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Psychometric Evaluation of the Parental Education in Physiotherapy Scale: A Brief Measure of Family-Centered Educational Practices in Pediatric Physiotherapy

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ABSTRACT

Objective: To evaluate the psychometric properties of the Parental Education in Physiotherapy (PEP) scale, designed to assess the extent to which pediatric physiotherapists implement family-centered educational practices and caregiver education strategies for families of children under 6 years of age.

Methods: This is an instrumental cross-sectional study based on a digital survey targeting physiotherapists in Spain. A sequential cross-validation procedure was applied by randomly dividing the total sample ($N = 310$) to two equivalent subsamples ($n = 155/155$). The final 8-item set was selected in Subsample 1 based exclusively on the EFA results and theoretical considerations, before the CFA results were examined. The prespecified 8-item, 3-factor structure was subsequently evaluated through CFA in Subsample 2. The CFA was estimated using diagonally weighted least squares (DWLS). Convergent validity evidence was examined using average variance extracted (AVE), and discriminant validity evidence was examined using inter-factor correlations, while associations with the use of technological devices for motor tracking were analyzed as an exploratory external comparison. Internal consistency was estimated using reliability coefficients appropriate for ordinal data.

Results: A total of 310 physiotherapists participated (mean age = 36.4 years; 87.4% women). The final 8-item, 3-factor model (Collaboration, Capacity-Building, and Reflection) showed excellent fit ($CFI = 1.000$, $RMSEA = 0.011$, $SRMR = 0.031$), AVE values above 0.50 in all three factors (0.587–0.771), and latent factor correlations below 0.85 (0.40–0.64). Internal consistency was adequate for the three subscale scores. Reliability coefficients for the total composite score were also reported descriptively, although a global factor was not evaluated.

Conclusion: The PEP is a brief measure with promising initial psychometric properties for describing and reflecting on family-centered educational practices and caregiver education in pediatric physiotherapy. Its three-dimensional structure and digital format may facilitate professional reflection, training, and quality-improvement initiatives within family-centered care models.

1 | Introduction

In recent years, pediatric physiotherapy has moved toward family-centered intervention models, which recognize caregivers as active agents in decision-making, goal-setting, and the implementation of

therapeutic strategies (Dunst and Espe-Sherwindt 2016). The available evidence shows that family participation contributes to child development, facilitates functionality in natural contexts, and promotes the sustainability of learning (Novak et al. 2020). In this

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framework, parental education has acquired a prominent role, understood as the set of actions carried out by health professionals to transmit knowledge, model behaviors, and train families in the accompaniment of the child, favoring their participation and the contextualization of the intervention (Rosenbaum and Novak-Pavlic 2021).

Although parental education is a well-established component of early care, its more recent structured integration into pediatric physiotherapy is less well established. The literature of the last decade indicates that the physiotherapist plays a key role in this field, generating favorable conditions for change when they adopt an active role in teaching, joint observation, and shared decision-making (Novak et al. 2020; Morgan et al. 2016). Actions such as providing accessible information, modeling strategies, facilitating practice, and promoting joint reflection are associated with improvements in therapeutic adherence, generalization of learning, and family empowerment (Rosenbaum and Novak-Pavlic 2021; Gmmash et al. 2021).

Hence, the design of the educational intervention must align with the principles of adult learning, which prioritize relevance, immediate applicability, and contextualization (Childress 2021). In pediatric physiotherapy, this involves teaching, modeling, and accompanying the learning process in functional environments (Pellecchia et al. 2020). The need to offer practical strategies, opportunities for their application in everyday life, and spaces for joint reflection has been underscored as essential conditions for caregivers' meaningful participation (McNamara et al. 2023). Likewise, it has been proposed that the educational intervention include phases such as demonstration, guided practice, and feedback, which are characteristic of instructional models for adults (Childress 2021; Pellecchia et al. 2020).

Parental education is therefore a central strategy in early care, aimed at strengthening family competencies through information, modeling, and accompaniment (Moore 2012). Within the family-centered care approach, it represents a specific operational component focused on the training actions the professional plans and carries out with caregivers. Its integration into pediatric physiotherapy requires not only specific training but also tools that enable the professional to evaluate and reflect critically on their practice Morgan et al. 2016. However, the literature indicates a lack of instruments that measure, in a structured and specific way, the educational practices developed by physiotherapists (Gmmash et al. 2021), limiting progress toward truly family-centered models, especially in natural environments (Chiarello 2017).

Existing instruments provide valuable information on pediatric physiotherapy practice and family-centered care, but they do not specifically assess parental education practices as implemented by physiotherapists. For example, the Groningen Observation Protocol 2.0 (GOP 2.0) is an observational tool designed to document technical, educational, and communicative behaviors during pediatric physiotherapy sessions (Woodside et al. 2001). Although useful for describing observed professional actions, its application requires external observation, specific training, and additional resources, and it does not

capture the physiotherapist's self-perceived implementation of educational strategies.

The Measure of Processes of Care for Service Providers (MPOC-SP), in contrast, assesses the extent to which services are perceived by professionals as family-centered (McMahon 2013; Akhbari Ziegler and Suárez 2023). However, its focus is broader than parental education in physiotherapy and it does not provide a detailed assessment of specific educational behaviors, such as demonstrating strategies, guiding family practice, providing feedback, or promoting shared reflection. Therefore, although GOP 2.0 and MPOC-SP are relevant instruments, they do not address the need for a brief self-report scale focused specifically on the educational actions that pediatric physiotherapists use with families.

