

Psychometric properties of an instrument for assessing patient safety teaching and learning in higher education*

HIGHLIGHTS

1. A novel instrument for assessing patient safety teaching and learning.
2. High content validity among expert judges and the target audience.
3. Psychometric properties with excellent model fit indices.
4. The instrument can identify gaps in Nursing Higher Education.

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ABSTRACT

Objective: To develop and evaluate the psychometric properties of an instrument for assessing teaching and learning strategies on patient safety in the context of Nursing Higher Education. **Method:** Methodological study conducted between February and April 2025, developed in three stages: literature review, instrument development, and psychometric validation. Content validity was assessed by 10 experts and 30 students. The instrument was administered to 195 students from five federal universities. The Content Validity Coefficient, Exploratory Factor Analysis, Composite Reliability, the H index, and item discrimination parameters based on Item Response Theory were used. **Results:** The review identified 19 publications that supported the instrument's development. The Content Validity Coefficient was 0.91 (experts) and 0.93 (target audience). Factor analysis showed satisfactory factor loadings and high reliability. **Conclusion:** The instrument demonstrated validity, a consistent factor structure, and high reliability, making it suitable for assessing teaching and learning strategies for patient safety in Higher Education.

DESCRIPTORS: Nursing; Validation Study; Teaching; Learning; Patient Safety.

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INTRODUCTION

Since the beginning of institutionalized education in Brazil, the banking model of education has predominated, characterized by a passive process in which students merely receive information while educators are regarded as the sole holders of knowledge. However, with social, economic, and cultural changes, students have assumed a more active and transformative role, becoming co-authors of their own education and driving important reforms in the traditional educational model¹.

In Higher Education in health, particularly in Nursing, certain topics should be addressed transversally, including Patient Safety (PS). PS encompasses actions that strengthen cultures, processes, and environments capable of reducing risks, preventing harm, and minimizing errors. The way healthcare professionals understand and apply PS depends directly on the quality of their education, reflecting their commitment to delivering safe and effective care².

The teaching and learning process is dynamic and requires collaboration between students and educators in environments that foster knowledge construction, critical thinking, and decision-making. The World Health Organization (WHO) emphasizes that integrating PS into undergraduate education is essential for ensuring safe care. Therefore, teaching strategies should be continuously evaluated and adapted to students' realities, promoting a culture of safety, critical reflection, and the practical application of concepts³.

Teaching and learning strategies are methods used to facilitate the understanding, retention, and application of knowledge, such as PS in nursing education. A scoping review identified the main strategies as clinical simulation, thematic courses, competency-based assessment, the lecture method, workshops, the Objective Structured Clinical Examination (OSCE), and the flipped classroom. When well planned, these approaches promoted the development of practical skills and safe attitudes among future healthcare professionals⁴.

Despite its importance, PS is still incorporated into curricula in a fragmented manner and is often poorly integrated with clinical practice settings. In general, it is taught only in practical courses or during final clinical placements, which may limit students' education. Nursing students must have access, from the beginning of their undergraduate education, to content, practices, and methods that foster early engagement with this topic⁵.

Understanding which strategies are offered during undergraduate education and how students perceive them can contribute to improving the educational process. To achieve this, validated instruments are needed to identify the strategies used, their frequency, and students' perceptions. However, the available instruments generally assess isolated methodologies, such as 3D software, case studies, or educational materials, revealing a gap in the integrated assessment of patient safety-specific teaching strategies⁶⁻⁸.

Given this context, this study aimed to develop and evaluate the psychometric properties of an instrument for assessing teaching and learning strategies on PS in the context of Nursing Higher Education.

METHOD

This was a descriptive methodological study conducted in three stages: literature review, instrument development, and validation of its psychometric properties. The

study was guided by the Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN)⁹.

The literature review consisted of a scoping review⁵ conducted to map teaching and learning strategies related to PS in health programs. The studies included in the scoping review supported the development of the instrument and identified the strategies most commonly used by educational institutions.

