Research Square

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Assessing the Satisfaction with knowledge transferring in Clinical Simulation: Development of the Clinical Simulation Learning Satisfaction Scale

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Abstract

Background:

Clinical simulation is a widely adopted methodology in nursing education that allows students to develop and consolidate both their technical skills and self-confidence in a controlled environment. Numerous studies have consistently reported high levels of student satisfaction with the use of clinical simulation, highlighting its effectiveness as a teaching and learning strategy.

Aim: This study aimed to develop and validate a scale to assess nursing students' satisfaction with the knowledge acquired through clinical simulation and its application in real healthcare settings.

Desing: This study was conducted at two spanish universities during the 2023-24 academic year with the objective of designing and validating a rating scale.

A total of 192 nursing students from both universities who had participated in clinical simulation sessions and had completed practical nursing placements were included in the study.

Methodology: The validation process consisted of three phases: (1) development of the questionnaire using the Delphi method with expert input, (2) a pilot test with a sample of 20 students, and (3) final validation using statistical techniques including Aiken's V, Cronbach's alpha, and exploratory factor analysis.

Results: The final instrument consisted of eight items and three open-ended questions. Construct validity was supported by an Aiken's V of 0.9. Internal consistency was high (Cronbach's α = 0.86), and exploratory factor analysis revealed a single factor explaining 46% of the variance.

Conclusions: the Clinical Simulation Learning Satisfaction Scale is an efficacious and straightforward questionnaire that can be employed to assess student satisfaction with the application of knowledge acquired in clinical simulation.

INTRODUCTION

Advanced Clinical Simulation (ACS) is an immersive educational methodology in which the student actively engage as protagonists in realistic clinical scenarios. The effectiveness of this approach depends on several factors, including the realism of the simulation environment, the expertise of the facilitators, and the students' ability to immerse themselves in the scenario[1].

The increasing availability of high-fidelity anatomical models and the growing specialization of simulation instructors have enhanced the realism and educational value of ACS. This immersive experience often leads students to enter a state of deep engagement, as defined by Csikszentmihaly as flow[2].

Student immersion in simulation is influenced by their level of engagement, which can be understood through the grounded theory proposed by Brown and Cairns, consisting of three stages: engagement, absorption, and total immersion[3], to better understand and optimize these immersive experiences, Ko et al. developed and validated a scale to measure the degree of immersion in clinical simulation[4].

Given that nursing is a highly practical discipline, ACS provides a safe and effective environment for students to develop technical skills while ensuring patient safety. Moreover, it promotes collaborative learning and enhances student satisfaction and involvement[5, 6].

Student satisfaction is a key factor in the effectiveness of learning, as motivation and engagement are essential for achieving meaningful immersion[5, 7].

Nursing student satisfaction can be understood as the degree to which students can provide maximum service while maintaining a positive, patient-centered attitude and demonstrating their teamwork skills in multidimensional healthcare settings[8, 9].

Student satisfaction plays a crucial role in learning outcomes in advanced clinical simulation[10]. When students perceive simulation as a positive and motivating experience, their level of engagement and knowledge retention increases significantly, and

it promotes the acquisition of practical skills essential for their professional performance[11]. ACS can become a tool that improves student satisfaction provided it is provided with quality tools such as equipment, environment, teaching experience, etc. [12].

While several scales exist to measure satisfaction with simulation itself, this study focuses on satisfaction during the clinical internship period when students apply the competencies acquired through ACS in real patient care settings. This approach emphasizes the perceived impact of simulation on clinical performance, rather than satisfaction with the simulation experience alone.

Previous research has demonstrated the effectiveness of ACS in improving knowledge, self-confidence, self-efficacy, and satisfaction among nursing students[13–15].

Our study does not simply describe clinical simulation as a training tool but rather focuses specifically on the transfer of knowledge acquired during simulation to real-world clinical practice. This distinction is fundamental, as transfer is the most robust indicator of educational effectiveness, being a widely recognized construct in educational sciences and healthcare training. In our work, we analyze how participants apply the skills developed in simulation to real-life situations, also identifying the factors that facilitate or hinder this transfer.