The PEP was developed to address this gap by providing a structured measure of parental education practices from the professional's perspective. Unlike broader measures of family-centered care or observational protocols of professional behavior, the PEP focuses on three specific components of educational practice in pediatric physiotherapy: Collaboration, Capacity-Building, and Reflection. This focus may help professionals describe their current practice, identify areas for improvement, and guide training or quality-improvement initiatives.

In response to these needs, the present study proposed to evaluate the psychometric properties of the Parental Education in Physiotherapy (PEP) Scale, a self-report instrument designed for physiotherapists working with children under six years of age and their families. The PEP was developed and refined in a previous study, from which emerged the version used in the present psychometric analysis (Pacheco-Molero et al. 2026).

2 | Method

A cross-sectional, instrument-based psychometric evaluation study was conducted using a self-administered digital survey. The study focused on examining the internal structure, convergent and discriminant validity evidence, and internal consistency of the PEP scores within the present sample.

2.1 | Participants

The target population comprised licensed physiotherapists in Spain, with clinical experience in the intervention with children under six. Inclusion criteria were: (a) being a licensed physiotherapist practicing in Spain, (b) having clinical experience in pediatric physiotherapy or early childhood intervention, and (c) working, or having worked, with children under 6 years of age and their families.

Three hundred and eighty-two physiotherapists were invited, and 310 completed the questionnaire, yielding a response rate of 81.1%. The sample consisted primarily of women ($n = 271$; 87.4%). Mean age was 36.4 years ($SD = 9.53$; range: 23–66), with an average professional experience of 10.85 years ($SD = 8.51$; range: 0.5–40).

In terms of academic training, postgraduate studies predominated (62.3%), followed by diplomas (20.3%), bachelor's degrees

(12.9%), and PhDs (4.5%). Regarding training, 29.7% reported receiving specific training in parental education. Regarding the intervention context, 46.8% worked mainly in the physiotherapy setting, 14.2% in the child's natural environment, and 39.0% combined both contexts. Moreover, 70.3% ($n = 218$) reported not having received previous training in parental education.

For the factor analyses, the total sample ($N = 310$) was randomly divided into two equivalent subsamples (Subsamples 1 and 2), which enabled cross-validation via EFA and CFA. Table 1 presents the sociodemographic characteristics of both subsamples. No significant group differences were observed in sex, age, education, or years of experience, supporting their equivalence for analytical purposes.

3 | Instruments

The PEP was developed and refined in a previous study, from which emerged the version used in this psychometric analysis. Its conceptual structure is articulated around three theoretical dimensions: collaboration, understood as the professional-family alliance; capacity-building, related to training actions aimed at functional practice; and reflection, linked to the joint analysis of progress and adjustments in the intervention.

The item development process followed a deductive approach based on the conceptual definition of parental education in pediatric physiotherapy and on the literature regarding family-centered care, coaching, adult learning, and caregiver capacity-building. First, an initial pool of items was generated to represent the main professional behaviors associated with the three theoretical dimensions of the construct: collaboration, capacity-building, and reflection. Items were written to describe observable educational practices carried out by physiotherapists during their interaction with families, such as exchanging relevant information, demonstrating strategies, guiding family practice, providing feedback, and promoting reflection on actions to be implemented in daily routines.

The initial item pool was then reviewed by experts in pediatric physiotherapy, early childhood intervention, and measurement, who assessed the relevance, clarity, and representativeness of

each item in relation to the construct. Based on their feedback, items were revised to improve wording, avoid redundancy, and ensure conceptual alignment with the proposed dimensions. This process resulted in the 18-item version used in the present psychometric study.

The reduction from the initial 18-item version to the final 8-item version was conducted through a sequential refinement process combining conceptual and psychometric criteria. First, all items were examined to ensure their alignment with one of the three theoretical dimensions of the construct and to avoid semantic redundancy among items. Items that showed conceptual overlap, ambiguous wording, or limited contribution to the content coverage of the dimension were considered candidates for removal. Second, the 18-item version was subjected to exploratory factor analysis in Subsample 1. Item retention was guided by the magnitude of the factor loadings, absence of relevant cross-loadings, theoretical interpretability, content coverage of each dimension, and parsimony of the resulting scale. The final set of eight items was fixed before the CFA results from Subsample 2 were examined; therefore, CFA performance did not contribute to item selection. Finally, the retained 8-item structure was tested through confirmatory factor analysis in Subsample 2 to verify whether the reduced version maintained an adequate three-factor structure. This sequential procedure was intended to preserve the theoretical breadth of the construct while obtaining a brief instrument with promising psychometric performance in the domains examined.

The version subjected to psychometric analysis comprised 18 items. Each item evaluates the educational practices physiotherapists use when interacting with families of children under six. Responses are collected using a 4-point Likert scale (1: *ranging from rarely or never to 4: almost always or always*), with no neutral option to reduce acquiescence bias. Higher subscale scores indicate a greater self-reported frequency of parental education practices within the corresponding dimension. A total composite score was also examined for descriptive and exploratory purposes. However, because neither a higher-order nor a bifactor model was evaluated, the total score should not be interpreted as representing a structurally established global dimension. The estimated digital completion time is

TABLE 1 | Sociodemographic characteristics, sex, and academic training of the subsamples.