The instrument was developed by the researchers using a word processor (Microsoft Word®), without the use of artificial intelligence tools or graphic design resources. It initially consisted of 29 items distributed into two categories: frequency of students' exposure to patient safety topics and teaching and learning strategies used to deliver the content.

Data collection was carried out between February and April 2025. For content validation, ten expert judges were intentionally selected, as recommended in the literature. Participants were recruited by convenience sampling using the snowball sampling technique and by consulting curricula available on the Lattes Platform of the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq)¹⁰⁻¹¹.

The inclusion criteria were professional or teaching experience in patient safety in Nursing Higher Education and completion of a graduate degree. Professionals with fewer than five years since graduation were excluded, as practical, teaching, or managerial experience was considered necessary to identify inconsistencies, ambiguities, and lack of clarity in the instrument.

The invitation was sent to the expert judges by email and included the study objectives and procedures, together with an online form containing the Free and Informed Consent Term (FICT) and a questionnaire for participant characterization. After agreeing to participate, they received, via Google Forms, the instrument to be evaluated along with detailed instructions. Each item was assessed using a 5-point Likert scale ranging from 1 (not at all clear) to 5 (very clear), with additional space provided for suggestions.

The responses were organized using Microsoft Excel® and analyzed according to the assigned scores and suggestions. As the first round yielded satisfactory results, the Delphi technique was not required to achieve consensus among the expert judges.

Content validation with the target audience aimed to assess the clarity of the language. Thirty nursing students from three public universities located in the Zona da Mata region of Minas Gerais, the state of Rio de Janeiro, and Três Lagoas (MS) participated. These students did not take part in the instrument administration stage, serving only as the target audience for validation purposes, as recommended in the literature¹².

The inclusion criteria were being regularly enrolled in the nursing program, aged 18 years or older, and having completed at least the fourth semester, thereby ensuring familiarity with the content being assessed. Students with irregular enrollment status, those transferring, re-entering the program, or with suspended enrollment were excluded, as these conditions could hinder the accurate identification of their academic semester and compromise the characterization of the target audience.

The instrument was administered to 195 students from five other federal universities. The institutions were selected by convenience sampling and were located in different Brazilian states: two in Minas Gerais, one in Mato Grosso do Sul, one in Rio de Janeiro, and one in Goiás.

Data collection combined face-to-face and remote strategies. For the face-to-face approach, instructors allocated class time for instrument administration after the study had been presented and instructions for completing the questionnaire had been

provided. For the remote approach, participant recruitment was conducted in partnership with university administrators, program coordinators, and student representatives through email invitations and announcements on institutional social media.

There was no sample loss: the online questionnaire required responses to all items, and during face-to-face data collection, the completed questionnaires were checked at the time of submission by an undergraduate nursing student and a master's student. All responses were considered valid for analysis.

The Content Validity Coefficient (CVC) was used to analyze the responses provided by the expert judges and the target audience. The CVC considers three main criteria: language clarity, practical relevance, and theoretical relevance. It was calculated based on the mean scores assigned on the Likert scale, divided by the maximum possible score, with adjustment for bias. A CVC value greater than 0.80 was considered satisfactory.

Exploratory Factor Analysis (EFA) was performed to evaluate the factor structure of the proposed instrument. Initially, sample adequacy was assessed using Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) index, considering KMO values above 0.60 and statistical significance ($p < 0.05$) in Bartlett's test as satisfactory.

The analysis was performed using a polychoric correlation matrix and the Robust Diagonally Weighted Least Squares (RDWLS) extraction method¹³. The number of factors to be retained was determined using Parallel Analysis with random permutation of the observed data¹⁴, and Robust Promin rotation¹⁵ was applied. A factor loading cutoff of 0.30 was adopted.

The model fit was evaluated using the Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). According to the literature¹⁶, RMSEA values should be below 0.08, with the confidence interval not reaching 0.10, while CFI and TLI values should exceed 0.90 and, preferably, 0.95.