This scale can be used to evaluate simulation programs, guide curriculum improvement, compare methodologies, monitor learning progression, identify gaps between simulation and practice, assess educational interventions, explore individual or contextual factors that influence transfer, generate evidence for longitudinal or multicenter studies, and analyze potential cross-cultural and communication problems.

THE STUDY

The principal objective of the study was the development and validation of a scale to assess the impact of clinical simulation on the development of satisfaction competencies in nursing students during the 2023-24 academic year. This is referred to as the Clinical Simulation Learning Satisfaction Scale (CSL-SS)[16].

METHODS/METHODOLOGY

Design:

A multimethod study was conducted between 2023 and 2024 at two Spanish university. The study involved the development and psychometric validation of a questionnaire.

Study setting and samplig:

The participating universities had comparable student populations, enhancing the reliability of the findings[17]. An estimated 450 students were eligible to participate. Based on methodological recommendations by DeVellis and Thorpe et al., a sample size of 200 was deemed sufficient, assuming communalities between 0.4 and 0.7 and 3–4 variables per factor[18].

Inclusion and/or Exclusion Criteria

In order to be included in the sample, students were required to have participated in clinical simulation sessions as part of the course and to have completed clinical practice as part of that course.

Students enrolled in exchange or transfer program were excluded.

To be included in the sample, students had to be in the 2nd, 3rd, or 4th year of the degree program and meet two conditions: having participated in clinical simulation sessions and having completed their clinical practice periods for that academic year.

Students enrolled in exchange or transfer programs during those academic years of the degree program were excluded.

Study interventions

The questionnaire was developed in three phases, as illustrated in Fig. 1. In the initial phase, the instrument was constructed. The second phase involved a pilot test with a sample of 20 nursing students. The objective of this phase was to ascertain whether the scale was sufficiently comprehended. In the third phase, the construct was validated by factor analysis and its stability and reproducibility in response to question 15 days after baseline.

First phase:

Instrument Development: An extensive literature review was conducted to identify the relevant dimensions of clinical simulation. Subsequently, a Delphi process was implemented with a panel of experts to generate and refine the questionnaire items. Experts were selected based on the following criteria[19, 20]:

- - Minimum 15 years of experience in healthcare education.
- - Experience as clinical simulation instructors or clinical educators.
- - Expertise in Spanish language and questionnaire development.

Content validity was assessed in terms of clarity, relevance, and appropriateness.

Second phase:

Pilot Testing: A pilot test was conducted with 20 nursing students to evaluate the clarity and comprehensibility of the questionnaire. Feedback was used to refine the instrument. To conduct the pilot study, 20 students were randomly selected—10 from each participating university—who met the same eligibility criteria as the study sample. The method used was a random number table obtained from Epidat version 4.2.

The students were informed about the purpose of the questionnaire, and their consent was obtained before the pilot study began. In addition, they were asked to indicate which questions they found confusing, ambiguous, or difficult to answer on a separate feedback sheet.

Third phase:

Construct validity was assessed through exploratory factor analysis (EFA), and internal consistency was evaluated using Cronbach's alpha and McDonald's omega. Temporal stability was assessed via test-retest reliability with a 15-day interval (n = 43) [21, 22].

Data Collection:

Data were collected by administering the survey electronically to the students. They were provided with a QR code that allowed them to access the survey on their devices and complete it. Members of the research team who were not directly involved in teaching these students participated in the data collection process. The data collected were stored in the repository of one of the participating universities.

Data analysis:

Data were collected electronically. Content validity was assessed using Aiken's V, with values above 0.8 considered acceptable[23–25]. EFA was conducted using the maximum likelihood method with direct Oblimin rotation. Sampling adequacy was evaluated using the Kaiser-Meyer-Olkin (KMO) test, and Bartlett's test of sphericity was used to confirm the suitability of the data for factor analysis.