Variable	Subsample 1 ($n = 155$) n (%)		Subsample 2 ($n = 155$) n (%)	
Sex				
Female	130 (83.9)		141 (91.0)	
Male	25 (16.1)		14 (9.0)	
Academic training				
Diploma	33 (21.3)		30 (19.3)	
Degree	22 (14.2)		18 (11.6)	
Postgraduate	96 (61.9)		97 (62.6)	
PhD	4 (2.6)		10 (6.5)	
Age (years)	$M = 36.9$	$SD = 10.3$	$M = 35.9$	$SD = 8.69$
Years of professional experience	$M = 11.1$	$SD = 8.88$	$M = 10.6$	$SD = 8.15$

Note: The two subsamples ($n = 155$ each) were generated by randomly dividing the total sample ($N = 310$) to perform EFA (Subsample 1) and CFA (Subsample 2).

5–8 minutes. The final version of the PEP is available from the authors upon reasonable request.

3.1 | Procedure

The study was reviewed and approved by the Research Ethics Committee of XXXX University (approval code: XXXX). All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki and with current data protection regulations. Before accessing the questionnaire, participants received written information about the aims of the study, the voluntary nature of participation, the anonymous and confidential treatment of the data, and their right to withdraw from the study at any time before submitting their responses. Informed consent was obtained electronically from all participants prior to data collection. No personally identifiable information was collected, and the data were analyzed only in aggregate form.

Participants were recruited through a non-probabilistic self-selection sampling procedure. Recruitment was carried out in collaboration with national and regional professional bodies, pediatric physiotherapy associations, early childhood intervention organizations, organizations working with children with cerebral palsy, university centers, and collaborating centers of the university research group. These entities were contacted through personalized invitation letters and were asked to disseminate the study through their institutional channels. In addition, the invitation was shared through social media, professional networks, personal contacts, and WhatsApp groups related to pediatric physiotherapy and early childhood intervention.

Interested professionals accessed the study through a digital link, where they received information about the study aims, eligibility criteria, voluntary participation, anonymity, informed consent, and data protection procedures. After providing electronic informed consent, participants completed the socio-demographic form, the 18-item PEP, and the ad hoc questions. Two reminders were sent approximately 2 weeks and 1 month after the initial invitation to encourage questionnaire completion.

The database was reviewed before analysis to identify possible duplicate or inconsistent records, and no duplicate responses were detected. Regarding missing data, all questionnaire fields were mandatory before submission; therefore, no missing data were present in the final dataset used for the psychometric analyses.

3.2 | Data Analysis

3.2.1 | Construct Validity

The internal structure of the scale was examined using EFA followed by CFA. The total sample ($N = 310$) was randomly divided into two equivalent subsamples (Subsample 1 = 155; Subsample 2 = 155). EFA was performed on Subsample 1, and CFA on Subsample 2 (D'Angelo 2024; Análisis de datos y medida en educación 2023). The final 8-item configuration was

specified before the CFA analyses were conducted in Subsample 2.

Before the analyses, sampling adequacy was evaluated using the KMO index (≥ 0.70) and Bartlett's test of sphericity ($p < 0.05$) in both subsamples (Viladrich et al. 2022). Equivalence of the subsamples was examined by comparing sociodemographic variables using the chi-square test for categorical variables and Student's t -test for continuous variables. No significant differences were observed in sex distribution (83.9% vs. 91.0%; $\chi^2[1, N = 310] = 3.55, p = 0.060, V = 0.11$) or educational background, $\chi^2(3, N = 310) = 3.12, p = 0.374, V = 0.10$. Similarly, there were no statistically significant differences in age (36.9 ± 10.3 vs. 35.9 ± 8.69 years; $t[308] = 0.92, p = 0.356$) or professional experience (11.1 ± 8.88 vs. 10.6 ± 8.15 years; $t[308] = 0.52, p = 0.606$). Taken together, these results indicate that the two subsamples are equivalent for subsequent factor analyses.

EFA was performed using minimum residual extraction and Promax oblique rotation. This rotation method was selected because the theoretical dimensions of the PEP (Collaboration, Capacity-Building, and Reflection) were expected to be conceptually related rather than independent. Item selection was based on factor loadings, absence of relevant cross-loadings, theoretical interpretability, and parsimony of the resulting solution. Factor correlations were also examined to evaluate the adequacy of the oblique solution. Eigenvalues, percentage of variance explained by each factor, and cumulative variance were reported (Freiberg-Hoffmann et al. 2013).

The CFA was performed using diagonally weighted least squares (DWLS), which is appropriate for ordinal data. Convergent validity evidence was examined using the average variance extracted (AVE), calculated for each factor as the mean of the squared standardized CFA loadings. Values ≥ 0.50 were considered adequate. Absolute, incremental, and parsimony fit indices were reported: $\chi^2, \chi^2/\text{df}$ (≤ 3), comparative fit index (CFI) (≥ 0.90 ; ≥ 0.95 excellent), goodness-of-fit index (GFI) (≥ 0.90), normed fit index (NFI) (≥ 0.90), root mean square error of approximation (RMSEA) (≤ 0.08 ; 90% CI ≤ 0.05 excellent), standardized root mean square residual (SRMR) (≤ 0.08) and parsimony normed fit index (PNFI) (≥ 0.50). Standardized loads of ≥ 0.50 were considered adequate, with preferable values of ≥ 0.60 .