Factor stability was assessed using the H index¹⁷. This index evaluates how well a set of items represents a common factor. H values range from 0 to 1. High H values (> 0.80) indicate a well-defined latent variable that is more likely to remain stable across different studies. Low H values suggest a poorly defined latent variable that is likely to be unstable across different studies.

Furthermore, the internal consistency of the factors was assessed by calculating composite reliability, with values above 0.70 considered satisfactory. Item discrimination parameters were also analyzed using Item Response Theory (IRT), allowing the assessment of each item's ability to distinguish individuals with different levels of the latent trait measured by the instrument, as well as the precision and adequacy of each threshold for the response scale categories¹⁸.

This study was approved by the Research Ethics Committee (REC) under approval number 7.415.164. All participants had access to the FICT, which they signed either in person or electronically through the online version before participating in the study.

RESULTS

The scoping review identified 19 studies on teaching and learning strategies for patient safety in higher education. The findings revealed the use of different teaching and learning strategies, particularly clinical simulation, patient safety courses, lectures, workshops, the OSCE, the flipped classroom, case-based assessment, questionnaires, role-playing, and educational games. These findings supported the development of the items related to the teaching and learning strategies included in the instrument.

During the instrument development process, 29 items were initially created and organized into two distinct categories. The first category was designed to identify the most frequently addressed patient safety topics, as well as the frequency with which students had been exposed to these topics throughout their education. The second category focused on the teaching and learning strategies used to address the topic. At the end of this stage, the instrument was entitled: Instrument for Assessing Teaching and Learning Strategies on Patient Safety in Nursing Higher Education.

All expert judges were female, with ages ranging from 36 to 69 years, with a mean age of 49.9. The mean length of professional experience was 25.8 years, ranging from 10 to 46 years. All reported previous experience in the field of patient safety. Regarding academic qualifications, four (40%) held a specialization degree, three (30%) held a master's degree, and three (30%) held a doctoral degree. Regarding their professional roles, five (50%) worked in healthcare management positions, such as nursing management or departmental coordination, four (40%) were involved in teaching activities, and one (10%) worked in direct patient care.

During the validation process, revisions were made to the instrument. One item was removed because of difficulties in illustrating the concept to students. Moreover, the wording of 15 items was revised to improve clarity and comprehension, including grammatical changes such as replacing prepositions and sentence subjects. Explanatory notes were added to nine items to clarify key concepts that might raise questions, including complementary definitions of teaching and learning strategies.

The first version of the instrument was evaluated by the expert judges, achieving a Content Validity Coefficient (CVC) of 0.91 (Table 1). The full instrument can be accessed at the following link <https://drive.google.com/file/d/1nzf6bAZjioNXH-aokdTVwEY-4NkqBB1z/view?usp=sharing>

Table 1. Content validation conducted by expert judges based on the criteria of clarity, pertinence, and relevance. Juiz de Fora, MG, Brazil, 2025

(continue)

Instrument items	Content Validity Coefficient		
	Language clarity	Practical relevance	Theoretical relevance
Category 1 - Topics in patient safety and their frequency			
Item 1	0.86	0.90	0.90
Item 2	0.86	0.90	0.90
Item 3	0.88	0.92	0.92
Item 4	0.94	0.98	0.98
Item 5	0.86	1.00	0.92
Item 6	1.00	1.00	1.00
Item 7	0.94	0.94	0.98
Item 8	0.92	0.92	0.92
Item 9	0.84	0.90	0.9
Item 10	0.98	0.96	1.00
Item 11	0.96	0.96	0.96
Item 12	0.96	0.90	0.92
Item 13	0.82	0.88	0.92
Item 14	0.90	0.92	0.92
Item 15	0.92	0.92	0.96
Item 16	0.90	0.94	0.98

Table 1. Content validation conducted by expert judges based on the criteria of clarity, pertinence, and relevance. Juiz de Fora, MG, Brazil, 2025