Internal consistency was measured using Cronbach's alpha and McDonald's omega, with values above 0.70 considered acceptable[26, 27].

Test-retest reliability was assessed using the intraclass correlation coefficient (ICC) and Bland-Altman plots[28]. As the questionnaire was self-administered, there was no requirement to assess interobserver reliability. Contrast tests were conducted with an alpha error of less than 5% and confidence intervals were calculated with 95% confidence. All analyses were performed using the SPSS 26 software.

RESULTS

Creating the scale:

To create the scale, a Delphi process was carried out in which a panel of experts was formed. The expert panel consisted of 15 university professors (5 men and 10 women), aged between 40 and 50 years. Among them, four were specialists in the Spanish language, seven were healthcare professionals with experience in clinical simulation instruction, and four were healthcare professionals with expertise in scale development and research on competencies in higher education.

The scale was initially composed of 13 items. Following three rounds of consultations with the Delphi experts, 9 items and two open-ended questions were agreed upon. This was done so that respondents could express their own opinions about their satisfaction with the clinical simulation and the transfer of the acquired knowledge to clinical practice.

In this phase, the scale was validated through the interpretation of its constituent elements. A consensus was reached on three levels of satisfaction among students with regard to the clinical simulation and the transfer of acquired knowledge to clinical practice.

These levels are:

9–18: Low student satisfaction with the application of the knowledge acquired in simulation in clinical simulation.

19–27: Moderate student satisfaction with the application of the knowledge acquired in clinical simulation.

28–36: High student satisfaction with the application of the knowledge acquired in clinical simulation.

Subsequently, the questionnaire was completed by 20 randomly selected nursing students. The questionnaire was deemed to be comprehensible and complete by all respondents and thus deemed suitable for content validation.

Content validation:

Once the questionnaire had been created, a group of five judges, comprising lecturers from the Degree in Nursing with a minimum of 15 years' experience in teaching clinical skills using simulation techniques, participated in the content validation of the questionnaire. This involved assessing the clarity, importance and relevance of each item on a Likert scale of 1 to 5 points, with 1 representing the lowest value and 5 the maximum for each attribute assessed. Table 1 presents the results of the Aiken V statistic for each item and for the overall scale. As can be observed, the overall Aiken V values obtained were greater than 0.8 for each of the three attributes of the questionnaire.

Table 1
Validation of scale content. Aiken's V values

1	ÍTEM	CLARIDAD	IMPORTANCIA	PERTINENCIA
	Considero que la simulación ha sido realista, es decir, tal y como suele ocurrir en la vida real (= práctica asistencial).	**0,9**	**0,95**	**0,95**
	Has participado en la simulación clínica de manera activa interactuando con el paciente estandarizado (actor/actriz) o simulador de alta fidelidad.	0,85	0,95	0,95
2	Durante tu participación en la simulación has sentido tener el control de la situación. Tener el control nos referimos a si has sabido qué hacer	0,7	0,95	0,938
	En el ámbito de la simulación clínica, de las tres afirmaciones siguientes, ¿con qué puntuación te identificas más?			
3	Afirmación 1: Me quedé bloqueado (= no saber qué hacer) durante la simulación clínica	0,8	0,95	0,95
4	Afirmación 2: Después de la simulación clínica me he sentido mejor preparado para la práctica asistencial	0,9	0,95	0,95
5	Afirmación 3: Después de la simulación clínica he mejorado aspectos relacionados con la seguridad del paciente	0,9	0,95	0,95
6	¿En qué porcentaje consideras que la simulación realizada se aproxima a la realidad asistencial?	0,95	0,95	0,95
7	¿En qué manera consideras que la simulación clínica te ha ayudado o servido para mejorar tus conocimientos?	0,75	0,95	0,95
8	¿En qué manera consideras que la simulación clínica te ha ayudado o servido para mejorar tus habilidades de comunicación?	0,75	0,95	0,95
9	¿En qué manera consideras que la simulación clínica te ha ayudado o servido para mejorar las habilidades técnicas?	0,75	0,95	0,95
PREGUNTAS DE RESPUESTA ABIERTA				
	Comenta brevemente si hay algún aspecto que consideres que tendríamos que tener en cuenta para mejorar / añadir en las simulaciones que has hecho durante el curso académico	0,95	0,95	0,95
	Comenta brevemente si hay algún tema o aspecto concreto que te hubiera gustado trabajar con la metodología de simulación.	0,95	0,95	0,95
	GLOBAL	0,88	0,947	0,947