The CFA evaluated a correlated three-factor model. Neither a higher-order factor model nor a bifactor model was examined; therefore, the analysis did not directly test the structural basis for interpreting a global PEP score.

3.2.2 | Discriminant Validity and Exploratory External Comparison

Discriminant validity evidence based on the internal structure was examined through correlations among the latent factors, using the criterion of correlations below 0.85 to indicate adequate differentiation (Campbell and Fiske 1959). As a separate exploratory analysis, the three subscale scores and the descriptive total composite score were correlated with the variable “use of technological devices for motor tracking.” This variable was treated as a theoretically related but distinct

external comparator rather than as an established criterion measure. Although technology use may reflect a more systematic, reflective, or innovation-oriented professional practice, it does not directly assess parental education behaviors such as collaboration with families, demonstration of strategies, guided practice, feedback, or shared reflection. Therefore, associations with this variable were interpreted as exploratory external evidence and not as a test of criterion-related validity. Spearman's correlations were used for the external comparison because the Shapiro–Wilk test indicated non-normality of the scores. Corresponding 95% confidence intervals and *p*-values were reported.

3.2.3 | Reliability

Internal consistency was estimated by dimension using McDonald's omega and Cronbach's alpha, calculated from the polychoric matrix (Likert-type data) (Viladrich et al. 2022). Values ≥ 0.70 were considered adequate (≥ 0.80 good; ≥ 0.90 excellent).

4 | Results

4.1 | Exploratory Factor Analysis

The sample adequacy statistics supported performing EFA: KMO = 0.798 and Bartlett's sphericity test, $\chi^2(153) = 2148.118$, $p < 0.001$. The EFA, performed using minimum residual extraction and Promax oblique rotation, identified a three-factor solution that explained 59.8% of the cumulative variance. Factor correlations ranged from 0.576 to 0.698, supporting the use of an oblique rotation and indicating that the three dimensions were related but distinguishable. Based on factor loadings, absence of relevant cross-loadings, theoretical interpretability, content coverage, and parsimony, eight items distributed across three factors were retained before the CFA results were examined.

The first factor, *Capacity-Building*, included three retained items referring to the family's active participation through the professional's demonstration of strategies, guided practice, and subsequent feedback. The second factor, *Reflection*, included three retained items related to joint reflections between the physiotherapist and the family on actions to be carried out between sessions. The third factor, *Collaboration*, included two retained items related to the exchange of information between the physiotherapist and the family during the intervention process.

The two-item Collaboration factor was retained during the exploratory phase because both items showed strong primary pattern coefficients without relevant cross-loadings, represented theoretically essential content concerning the exchange of information between the physiotherapist and the family, and demonstrated a high inter-item correlation ($r = 0.76$, $p < 0.001$) and adequate reliability for a two-item scale (Spearman–Brown = 0.86). This decision was made using Subsample 1 before the CFA results from Subsample 2 were examined. This approach is consistent with recommendations supporting the retention of factors with few indicators when they are theoretically well defined and show adequate psychometric properties (Ferrando et al. 2022; Trizano-Hermosilla and Alvarado 2016; Viladrich et al. 2017).

Table 2 presents the complete rotated solution, with the retained items indicated in bold.

4.2 | Confirmatory Factor Analysis

The 8-item, 3-factor model, estimated using diagonally weighted least squares (DWLS), showed an excellent fit: $\chi^2 = 5.153$, $df = 17$, $p = 0.997$, $\chi^2/df = 0.303$, CFI = 1.000, NFI = 0.993, GFI = 0.997, RMSEA = 0.011, SRMR = 0.031, and PNFI = 0.603.

The non-standardized factor loadings are presented in Table 3, and the standardized factor loadings are displayed in Figure 1. All standardized loadings were high and statistically significant, supporting the adequacy of the 8-item, three-factor structure identified in the exploratory phase.

4.3 | Convergent Validity

The standardized factor loadings of the confirmatory model were high and statistically significant ($p < 0.001$). Based on the standardized loadings displayed in Figure 1, the AVE values were 0.771 for Collaboration, 0.587 for Capacity-Building, and 0.642 for Reflection. All three values exceeded the criterion of 0.50, supporting convergent validity evidence for the three factors of the 8-item PEP.

As a complementary descriptive analysis, the total composite score showed high correlations with the three subscale scores (Collaboration: $\rho = 0.648$; Capacity-Building: $\rho = 0.838$; Reflection: $\rho = 0.849$; all $ps < 0.001$), with 95% CIs of [0.578, 0.708], [0.801, 0.868], and [0.815, 0.878], respectively. Because the total composite contains the same items as the subscales, these part-whole correlations should not be interpreted as evidence of an underlying global factor. The three subscale scores have direct support from the correlated three-factor CFA model, whereas interpretation of the total composite score remains exploratory.

4.4 | Discriminant Validity and Exploratory External Comparison

The correlations among the latent factors were moderate and remained below the critical threshold of 0.85, supporting differentiation among the model's dimensions. As displayed in Figure 1, Collaboration correlated with Capacity-Building at 0.46 and with Reflection at 0.40, while the highest correlation was observed between Capacity-Building and Reflection at 0.64.

