Supplementary File S1

CEI-UGR-PY | Data provenance, ordinal response audit and reproducible factor-model specification

Education Sciences — manuscript education-4512987 | Paraguay and Spain | 24 October 2026

S1.1. Study records and analytical provenance

The original Google Forms response export comprised N = 205 complete participant records (Paraguay n = 102; Spain n = 103). Each participant completed the 36 CEI-UGR-PY five-category Likert-type items, with coded values 1–5 and no missing item values. For privacy, the analytical dataset used here retains only country and anonymized I01–I36 values. The archived N = 200 analytical sample can be reconstructed as the first 100 observations per country in preserved file order; the initial exclusion rule was not independently recorded. Historical CFA/MG-CFA estimates are distinguished from the new N = 205 ordinal sensitivity results.

S1.2. Actual response-category audit

Population	N	Items	Missing item responses	Items with ≥1 empty category	Empty item×category cells
Overall (N = 205)	205	36	0	11	11
Paraguay (n = 102)	102	36	0	13	15
Spain (n = 103)	103	36	0	20	22

Counts were verified directly on the de-identified 205-row item matrix. Empty item×category cells reflect response levels unused by participants, not missing questionnaires. Such empty cells can compromise identification and estimation of group-specific ordinal thresholds. The administered five-point format is retained for the primary data audit; any common response-category collapse is separately documented as a sensitivity recoding.

S1.3. Software and numerical results of the completed ordinal analyses

The independently computed sensitivity models used Python 3 and SciPy 1.17.0. Pairwise polychoric correlations were estimated via maximum likelihood from bivariate ordinal-normal cells. A correlated 36-indicator, three-factor CFA-shaped model (12 items per factor) was fitted to the off-diagonal polychoric correlations by unweighted least squares. The reported RMSE is calculated on those off-diagonal residual correlations, not from an ordinal WLSMV discrepancy function.

Completed analysis	N	Calculated outcome
Correlated three-factor residual RMSE; full matrix	205	.0764
Country-specific RMSE; Paraguay	102	.1046
Country-specific RMSE; Spain	103	.0884
Separate national factor loadings	205	RMSE = .0968; ULS residual total = 11.8163
All 36 standardized loadings constrained equal	205	RMSE = .1110; ULS residual total = 15.5327
Correlated-factor relations: cultures / policies	205	.809
Correlated-factor relations: cultures / practices	205	.716
Correlated-factor relations: policies / practices	205	.811

The residual deterioration under equal loadings is descriptive. Differences between ULS objective functions do not supply a calibrated WLSMV chi-square difference test or establish ordinal threshold invariance.

S1.4. Fully specified ordinal CFA/MG-CFA re-estimation protocol

An executable script, RUN_CEI_UGR_PY_WLSMV.R, is supplied with the editorial supplementary materials (with individual participant-level data held separately by the authors). The script specifies R with lavaan and semTools and uses the original five-category data for single-sample ordinal CFA and planned country-level categorical invariance checks. For single-sample models it evaluates (a) one general factor, (b) three correlated domains, and (c) a general-plus-three-specific orthogonal bifactor model. For MG-CFA it uses theta parameterization, ID.cat = "Wu.Estabrook.2016", ID.fac = "std.lv", and configural → equal thresholds → equal thresholds + loadings → additional identified equality restrictions. The script logs nonconvergence, warnings, inadmissible matrices, and model-test availability. Empty response categories are explicitly audited before attempting group threshold estimates.

A separate sensitivity branch recodes categories 1–3 → 1, category 4 → 2, and category 5 → 3, identically across groups. A result obtained on this recoded format cannot be represented as invariant thresholds on the administered original five-category scale. Where a model is underidentified or comparisons have identical degrees of freedom, an independent test may not exist.

S1.5. Reporting provenance and analysis boundaries

The numerical results provided in S1.3 have been calculated using Python/SciPy and independently checked against the retrieved source analysis report. The 200-case CFA and MG-CFA results remain labeled as archival because the source code and original estimator are unavailable. The supplementary R syntax specifies how to obtain true WLSMV estimates but has not been executed as part of the provided output. In particular, no new WLSMV CFI, TLI, RMSEA, SRMR, chi-square difference tests, threshold-invariance estimates, or latent-mean comparisons have been reported. These are distinct statistical outputs and cannot be inferred from the existing ULS residual measures.

S1.6. Reproducibility documents and access

The independent audit retains a protected de-identified N = 205 CSV, a derived N = 200 file, the I01–I36 questionnaire codebook, and the script in author-controlled storage. These individual-response data files are not bundled with the editorial upload; controlled access is subject to the applicable research-team approvals and institutional requirements. Official statistical documentation: https://lavaan.ugent.be/tutorial/cat.html and https://search.r-project.org/CRAN/refmans/semTools/html/measEq.syntax.html.