Construct validation:

A total of 192 undergraduate nursing students from both universities participated in the construct validation phase of the study. The mean age of the participants was 24.6 years (standard deviation 5.7; 95% confidence interval 23.8–25.4), with a range of 19 to 54 years. The majority of participants were female (83.3%, 160 students), with the largest proportion being fourth-year undergraduates (54.7%, 105 students). The remaining participants were health workers (50.5%, 97 students). Table 2 presents a description of the characteristics of the study sample.

Table 2
Characteristics of construct validation participants

VARIABLE	Total Mean (DE) n (%)	Women N = 160	Men N = 32	p
Age	24.6 (5.7)	24.4 (6)	25.8 (5.7)	0.23*
UNIVERSITIES				
1	115 (59,9%)	95 (82.6%)	19 (16.5%)	0.53**
2	77 (40.1%)	65 (84.4%)	12 (15.6%)	
YEAR				
SECOND	77 (40.1%)	65 (84.4%)	11 (14.3%)	0.97**
THIRD	10 (5.2%)	8 (80%)	2 (20%)	
FOURTH	105 (54.7%)	87 (82.9%)	18 (17.1%)	
Health Care Worker YES	97 (50.5%)	75 (77.3%)	22 (22.7%)	0.15**

*T-test for comparing two independent means

**Chi^2 test for comparing independent proportions

Internal reliability (consistency):

With regard to the total scale (items 1 to 9, excluding open-ended questions), the value of Cronbach's α and McDonald's ω statistic was 0.805 and 0.849, respectively. The sensitivity analysis demonstrated a notable alteration in the internal reliability statistics for the eight-item scale when item 3 was excluded, resulting in the following values: Cronbach's α was 0.863 with a 95% confidence interval (CI) of (0.831, 0.888), while McDonald's ω was 0.862 with a 95% CI of (0.827, 0.891). Following a comprehensive examination by the research team, it was determined that item no. 3. Accordingly, the scale was definitively configured with eight items.

Temporal stability or intra-observer reliability:

To evaluate the intra-observer reliability, a sample of 43 students from the second, third and fourth years of the nursing programme was selected. These students completed the questionnaire on two occasions, with a 15-day interval between the initial administration (test) and the subsequent retest. The ICC value was 0.963 (95% CI: 0.933–0.979). Furthermore, temporal stability was evaluated through the use of a Bland and Altman plot (Fig. 2).

Exploratory Factor Analysis (EFA):

The correlation matrix between the eight items (variables) of the questionnaire yielded a determinant value of 0.019. Moreover, the KMO statistic yielded a value of 0.861 for the sample adequacy measure, and Bartlett's test of sphericity was found to be highly significant ($p < 0.001$), thereby confirming the appropriateness of conducting a PIA. The factorial solution proposed a single factor or dimension that explained 46.8% of the total variance of the model. Table 3 presents the factorial matrix, given that a single factor was identified and the rotated solution could not be obtained. Figure 3 depicts the sedimentation plot.

Table 3
AFE. Factor matrix with factor loadings and uniqueness values.

