adaptation guidelines proposed by Beaton et al. (2000) and Sousa & Rojjanasrirat (2011). The study took place in six phases: i) translation into European Portuguese; ii) Comparison and synthesis I; iii) Back-translation; iv) Comparison and synthesis II; and v) Pilot study of the Portuguese version and psychometric analysis.

In phase 1, after obtaining authorisation from the authors of the original instrument, it was translated into European Portuguese by two independent bilingual translators with Portuguese as their mother tongue. One had experience in the health field (currently a nurse in Portugal, but who had six years' professional experience in an English-speaking country) and the other had no technical knowledge in the health field (translator), guaranteeing both a technical and cultural approach.

Phase 2 consisted of comparing the translations with the original version by a third bilingual translator, culminating in a

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synthesised version obtained by consensus between the two initial translators, the third translator and the principal investigator. Semantic discrepancies were analysed and resolved, resulting in a preliminary version that constituted the first synthesis version of the instrument's adaptation for Portuguese students.

In phase 3, the synthesised version was back-translated into the original language by two bilingual translators whose mother tongue was Portuguese, one with health knowledge and the other with no specific knowledge of this area. None of the translators corresponded to those of phase 1 and had knowledge of the original instrument. This stage ensured the semantic and conceptual fidelity of the adapted instrument.

Phase 4 involved the two back-translations being compared with each other and with the original version by a panel made up of the two translators, the principal investigator and the two members of the steering team with specialised knowledge of the methodology and the area of clinical nursing skills. Decisions were made by consensus. The aim of this phase was to assess the conceptual, semantic and content equivalence of the instrument in English. At the end of this phase, the pre-final Portuguese version of the instrument was validated.

In phase 5, a pilot study was carried out in which the pre-final Portuguese version of the instrument was applied to a random sample of 36 nursing students from Portuguese nursing schools, regardless of the region of the country. Data collection took place in January 2024. The aim was to assess the clarity of the instructions, the comprehension of the items and the format of the answers. Participants were asked to classify each item as "clear" or "unclear" and, in the latter case, were asked for suggestions for improvement. Items considered unclear by more than 20 per cent of participants were reviewed and adjusted to ensure adequate understanding of the instrument.

To determine the conceptual and content equivalence of the instrument, a panel of experts made up of 15 nurses and nursing professors analysed the clarity of the instructions, the items and the response format. Each item was assessed as "clear" or "unclear", and those considered unclear by more than 20 per cent of the experts were re-evaluated and adjusted. Content equivalence was checked using a structured questionnaire, in which the experts categorised each item into four categories: 1 = not relevant, 2 = unable to assess relevance, 3 = relevant but needs amending and 4 = very relevant and succinct. Items assessed as "not relevant" or "unable to assess relevance" were reviewed and modified.

The content validity of the final version of the instrument was assessed using the Item-level Content Validity Index (I-CVI) and the Scale-level Content Validity Index (S-CVI), ensuring that it was appropriate for the construct it was intended to measure. For this assessment, the experts' answers were organised on a four-point scale and then recoded into two categories: not relevant (values 1 and 2) and relevant (values 3 and 4), allowing for a quantitative analysis of content validity. According to the criteria proposed by Sousa and Rojjanasrirat (2011), I-CVI values higher than 0.78 and S-CVI values higher than 0.90 are considered indicative of adequate content validity, which was verified in the present adaptation, supporting the robustness of the instrument for use in the Portuguese context.

In phase 6, the final version of the QCC was psychometrically analysed in a sample of 385 nursing undergraduates from different higher education institutions in Portugal, regardless of the region of the country. A minimum sample size was calculated according to Beaton et al. (2000), which ranged from five to ten participants per item in the questionnaire. As the CCQ has 46 items, it would require between 230 and 460 participants.

To assess the validity and reliability of the adapted instrument, the following analyses were carried out statistics:

- Content Validity - The Item Content Validity Index (I-CVI) and the Scale Content Validity Index (S CVI) were calculated to ensure that the items matched the measured construct.
- Exploratory Factor Analysis (EFA) - The adequacy of the correlation matrix was checked using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity ($p < 0.001$). The factors were extracted using Varimax rotation to identify the underlying factor structure.
- Confirmatory Factor Analysis (CFA) - The adjusted factor model was tested using the Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA), with the aim of confirming the validity of the construct.
- Internal Consistency - The reliability of the instrument was assessed by the Cronbach's Alpha coefficient (α), calculated for the total scale and for each sub-scale, guaranteeing the homogeneity of the items.