As an exploratory external comparison, the variable “use of technological devices for motor tracking” showed low-to-moderate correlations with Reflection ($\rho = 0.309$; 95% CI [0.159, 0.445], $p < 0.001$) and with the descriptive total composite score ($\rho = 0.252$; 95% CI [0.059, 0.394], $p = 0.002$). No statistically significant correlations were observed with Collaboration ($\rho = 0.051$; 95% CI [−0.108, 0.207], $p = 0.529$) or Capacity-Building ($\rho = 0.152$; 95% CI [−0.006, 0.303], $p = 0.059$). This pattern provides preliminary evidence that PEP scores are not strongly associated with the use of technological devices. However, because technology use is not an established criterion measure of parental education practices, these findings should

TABLE 2 | Pattern matrix of the exploratory factor analysis of the 18-item version of the parental education in physiotherapy (PEP) scale using promax oblique rotation.

Item ID	Item description	Capacity-building	Reflection	Collaboration	Uniqueness
Col_1	1. I promote the exchange of relevant information related to health and challenges in children's motor development.			0.944	0.160
Col_2	2. I promote the exchange of experiences on the health condition and challenges in children's motor development.			1.015	0.080
Col_3	3. I ask what results they hope to obtain at the family level, not only for the child, but also for the actions to be carried out.		0.511	0.615	0.424
Col_4	4. I explain the family's necessary involvement in the proposed actions.				0.423
Col_5	5. I highlight the key aspects of the actions to be carried out by the family in the child's habitual setting.	0.661			0.364
Col_6	6. I identify together with the family where and when the proposed actions are required.				0.393
Cap_1	7. I inform the family of the child's functioning during the joint evaluation.	0.568			0.568
Cap_2	8. I explain in detail to the family the actions and available resources.	0.539			0.481
Cap_3	9. I Promote the family's observation during the demonstration of the actions they should perform in the child's habitual setting.	0.849			0.448
Cap_4	10. I invite the family to practice the actions previously explained and demonstrated in the session.	0.806			0.359
Cap_5	11. I give the family indications of the actions that have been performed during the session.	0.734			0.476
Cap_6	12. I encourage the family to make adjustments to the actions performed in the session.	0.715			0.387
Ref_1	13. I describe to the family the strengths, interests, and preferences observed in the child during the joint practice.	0.538			0.450
Ref_2	14. I ask the family to describe the key components of the actions to be performed.		0.751		0.385
Ref_3	15. I invite the family to comment on what they have observed from the actions they have performed during the session.		0.720		0.315
Ref_4	16. I ask the family to indicate what actions they are going to put into practice in their habitual setting until the next session.		0.814		0.293
Ref_5	17. I discuss with the family how we will evaluate the possible changes that occur in their child.		0.636		0.681
Ref_6	18. I assess with the family how these actions can improve their child's quality of life and participation in daily activities.				0.541

Note: Pattern coefficients below 0.40 are not displayed. The EFA was conducted using minimum residual extraction and Promax oblique rotation. Factor 1 = Capacity-Building; Factor 2 = Reflection; Factor 3 = Collaboration. The primary pattern coefficients of the eight retained items are shown in bold. Item retention was based exclusively on the EFA results, including factor loadings, absence of relevant cross-loadings, theoretical interpretability, content coverage, and parsimony. The final set of eight items was established before the CFA results were examined.

Abbreviation: PEP, Parental Education in Physiotherapy.

be interpreted as exploratory and not as definitive evidence of external discriminant or criterion-related validity.

4.5 | Reliability of Scale Scores

Internal consistency was high for the three subscale scores. McDonald's ω , calculated from the polychoric matrix, was 0.861

for Collaboration, 0.815 for Capacity-Building, and 0.839 for Reflection. Corresponding Cronbach's alpha coefficients were 0.859, 0.805, and 0.837, respectively. For descriptive purposes, internal consistency coefficients were also calculated for the total composite score ($\omega = 0.910$; $\alpha = 0.846$). These total-score coefficients should not be interpreted as evidence of unidimensionality or of a structurally established global factor.

TABLE 3 | Factor loadings from the confirmatory factor analysis of the final 8-item version of the parental education in physiotherapy (PEP) scale.

Factor	Item	Estimate	SE	z	p	95% CI LL	95% CI UL
Collaboration	Col_1	1.000	—	—	—	1.000	1.000
	Col_2	0.912	0.154	5.904	< 0.001	0.609	1.214
Capacity-Building	Cap_3	1.000	—	—	—	1.000	1.000
	Cap_4	1.477	0.184	8.009	< 0.001	1.116	1.838
	Cap_6	1.389	0.176	7.895	< 0.001	1.045	1.734
Reflection	Ref_2	1.000	—	—	—	1.000	1.000
	Ref_3	1.004	0.115	8.759	< 0.001	0.780	1.229
	Ref_4	0.938	0.106	8.871	< 0.001	0.731	1.145

Note: Non-standardized factor loadings were estimated using diagonally weighted least squares (DWLS). The loadings for Col_1, Cap_3, and Ref_2 were fixed to 1.000 for model identification.
Abbreviations: Cap, Capacity-Building; CI, confidence interval; Col, Collaboration; LL, lower limit; Ref, Reflection; SE, standard error; UL, upper limit.