ÍTEM	FACTOR 1	
	Factor loading	**Uniqueness**
1	0.566	0.680
2	0.362	0.869
4	0.593	0.649
5	0.497	0.753
6	0.710	0.496
7	0.903	0.184
8	0.817	0.333
9	0.843	0.289

The method of extraction was conducted using maximum likelihood, and the method of rotation was the Oblimin Kaiser method. It was revealed that all factor loadings of the standard matrix exceeded 0.5, with the exception of items 2 and 5.

DISCUSSION

This study aimed to develop and validate a scale to assess nursing students' satisfaction with the application of knowledge acquired through clinical simulation in real clinical settings. Unlike existing instruments that focus on satisfaction with simulation sessions, instructors, or materials, the CSL-SS emphasizes the perceived impact of simulation on clinical competence, including patient safety, communication, and technical skills [29, 30].

The internal consistency of the scale, as measured by Cronbach's alpha (0.86), is comparable to other validated instruments such as the Spanish version of the Student Satisfaction and Self-Confidence in Learning Scale and the simulation quality satisfaction scale developed by Astudillo et al. [31].

Upon analysis of intra-temporal or intra-observer stability, a result of 0.96 was obtained, comparable to that observed in scales such as the Lasater Clinical Judgement Rubric[32].

The exploratory Factor Analysis revealed a single-factor structure, indicating that the scale measures a unified construct student experience. This simplicity enhances usability and interpretability, especially in educational settings.

This indicates that the questionnaire has a simple structure, which is beneficial for use with students, in contrast to other scales used to measure student satisfaction in which the Exploratory Factor Analysis (EFA)[33] establishes the existence of several factors, as demonstrated in the study by Ko and colleague[4].

the CSL-SS explains nearly half of the variance with a single factor. This suggests that the scale is both efficient and aligned with its intended purpose.

Evaluating students' perceptions of their clinical competence following simulation is essential for improving educational strategies. The CSL-SS provides actionable insights that can guide the refinement of simulation-based learning.

A limitation of the study is the slightly lower-than-expected sample size. However, the final number of participants was close to the target and sufficient for the analyses conducted. Another limitation is the scale's simplicity, though this is mitigated by the inclusion of open-ended questions that enrich the data collected.

CONCLUSIONS

The Clinical Simulation Learning Satisfaction Scale (CSL-SS) is a valid, reliable, and user-friendly instrument for assessing nursing students' satisfaction with the transfer of knowledge from simulation to clinical practice. Its application can support the continuous improvement of simulation-based education and enhance its acceptance among students.

Declarations

Ethics approval and consent to participate

The research study was conducted in accordance with the Declaration of Helsinki Ethical approval was obtained from the Research Ethics Committees of both universities. CEEI 23-442 (Research Ethics Committee, covering academic studies in the health sciences at Cardenal Herrera-CEU University, Spain) and 141-BIS2IP (Research Ethics Committee, linked to academic studies of the University of Vic - Central University of Catalonia, University of Manresa (UManresa), Spain). All participants were informed about the study objectives and provided written informed consent.

Consent for publication

Not Applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding Statement

This study has not had any funding.

Authors' contributions

Author	Conceptualization	Methodology	Investigation	Formal Analysis	Supervision	Writing Original draft	Writing review & editing	Agrees to be held accountable for all aspects of work, ensuring integrity and accuracy
R G M	X	X	X	X	X	X	X	X
B R C	X	X	X	X	X	X	X	X
E R B	X	X	X					X
M R S	X	X		X			X	X
V N A	X	X	X		X			X
D G G	X	X	X		X	X	X	X
C G S	X	X	X		X	X	X	X

Data availability statement

The database is available in an open access repository and will be provided upon reasoned request.

Declaration of the use of AI

AI has been used to improve the writing of the article.

