

Supplementary Material — Study Instruments

Immersive virtual reality versus low-fidelity simulation for catheterization skills in nursing students: A cluster randomized controlled study of blinded OSCE performance and knowledge retention

This file provides the study instruments to support transparency and replication. Validated/adapted self-report scales are cited rather than reproduced, in line with copyright and licensing requirements; the study-specific instruments (OSCE checklist and global rating scale, and the knowledge-test blueprint) are provided in full.

Appendix A. OSCE performance instrument

The same instrument was applied at the three stations (urinary, nasogastric, rectal catheterization) and scored independently by two blinded assessors.

A1. Technical performance checklist (0 = not performed/incorrect; 1 = performed correctly)

No.	Item
1	Introduces self, verifies patient identity, and explains the procedure.
2	Performs hand hygiene and uses appropriate personal protective equipment (PPE).
3	Checks and correctly prepares the required material.
4	Positions the patient appropriately for the procedure.
5	Maintains the patient's privacy and dignity throughout the technique.
6	Maintains aseptic technique throughout the manipulation.
7	Performs catheter insertion with correct technique and direction.
8	Verifies correct placement.
9	Secures the catheter correctly and ensures patient comfort.
10	Removes and safely disposes of material according to protocol.
11	Adequately documents the procedure.

Checklist total: ____ / 11 Achievement %: $(\text{total} \div 11) \times 100 = \text{____} \%$

A2. Global Rating Scale (GRS; 1–5)

Dimension	1 (poor)	2	3 (acceptable)	4 (good)	5 (excellent)
Technical and procedural precision					
Maintenance of safety and asepsis					
Communication and rapport with					

Dimension	1 (poor)	2	3 (acceptable)	4 (good)	5 (excellent)
the patient					
Professionalism and organization					
Overall performance (mean of the above)					

Overall interpretation: 1–2 = insufficient; 3 = acceptable with areas for improvement; 4 = good; 5 = excellent, safe and autonomous.

A3. Final performance summary

Indicator	Result	Interpretation
Checklist total (%)	___ %	≥85% = excellent / 70–84% = good / <70% = needs improvement
Global rating (1–5)	___	≥4 = good overall performance

Instrument development. The checklist and GRS were developed by the teaching team from the course learning objectives, the clinical and simulation practice protocols used in the program, and the critical safety, technique, verification, and documentation steps of each procedure; item content was additionally informed by the skill dimensions assessed in prior catheterization training studies (Butt et al., 2018; Park & Yoon, 2023; Şendir et al., 2022), and the instrument followed the standard OSCE format (Harden et al., 1975; Khan et al., 2013; Boursicot et al., 2021). Items and the GRS were reviewed by the teaching team for content relevance and clarity before use; inter-rater reliability was formally estimated and reported in the manuscript (Table 3).

Appendix B. Four-week knowledge test — blueprint

- **Format:** 30 single-best-answer multiple-choice items (one correct option per item), scored 1 (correct) / 0 (incorrect); total range 0–30.
- **Blueprint:** 10 items on urinary catheterization, 10 on nasogastric catheterization, 10 on rectal catheterization (subscores 0–10 each).
- **Administration:** twice — immediately after the Session-2 seminar and four weeks after the initial training session; two parallel versions (A and B) distributed approximately evenly across arms; automated scoring against a fixed answer key.
- **Reliability:** KR-20 (reported in the manuscript).

The full item stems, options, and scoring keys for both parallel forms (A and B) are provided as separate supplementary files, in the original Spanish (administered version) and in an English translation for reference (student forms and instructor scoring guide).

Appendix C. Self-reported instruments (VR arm) — sources and scoring

These instruments are standard or adapted scales; they are cited rather than reproduced here.

Construct	Instrument	Scoring range	Reference
Satisfaction & self-confidence	Student Satisfaction and Self-Confidence in Learning (SSSCL), adapted	Satisfaction 5–25; self-confidence 8–40	National League for Nursing (NLN) SSSCL scale
Perceived workload	Raw NASA Task Load Index (Raw NASA-TLX)	Mean of six 0–10 dimensions	Hart & Staveland (1988)
Presence	Igroup Presence Questionnaire (IPQ), 8-item score	Per-item 1–7	Schubert et al. (2001)

Note. The SSSCL was administered pre- and post-intervention; the NASA-TLX and IPQ post-intervention. Adaptations were limited to translation and contextual wording.