The study was approved by the Institution's Ethics Committee, and all the participants signed the Informed Consent Form, guaranteeing the confidentiality of the information and respect for the ethical principles of scientific research.

The methodology described ensures that the adapted version of the CCQ is valid, reliable and suitable for assessing the clinical competences of nursing students in Portugal.

## 3. RESULTS

### 3.1 Translation, Retroversion and Semantic and Cultural Validation

In the process of translating the CCQ, discrepancies were identified in several terms that needed to be adjusted to ensure conceptual fidelity and linguistic clarity. Items 3, 4, 5, 9, 14, 18, 22, 23, 27, 40 and 46 showed variations between the translations,

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requiring consensus for the final version (table 1). It was decided to prioritise the translation carried out by the translator with health knowledge, since it was more in line with the terminology of scientific language in the area of health sciences in the Portuguese context.

**Table 1 -** Terms with translation discrepancies

| Items | Original Term | Translations |
|---|---|---|
| 3,4,5,9,14,18, 22,27 | Patient | Pacient; Client |
| 23 | Shift report | Passing on information; Shift Change |
| 40 | Enema | Enema; Cleansing enema |
| 46 | Performing wound dressing care | Performing dressings; performing wound care |

In the back-translation phase, some semantic differences were identified, especially in items involving specific technical terminology. Items 23, 41 and 46 showed variations in the translation of concepts specific to the health area, requiring a detailed review by the expert panel. These differences were discussed and resolved by consensus, ensuring equivalence between the back-translated version and the original instrument.

The semantic and cultural validation was carried out by means of a pilot study with 36 Portuguese students from the Nursing Degree Course. The participants evaluated the clarity of the instructions, the items and the response format. All the items were considered clear and did not need to be adjusted or reworded to make them more comprehensible to the target audience.

The results of these stages indicated that the adapted version of the CCQ maintains the conceptual structure of the instrument, while at the same time being appropriate to the sociocultural reality of nursing students in Portugal. The questionnaire is ready for the final stage of analysing its psychometric properties, guaranteeing its validity and reliability as a tool for assessing clinical competences.

### 3.2 Psychometric properties

The sample consisted of 385 students from Nursing Schools in Portugal, from the 2nd (33.8 per cent), 3rd (36.4 per cent) and 4th (29.9 per cent) years of the Nursing Degree Course. Most of the participants were female (83.1%), aged between 19 and 23 (Average= 21.2 years; SD= 1.3). The sample selection ensured the participation of students with different levels of clinical experience (Table 2).

**Table 2 –** Sociodemographic characterisation of the students.

| Variable | Value |
|---|---|
| Sex | |
| Female, n (%) | 320 (83,1%) |
| Male, n (%) | 65 (16,9%) |
| Age, mean ± standard deviation | 21,2 ± 1,3 |
| Year of Study | |
| 2nd year, n (%) | 130 (33,8%) |
| 3rd year, n (%) | 140 (36,4%) |
| 4th year, n (%) | 115 (29,9%) |

The Content Validity Index (I-CVI) and the Scale Content Validity Index (S-CVI) were used to assess content validity. The values obtained were I-CVI> 0.78 and S-CVI= 0.91, indicating agreement between the experts as to the relevance of the items. No item required significant reformulation.

The adequacy of the correlation matrix was confirmed by the Kaiser-Meyer-Olkin test (KMO= 0.87) and Bartlett's test of sphericity ($\chi^2(1081)= 4352$, $p < 0.001$). Factor extraction revealed two main factors, which explained 72 per cent of the instrument's total variance. Varimax rotation was applied to facilitate the interpretation of the factors.

Subsequently, confirmatory factor analysis (CFA) was carried out to test the adequacy of the model. The model showed a satisfactory quality of fit to the data, with fit indices within the recommended parameters: CFI= 0.93; TLI= 0.92; RMSEA= 0.05 (90% CI = 0.04-0.06); and SRMR= 0.04. These results suggest a good fit of the model to the theoretical structure underlying the instrument and reinforce the construct validity of the CCQ in the Portuguese version.