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Figures

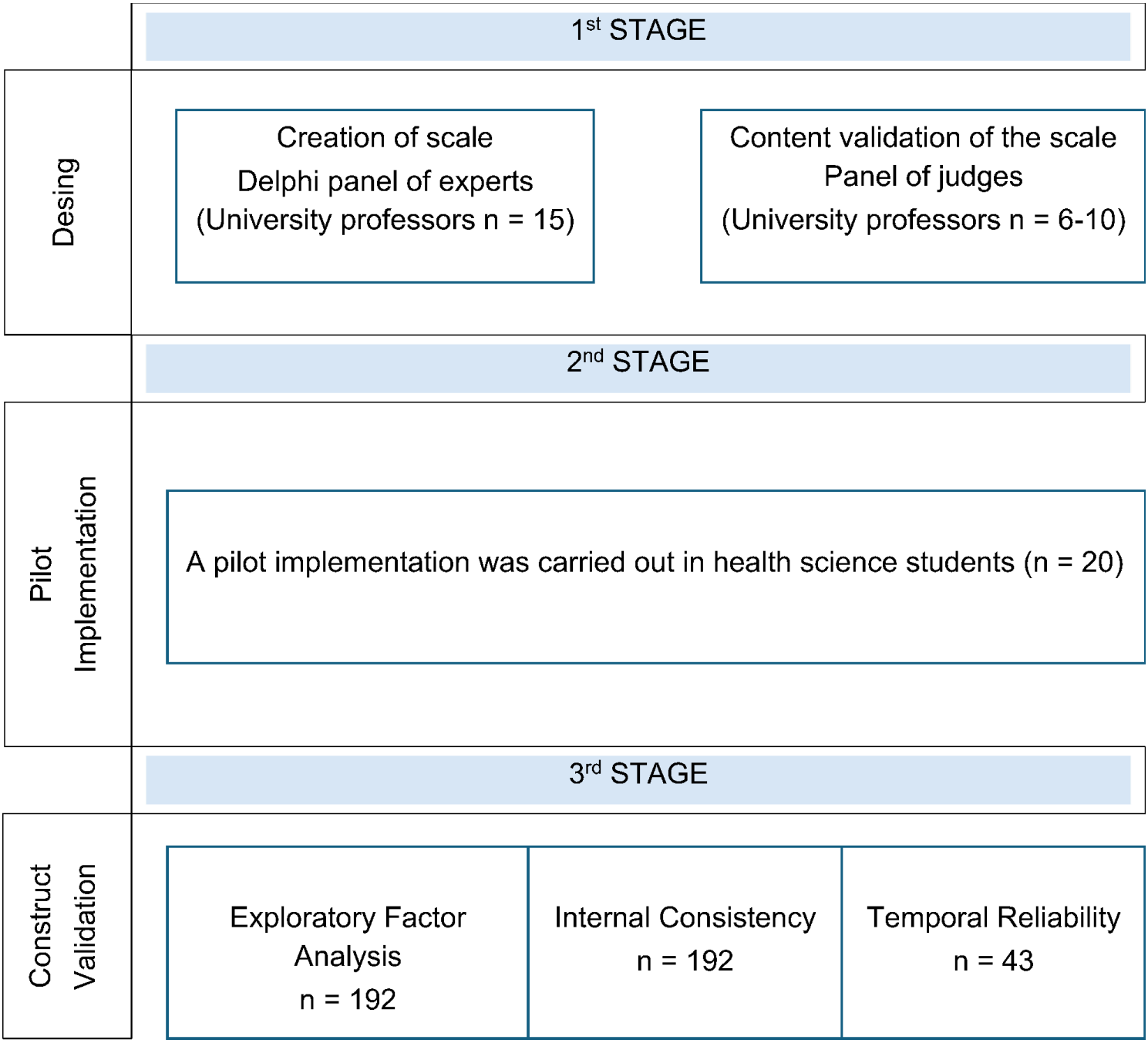


Figure 1

Design and validation stages of the CSL-SS