(conclusion)

Instrument items	Content Validity Coefficient		
	Language clarity	Practical relevance	Theoretical relevance
Item 17	0.86	0.92	0.92
Item 18	0.84	0.88	0.88
Category 2- Teaching and learning strategies used to address the topic			
Item 19	0.98	0.98	1.00
Item 20	0.80	0.90	0.90
Item 21	0.98	0.98	1.00
Item 22	1.00	1.00	1.00
Item 23	0.84	0.90	0.92
Item 24	0.86	0.86	0.86
Item 25	0.90	0.88	0.94
Item 26	0.88	0.84	0.90
Item 27	0.90	0.94	0.98
Item 28	0.98	0.98	0.96

Source: The authors (2025).

The instrument's content validation regarding language clarity was conducted with the participation of 30 nursing students, who represented the target audience. The participants had a mean age of 25 years (SD = 7.6), ranging from 19 to 45 years. Most participants were female (25; 83.3%) and were primarily enrolled in the fifth semester of the program, followed by the eighth and sixth semesters. The data obtained were used to calculate the CVC, which yielded a mean value of 0.93.

Bartlett's test of sphericity (2116.5, df = 378, $p < 0.001$) and KMO test (0.84) were performed, and the results supported the factorability of the item correlation matrix. Parallel analysis suggested that two factors were the most representative of the data, as they explained a greater percentage of variance than the randomly generated data (Table 2).

Table 2. Study Parallel Analysis results. Juiz de Fora, MG, Brazil, 2025

(continue)

Factors	Percentage of variance explained by the observed data	Percentage of variance explained by the random data (95% CI [†])
Factor 1	50.19	8.57
Factor 2	10.96	7.73
Factor 3	5.31	7.23
Factor 4	3.97	6.70
Factor 5	3.54	6.33
Factor 6	3.13	5.98
Factor 7	2.87	5.67
Factor 8	2.54	5.39
Factor 9	2.20	5.08
Factor 10	1.97	4.80

Table 2. Study Parallel Analysis results. Juiz de Fora, MG, Brazil, 2025

(conclusion)

Factors	Percentage of variance explained by the observed data	Percentage of variance explained by the random data (95% CI [†])
Factor 11	1.73	4.54
Factor 12	1.57	4.27
Factor 13	1.51	3.99
Factor 14	1.39	3.76
Factor 15	1.22	3.56
Factor 16	1.01	3.30
Factor 17	0.86	3.07
Factor 18	0.72	2.85
Factor 19	0.68	2.64
Factor 20	0.61	2.41
Factor 21	0.58	2.19
Factor 22	0.48	1.95
Factor 23	0.40	1.72
Factor 24	0.31	1.48
Factor 25	0.14	1.21
Factor 26	0.08	0.93
Factor 27	0.02	0.65

Note: [†]CI = Confidence interval.

Source: The authors (2025).

The analysis of factor loadings demonstrated a clear two-factor structure. Factor 1 comprised the items related to patient safety topics addressed during undergraduate education, with factor loadings ranging from 0.51 to 0.97. Factor 2 comprised the items related to the teaching and learning strategies used to address the topic, with factor loadings ranging from 0.42 to 0.80 (Table 3).

Table 3. Factor loadings for each item in the questionnaire. Juiz de Fora, MG, Brazil, 2025

(continue)

Questions	Factor 1	Factor 2
Item 1	0.53	-0.10
Item 2	0.97	-0.49
Item 3	0.91	-0.29
Item 4	0.95	-0.33
Item 5	0.58	0.19
Item 6	0.91	-0.38
Item 7	0.87	-0.19
Item 8	0.69	0.04
Item 9	0.83	-0.08
Item 10	0.90	-0.25
Item 11	0.86	-0.07

Table 3. Factor loadings for each item in the questionnaire. Juiz de Fora, MG, Brazil, 2025

(conclusion)

Questions	Factor 1	Factor 2
Item 12	0.82	0.08
Item 13	0.78	0.14
Item 14	0.62	0.26
Item 15	0.73	0.16
Item 16	0.75	0.16
Item 17	0.77	0.19
Item 18	0.51	0.33
Item 19	0.24	0.42
Item 20	0.03	0.73
Item 21	0.50	0.15
Item 22	0.25	0.54
Item 23	0.37	0.28
Item 24	0.27	0.59
Item 25	0.26	0.63
Item 26	0.28	0.54
Item 27	0.11	0.80
Item 28	0.17	0.63

Source: The authors (2025).