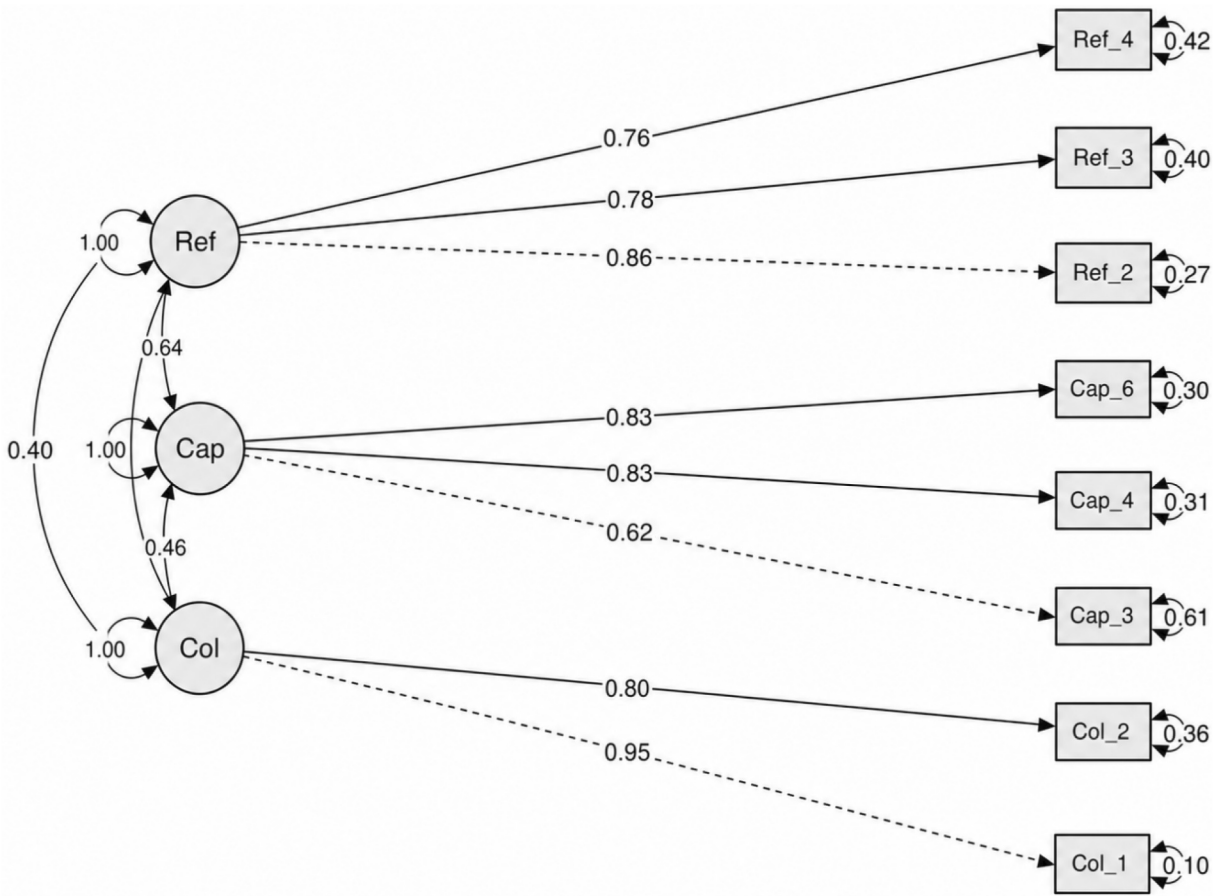


FIGURE 1 | Confirmatory factor analysis model of the final 8-item version of the parental education in physiotherapy (PEP) Scale. Standardized factor loadings are displayed on the paths from the latent factors to the observed items. Curved double-headed arrows indicate correlations among latent factors, and residual variances are shown next to each observed item. Cap, Capacity-Building; Col, Collaboration; Ref, Reflection.

For the Collaboration factor, composed of two items, the reliability estimated by the Spearman–Brown formula was 0.861, confirming the adequacy and stability of this composite score. Taken together, these results support the internal consistency of the three subscale scores. Although the total composite also showed adequate internal consistency, its structural interpretation remains exploratory.

5 | Discussion

This study aimed to examine the psychometric properties of the PEP scale. The final version showed a parsimonious three-factor structure and a solid confirmatory fit, with indices in acceptable and, in several cases, excellent ranges (Muñiz and Fonseca-Pedrero 2019), providing evidence supporting its internal structure within the scope of the present study.

Based on the preliminary 18-item version analyzed in the pilot study (Pacheco-Molero et al. 2026), a sequential cross-validation strategy was applied. The EFA was conducted in Subsample 1, and the final 8-item solution was established from the EFA results and theoretical considerations before the CFA results were examined. The prespecified 8-item, 3-factor structure was then evaluated through CFA in the independent Subsample 2 (Osborne 2014; Floyd and Widaman 1995). The exploratory analysis used minimum residual extraction and Promax oblique rotation because the theoretical dimensions of parental education in physiotherapy were expected to be related rather than independent. The observed factor correlations supported this assumption and allowed the identification of a theoretically coherent three-factor structure.

The final 8-item, 3-factor solution (Collaboration, Capacity-Building, and Reflection) provided excellent fit across the model's essential fit indices. The standardized loadings were high, and there was no need to introduce error correlations between the indicators to improve the fit, reinforcing the parsimony and theoretical coherence of the factors (Ferrando et al. 2022). Because the final item set was fixed before the CFA results were examined, its evaluation in the independent second subsample reduced the risk of overfitting and provided additional support for the interpretation of Collaboration, Capacity-Building, and Reflection as related but distinct dimensions.