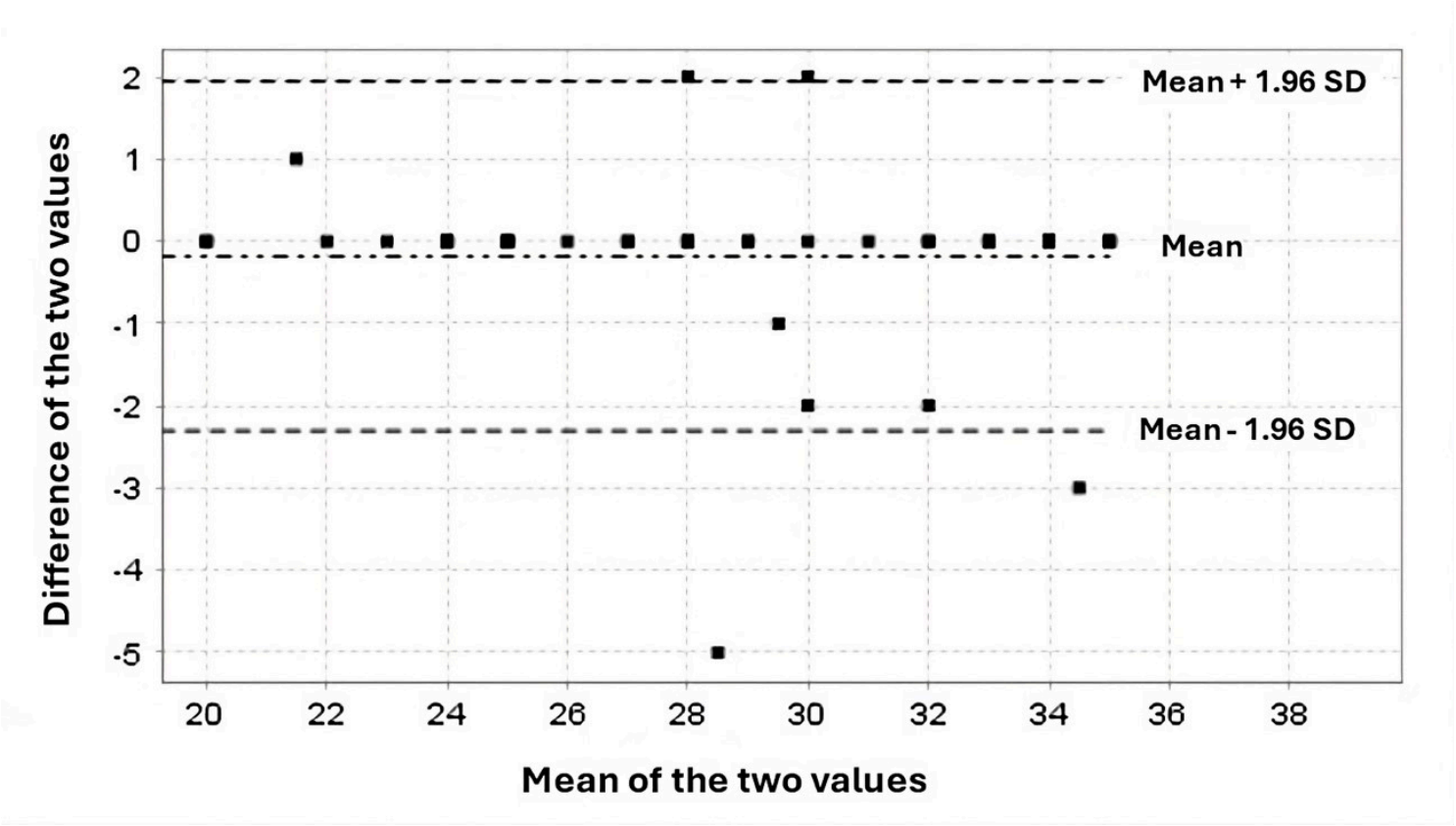


Figure 2

Concordance between test-retest scores. Bland and Altman graph

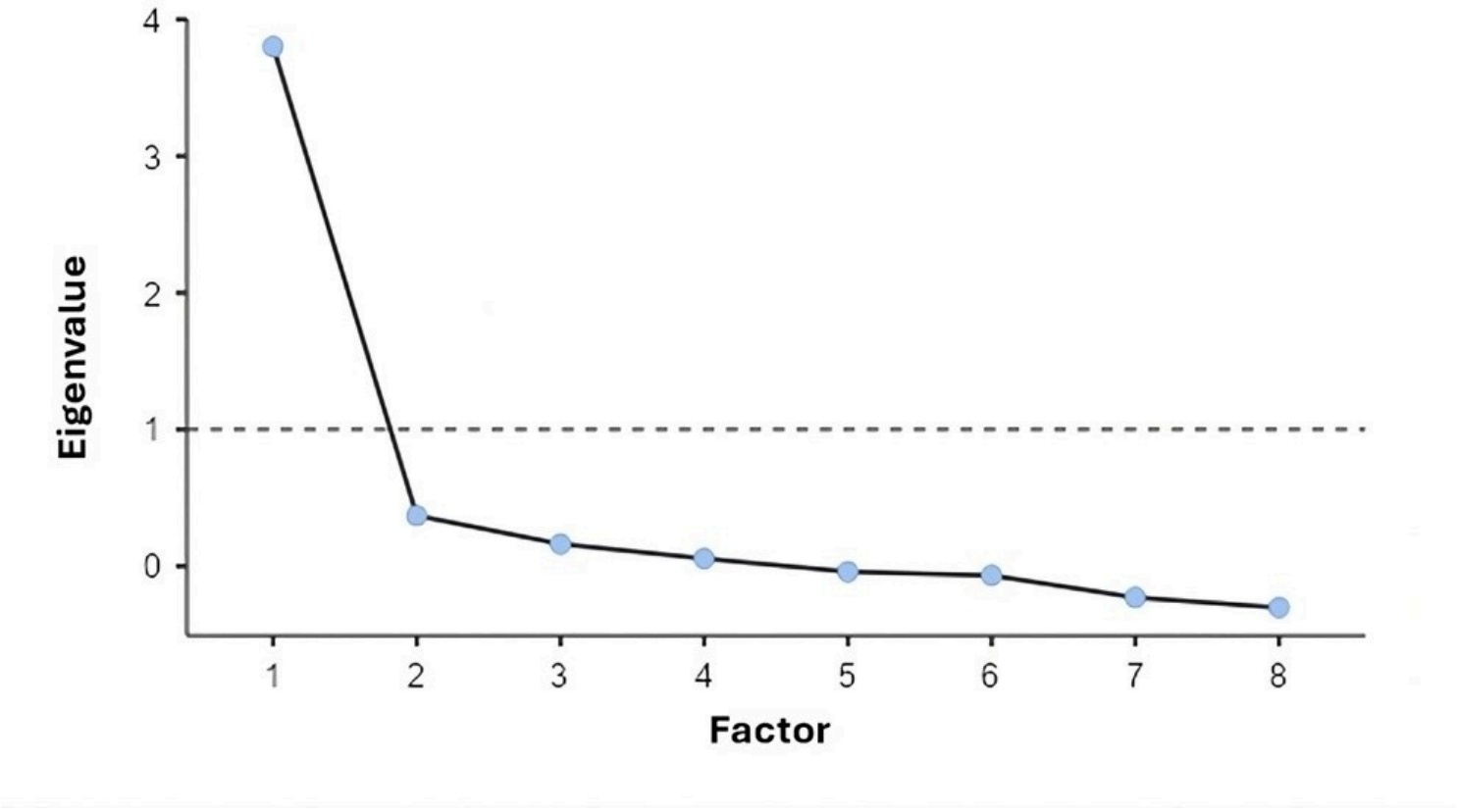


Figure 3

AFE. Sedimentation plot for factor extraction

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- EscaleEnglish.docx