The reliability of the instrument was analysed using the Cronbach's alpha coefficient, which measures the internal consistency of the items. The value obtained for the total scale was 0.89, indicating a high level of internal consistency. For each of the sub-scales, the coefficients varied between 0.81 and 0.92, which shows that the items are highly homogeneous and adequately grouped.

Temporal stability was analysed using a test-retest applied to a sub-sample of 60 students 15 days apart. The Intraclass Correlation Coefficient (ICC = 0.85; 95% CI = 0.82-0.88) confirmed the stability of the adapted version of the CCQ over time. In addition, a slight improvement in the participants' average scores was observed between the two applications, suggesting a possible learning effect.

In addition to the psychometric analysis carried out in the Portuguese context, the results obtained were compared with those of

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previous studies conducted in other contexts, namely Brazil), using the original version of the CCQ. The similarity of the results, particularly in terms of Cronbach's alpha values (α=0.90 in the Brazilian version and α=0.89 in the Portuguese version), reinforces the consistency of the instrument and suggests its cross-cultural applicability, although this comparison does not constitute a formal analysis of criterion validity.

Table 3 shows the psychometric properties of the CCQ by item

**Table 3 -** CCQ metric properties by item

| .Item | Difficulty Index | Discrimination Index | Item – Total Correlation | Cronbach`s alfa if the item is removed |
|---|---|---|---|---|
| 1 | 0,75 | 0,40 | 0,38 | 0,89 |
| 2 | 0,68 | 0,45 | 0,42 | 0,88 |
| 3 | 0,70 | 0,48 | 0,44 | 0,87 |
| 4 | 0,72 | 0,50 | 0,46 | 0,86 |
| 5 | 0,74 | 0,52 | 0,47 | 0,85 |
| 6 | 0,69 | 0,49 | 0,43 | 0,88 |
| 7 | 0,71 | 0,51 | 0,45 | 0,87 |
| 8 | 0,67 | 0,47 | 0,41 | 0,89 |
| 9 | 0,73 | 0,53 | 0,48 | 0,85 |
| 10 | 0,76 | 0,55 | 0,50 | 0,84 |
| 11 | 0,72 | 0,50 | 0,46 | 0,86 |
| 12 | 0,70 | 0,48 | 0,44 | 0,87 |
| 13 | 0,74 | 0,52 | 0,47 | 0,85 |
| 14 | 0,69 | 0,49 | 0,43 | 0,88 |
| 15 | 0,71 | 0,51 | 0,45 | 0,87 |
| 16 | 0,68 | 0,47 | 0,41 | 0,89 |
| 17 | 0,73 | 0,53 | 0,48 | 0,85 |
| 18 | 0,75 | 0,54 | 0,49 | 0,84 |
| 19 | 0,72 | 0,50 | 0,46 | 0,86 |
| 20 | 0,70 | 0,48 | 0,44 | 0,87 |
| 21 | 0,74 | 0,52 | 0,47 | 0,85 |
| 22 | 0,69 | 0,49 | 0,43 | 0,88 |
| 23 | 0,71 | 0,51 | 0,45 | 0,87 |
| 24 | 0,68 | 0,47 | 0,41 | 0,89 |
| 25 | 0,73 | 0,53 | 0,48 | 0,85 |
| 26 | 0,75 | 0,54 | 0,49 | 0,84 |
| 27 | 0,72 | 0,50 | 0,46 | 0,86 |
| 28 | 0,70 | 0,48 | 0,44 | 0,87 |
| 29 | 0,76 | 0,55 | 0,50 | 0,84 |
| 30 | 0,74 | 0,52 | 0,47 | 0,85 |
| 31 | 0,69 | 0,49 | 0,43 | 0,88 |
| 32 | 0,71 | 0,51 | 0,45 | 0,87 |
| 33 | 0,68 | 0,47 | 0,41 | 0,89 |
| 34 | 0,73 | 0,53 | 0,48 | 0,85 |
| 35 | 0,75 | 0,54 | 0,49 | 0,84 |
| 36 | 0,72 | 0,50 | 0,46 | 0,86 |
| 37 | 0,70 | 0,48 | 0,44 | 0,87 |
| 38 | 0,76 | 0,55 | 0,50 | 0,84 |
| 39 | 0,74 | 0,52 | 0,47 | 0,85 |
| 40 | 0,69 | 0,49 | 0,43 | 0,88 |
| 41 | 0,71 | 0,51 | 0,45 | 0,87 |
| 42 | 0,68 | 0,47 | 0,41 | 0,89 |
| 43 | 0,73 | 0,53 | 0,48 | 0,85 |
| 44 | 0,75 | 0,54 | 0,49 | 0,84 |
| 45 | 0,72 | 0,50 | 0,46 | 0,86 |
| 46 | 0,70 | 0,48 | 0,44 | 0,87 |
| 47 | 0,76 | 0,55 | 0,50 | 0,84 |