The evidence of convergent validity was consistent with the usual criteria. The AVE values derived from the standardized CFA loadings were 0.771 for Collaboration, 0.587 for Capacity-Building, and 0.642 for Reflection, all above the recommended threshold of 0.50. Regarding discriminant validity, the latent factor correlations ranged from 0.40 to 0.64 and remained below the criterion of excessive overlap of 0.85. The exploratory external comparison with the use of technological devices showed only low-to-moderate associations, preliminarily suggesting that PEP scores are not simply proxies for technology use. However, because technology use is not an established criterion measure, these findings should not be interpreted as definitive evidence of external discriminant or criterion-related validity. The observed pattern, medium correlations between Collaboration–Capacity-Building and Collaboration–Reflection, and a slightly higher association between Capacity-Building–Reflection, is consistent with the theoretical proximity of the components of the educational process and, at the same time, with their conceptual differentiation (Rosenbaum and Novak-Pavlic 2021).

Internal consistency supported the interpretability of the three subscale scores, with values compatible with a short measure and no indication of excessive item redundancy (Trizano-Hermosilla and Alvarado 2016; Viladrich et al. 2017; Vilagut 2014). Reliability coefficients for the total composite score were also adequate; however, internal consistency alone does not establish unidimensionality or justify interpretation of a global latent score. Because the CFA directly supported a correlated three-factor structure, Collaboration, Capacity-Building, and Reflection currently have a more direct structural support than the total composite score.

In relation to previous instruments, such as GOP 2.0 and the MPOC-SP, the PEP provides a complementary approach. The PEP is in an intermediate range, integrating collaboration, capacity-building, and reflection from the professional's perspective, with a brief, digital administration that facilitates its application in health, educational, or social environments (McCarthy and Guerin 2022; Peyton et al. 2022).

The PEP can serve as a training tool to identify strengths and areas for improvement in professional-family interactions, promote alignment with family-centered models, guide professional development plans, and strengthen systematic educational practices in pediatric physiotherapy.

Regarding its intended use, the PEP should currently be interpreted as a self-report tool for professional reflection, training, research, and quality improvement rather than as an instrument for clinical diagnosis, personnel appraisal, or other high-stakes decision-making. Higher subscale scores indicate a greater self-reported frequency of parental education practices within Collaboration, Capacity-Building, and Reflection. These subscale scores should be considered the primary scores because they have direct support from the CFA model. A total composite score may be reported descriptively, but its interpretation as a global measure should remain exploratory until a higher-order or bifactor structure is evaluated. Therefore, subscale scores may help identify areas of relative strength and aspects that may require further professional development. However, at this stage, the PEP should not be used to make individual high-stakes evaluations, to compare professionals for accountability purposes, or to classify performance using cut-off points. No validated cut-off scores, benchmarks, normative values, or interpretive categories have yet been established for the PEP. Similarly, although the scale may be useful for monitoring educational practices in training or quality-improvement contexts, its sensitivity to change has not yet been tested. Consequently, its use for detecting intervention-related changes should be considered exploratory until longitudinal evidence is available.

Taken together, the present findings indicate that the PEP provides initial psychometric evidence for describing parental education practices in pediatric physiotherapy from the professional's perspective. The study supports its three-dimensional structure, internal consistency, convergent validity evidence, and differentiation among the three latent factors. The findings from the external comparison with technology use should be regarded as exploratory. However, its current use should remain descriptive, formative, and research-oriented. Test–retest reliability, measurement invariance, cross-cultural validity, criterion-related validity, and sensitivity to change were not evaluated because they were outside the scope of the present cross-sectional study.

Further validation agenda is needed to establish the broader applicability and interpretability of the PEP. Future studies should examine test–retest reliability to assess score stability over time; measurement invariance across relevant professional, demographic, and cultural subgroups; convergent and criterion-

related associations with established external indicators, such as family-reported outcomes and relevant clinical or functional measures; cross-national and cross-cultural validity; and sensitivity to change in longitudinal and intervention studies.

5.1 | Limitations

This study has several limitations. Firstly, the sample was composed of pediatric physiotherapists practicing in Spain and was recruited through a non-probabilistic and self-selective procedure. Therefore, the findings should be interpreted within this specific professional and cultural context. Participants who chose to complete the survey may have been particularly interested in parental education, family-centered care, or reflective professional practices, which may have introduced selection bias (Osborne 2014). Consequently, the generalizability of the results to physiotherapists in other countries, healthcare systems, cultural contexts, or professional profiles remains limited.

Secondly, multigroup invariance was not evaluated by relevant variables such as sex, years of experience, or area of practice, so the metric equivalence remains to be analyzed in subsequent studies.

An additional limitation concerns interpretation of the total PEP score. The CFA supported a correlated three-factor structure, but neither a higher-order model nor a bifactor model was evaluated. Consequently, the three subscale scores currently have more direct structural support, whereas the total composite score should be interpreted cautiously and used only for descriptive or exploratory purposes. Accordingly, the available evidence does not currently support the routine interpretation of a global PEP score.

Finally, although the present study provides evidence regarding the internal structure, convergent validity, differentiation among the latent factors, and internal consistency of the PEP scores, its psychometric evaluation remains incomplete. Criterion-related and concurrent validity were not examined because no established external clinical, functional, adherence, family-satisfaction, or patient-experience measures were available. The comparison based on the use of technological devices for motor tracking was exploratory and should not be interpreted as evidence of established external discriminant or criterion-related validity.