The composite reliability analysis demonstrated adequate internal consistency for both factors (0.96 and 0.83), with values exceeding the recommended minimum of 0.70. In addition, the high replicability indices indicated that the identified factor structure has high stability and is likely to be replicated in future studies (Table 4).

Table 4. Composite Reliability Indices. Juiz de Fora, MG, Brazil, 2025

Assessed items	Factor 1	Factor 2
Composite reliability	0.96	0.83
H-latent	0.97	0.92
H-observed	1.00	0.92

Source: The authors (2025).

The items showed adequate factor loadings, with high loadings on their respective factors. Overall, four items exhibited cross-loadings greater than 0.30 on more than one factor, namely items 2, 4, 6, and 18.

The instrument demonstrated excellent model fit, as indicated by the robust fit indices: $\chi^2(df = 323) = 342.30$; $p = 0.220$; RMSEA = 0.018 (90% CI: 0.010-0.050); CFI = 0.999; TLI = 0.999; GFI = 1.000; and AGFI = 1.000, indicating an adequate and near-perfect fit.

IRT analysis demonstrated adequate item discrimination. The highest discrimination parameters were observed for the items related to patient identification (1.74), safety in medication prescribing, use, and administration (1.71), and factors influencing patient safety (1.68) in Factor 1, as well as for the role-playing item (1.56) in Factor 2. These

findings indicate that these items were particularly sensitive in distinguishing students with different levels of exposure to the content and teaching and learning strategies assessed (Table 5).

Table 5. Item discrimination parameters. Juiz de Fora, MG, Brazil, 2025

Items	Factor 1	Factor 2
Item 1	0.60	-0.11
Item 2	1.74	-0.88
Item 3	1.51	-0.48
Item 4	1.71	-0.59
Item 5	0.82	0.27
Item 6	1.44	-0.60
Item 7	1.41	-0.31
Item 8	0.98	0.05
Item 9	1.37	-0.13
Item 10	1.50	-0.42
Item 11	1.53	-0.12
Item 12	1.65	0.16
Item 13	1.53	0.27
Item 14	1.00	0.42
Item 15	1.27	0.27
Item 16	1.42	0.30
Item 17	1.68	0.42
Item 18	0.74	0.48
Item 19	0.29	0.51
Item 20	0.05	1.00
Item 21	0.62	0.18
Item 22	0.36	0.75
Item 23	0.46	0.34
Item 24	0.42	0.91
Item 25	0.43	1.04
Item 26	0.42	0.79
Item 27	0.21	1.56
Item 28	0.24	0.91

Source: The authors (2025).

DISCUSSION

This study developed and identified psychometric validity evidence for an instrument to assess teaching and learning strategies on patient safety in Nursing Higher Education. The findings demonstrated that both content validity and internal reliability indices reached satisfactory levels, confirming the instrument's adequacy. Its application makes it possible to map the frequency with which students are exposed to fundamental patient safety topics, as well as the teaching and learning strategies used to address this content within the context of academic education¹⁹⁻²⁰.

This study's relevance lies in the gap identified in the literature regarding the availability of validated instruments capable of mapping the frequency with which nursing students are exposed to patient safety-related content and identifying the teaching and learning strategies most frequently used to address this topic in the classroom. Since health education is a complex and dynamic process that influences decision-making and the development of competencies related to safe care, there is a clear need to incorporate innovative educational methodologies, teaching and learning strategies, educational technologies, and contextualized learning environments²¹⁻²².