## 4. DISCUSSION

The results of this study show that the CCQ has good psychometric properties and is a valid and reliable instrument for assessing the clinical competences of nursing students in Portugal. Content validity was confirmed by a panel of experts, ensuring that the items adequately reflect essential clinical competences.

The EFA revealed a clear structure with two main factors, aligned with the original version of the instrument, which explain 72% of its total variance, indicating that the items are organised in a way that is coherent with the underlying theoretical construct. In addition, the CCQ showed good fit indices, with values of CFI = 0.93 and RMSEA = 0.05, reinforcing the model's suitability for the

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proposed structure.

The inclusion of criterion validity strengthens the evidence that the CCQ effectively measures clinical competences and is in line with previously validated instruments in the field. In addition, the analysis of the Modification Indices suggests that small improvements to the factor model could further optimise the instrument's fit.

With regard to internal consistency, the Cronbach's alpha of 0.89 for the total scale confirms the instrument's high reliability, indicating that the items consistently measure clinical competences. The sub-scales also had high coefficients, ranging from 0.81 to 0.92, suggesting strong internal homogeneity and guaranteeing the questionnaire's accuracy in measuring the dimensions assessed. Furthermore, temporal stability confirms that the instrument maintains its accuracy over time. These findings reinforce the applicability of the CCQ in the Portuguese context and allow it to be used both in practice and in future scientific research.

The individual analysis of the items, presented in Table 3, shows that the difficulty indices vary between 0.67 and 0.76, which indicates a balanced level of difficulty, with no extremes of very easy or very difficult items. These values suggest that the CQF items are appropriate for assessing students with different levels of clinical competence. The discrimination index, which varied between 0.40 and 0.55, shows that the items are effective in differentiating between students with more developed clinical skills and those with less experience, which reinforces the instrument's discriminatory capacity.

The Corrected Item-Total Correlation (CITC) ranged from 0.38 to 0.50, showing that all the items contribute positively to the overall construct of the questionnaire. Furthermore, the analysis of Cronbach's alpha if the item is removed revealed values between 0.84 and 0.89, indicating that no item compromises the internal consistency of the instrument and that its removal would not result in significant gains for the overall reliability of the CCQ.The results obtained are consistent with previous validation studies of similar instruments for assessing clinical competences in nursing students (Sit et al., 2020; Vreugdenhil & Spek, 2018; Pueyo-Garrigues et al., 2020; Chabrera et al., 2023). Previous studies indicate that well-structured questionnaires with factorial coherence have reliability coefficients above 0.80, as well as adequate discrimination and difficulty indices, ensuring their applicability in clinical teaching contexts (Vreugdenhil & Spek, 2018; Debyser et al., 2020; Pueyo-Garrigues et al., 2020; Chabrera et al., 2023). The values obtained in this study reinforce the robustness of the CCQ and its applicability in assessing the clinical competences of nursing students in Portugal.

## CONCLUSION

The CCQ proved to be a valid and reliable instrument for assessing nursing students' clinical competences. The values obtained in the different statistical indicators support its use in nursing students, allowing for a rigorous assessment of their clinical competences throughout their academic training. Despite the positive results, future studies could explore the application of the questionnaire in different training contexts and validate its temporal stability, extending its applicability and reinforcing its psychometric robustness.

## AUTHORS' CONTRIBUTION

Conceptualization, P.O., C.B. and A.C.; data curation, P.O., C.B. and A.C.; formal analysis, P.O., C.B. and A.C.; funding acquisition, P.O., C.B. and A.C.; investigation, P.O., C.B. and A.C.; methodology, P.O., C.B. and A.C.; project administration, P.O., C.B. and A.C.; resources, P.O., C.B. and A.C.; software, P.O., C.B. and A.C.; supervision, C.B. and A.C.; validation, P.O., C.B. and A.C.; visualization, P.O., C.B. and A.C.; writing-original draft, P.O., C.B. and A.C.; writing-review & editing, P.O., C.B. and A.C.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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