Evidence supports the positive effects of active teaching and learning strategies on the development of technical skills, the consolidation of theoretical knowledge, and the promotion of critical decision-making abilities. Furthermore, these strategies contribute to creating a safe educational environment in which students feel comfortable recognizing and reflecting on errors, thereby promoting meaningful learning and better preparation for professional practice^{4,23-24}.

In this context, the use of valid and reliable instruments is essential for identifying gaps in the teaching and learning process of nursing programs and guiding improvement strategies. It is estimated that 55% of nurses are at risk of committing errors associated with patient safety failures during the first five years after graduation. This finding highlights the urgent need to review how patient safety competencies have been addressed during academic education in order to identify those that are lacking and those that require further reinforcement^{21,25}.

The careful selection of evaluators, based on qualitative and quantitative criteria combined with professional experience in patient safety-related fields and strong academic qualifications, was essential to ensure a critical and expert assessment of the proposed items. This strategy contributed to the convergence of opinions, the elimination of ambiguities, and the enhancement of the instrument's reliability and accuracy²⁶.

During the validation stage with the target audience, consisting of undergraduate nursing students, the participants confirmed the clarity, relevance, and appropriateness of the instrument's items. This stage was essential because students undergo experiences throughout their undergraduate education that shape and influence their professional development. Furthermore, it made it possible to verify whether the instrument, although validated by experts, was understandable and appropriate in terms of language and context for the population for whom it was intended¹².

In this study, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin index indicated the adequacy of the correlation matrix among the items, thereby supporting the use of EFA. This analysis made it possible to evaluate the instrument's structural validity, assist in defining the factors, and identify relationships among the variables. Even for instruments developed for different purposes, the literature consistently reports the use of EFA as an effective method for identifying robust factor structures²⁷.

The findings demonstrated that the factor model showed high reliability and excellent replicability of the factor scores. Composite reliability ranged from 0.827 to 0.963 and was considered excellent for Factor 1, which assesses the frequency with which PS-related content was taught during undergraduate education, and adequate for Factor 2, which concerns the teaching and learning strategies used by instructors. The H-latent and H-observed indices also remained high, reinforcing the stability of the factor structure and its potential for replication in future studies²⁸.

The association of certain items with more than one dimension of the instrument may be explained by the central role of these concepts in patient safety. Topics related to incident prevention, risk identification, and the promotion of quality of care permeate different aspects of health education and are often addressed in an integrated manner

throughout undergraduate education. This characteristic is consistent with the Patient Safety Curriculum Guide, which recommends integrating patient safety content into health curricula to promote the development of essential competencies for safe practice^{20,29}.

From another perspective, the confirmatory model demonstrated excellent fit, with values close to or equal to 1.0 and an RMSEA of 0.018. The construct evaluated showed strong internal consistency and a well-defined conceptual structure, supporting its reliable application across different contexts. The use of this instrument by higher education institutions may assist in identifying curricular gaps, planning pedagogical strategies, and promoting continuous improvements in patient safety education³⁰.

This study's limitations include the scarcity of methodological research on this topic and the absence of previously validated instruments with a similar purpose. This limited the possibility of comparing both the psychometric findings and the instrument's structure with the evidence available in the literature. Nevertheless, this scientific gap reinforces the study's original contribution by proposing and validating a specific instrument for assessing teaching and learning strategies on patient safety in the context of nursing education.

CONCLUSION

This study developed and identified evidence of the validity of the Instrument for Assessing Teaching and Learning Strategies on Patient Safety in Nursing Higher Education. The findings demonstrated satisfactory psychometric properties, with high reliability, a robust factor structure, and excellent model fit, indicating that the instrument is valid and reliable for the context in which it was developed. It represents a valuable resource to support decision-making by faculty members, program coordinators, and educational administrators, fostering reflection on health education and promoting the development of educational practices that are more closely aligned with the principles of safe care.

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