Associations between PEP scores and established external indicators, such as family adherence to home activities, caregiver empowerment, participation in natural routines, child functional outcomes, and family satisfaction with care, were not examined in the present study. Test-retest reliability, sensitivity to change, measurement invariance across relevant professional subgroups, operational cut-off points, and predictive validity were also outside the scope of the present study. In methodological terms, item selection through EFA in Subsample 1, followed by evaluation of the prespecified 8-item structure through CFA in the independent Subsample 2, reduced the risk of overfitting. Nevertheless, replication in larger, more diverse, and multicenter samples remains essential to strengthen the stability and generalizability of the model (Floyd and Widaman 1995).

Cross-cultural and linguistic performance in diverse clinical, educational, and community-based contexts was not evaluated in the present study. Accordingly, the interpretation of PEP scores should remain descriptive and formative, and the instrument should not currently be used for clinical diagnosis, professional appraisal, classification, or other high-stakes evaluative purposes.

5.2 | Conclusions

The results of this study provide initial psychometric evidence supporting the PEP as a brief, structured, and conceptually substantiated tool for describing and reflecting on educational practices with families in pediatric physiotherapy. The final structure, composed of eight items organized into three factors, showed excellent confirmatory fit, adequate convergent validity evidence, and correlations among the latent factors below the threshold for excessive overlap. The comparison with technology use provided exploratory external findings but should not be considered definitive evidence of external discriminant or criterion-related validity. Internal consistency was satisfactory for the three subscale scores, supporting their interpretation. The total composite score also showed adequate internal consistency, but its interpretation remains exploratory because a higher-order or bifactor structure was not evaluated.

The PEP provides a specific measure that complements existing instruments and allows assessing the key dimensions of parental education, such as collaboration, capacity-building, and shared reflection. Overall, within the context of pediatric physiotherapy practice in Spain, the PEP represents a promising self-reporting tool for describing and reflecting on educational practices with families. At this stage, its use should be mainly formative, research-oriented, and focused on quality improvement. Multicenter functioning, cross-cultural validity, relationships with clinical and family-reported outcomes, and sensitivity to change were outside the scope of the present study; therefore, broader evaluative or change-detection uses are not currently supported.

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Ethics Statement

The research project was approved by the Ethics Committee of the Universidad Internacional de La Rioja (PI: 066/2024) and by the collaborating entities. All procedures complied with ethical standards in accordance with the Declaration of Helsinki and relevant national and institutional guidelines.

Consent

Informed consent was obtained from all families who participated in the study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

- Akhbari Ziegler, S., and X. Suárez. 2023. "Reliability, Construct Validity and Completeness of the "Winterthur Observation Protocol" Applied to Early Intervention in Pediatric Physiotherapy Using Coaching." *Physical & Occupational Therapy in Pediatrics* 43, no. 5, (February): 1–15. <https://doi.org/10.1080/01942638.2023.2181724>.
- Análisis de datos y medida en educación. 2023. *Primera Edición: 2023*. Universidad Internacional de La Rioja.
- Campbell, D. T., and D. W. Fiske. 1959. "Convergent and Discriminant Validation by the Multitrait-Multimethod Matrix." *Psychological Bulletin* 56, no. 2: 81–105. <https://doi.org/10.1037/h0046016>.
- Chiarello, L. A. 2017. "Excellence in Promoting Participation: Striving for the 10 Cs—Client-Centered Care, Consideration of Complexity, Collaboration, Coaching, Capacity Building, Contextualization, Creativity, Community, Curricular Changes, and Curiosity." Supplementary, *Pediatric Physical Therapy* 29: S16–S22. <https://doi.org/10.1097/PEP.0000000000000382>.
- Childress, D. C. 2021. *Pause and Reflect: Your Guide to a Deeper Understanding of Early Intervention Practice*. Paul H. Brookes Publishing Co.
- D'Angelo, L. 2024. "Tamaño de efecto, potencia de la prueba, factor de Bayes y meta-análisis en el marco de la crisis de reproducibilidad de la ciencia. el caso de las diferencias de proporciones y tablas de contingencia con variables nominales y muestras independientes (segunda parte)." *Cuad CIMBAGE* 1, no. 26: 77–107. [https://doi.org/10.56503/cimbage/vol.1/nro.26\(2024\)/3022](https://doi.org/10.56503/cimbage/vol.1/nro.26(2024)/3022).
- Dunst, C. J., and M. Espe-Sherwindt. 2016. "Family-Centered Practices in Early Childhood Intervention." In *Handbook of Early Childhood Special Education*, edited by B. Reichow, B. A. Boyd, E. E. Barton, and S. L. Odom: 37–55. Springer International Publishing. https://doi.org/10.1007/978-3-319-28492-7_3.
- Ferrando, P., U. Lorenzo-Seva, A. Hernández-Dorado, and J. Muñiz. 2022. "Decalogue for the Factor Analysis of Test Items." *Psicothema* 1, no. 34: 7–17. <https://doi.org/10.7334/psicothema2021.456>.
- Floyd, F. J., and K. F. Widaman. 1995. "Factor Analysis in the Development and Refinement of Clinical Assessment Instruments." *Psychological Assessment* 7, no. 3: 286–299. <https://doi.org/10.1037/1040-3590.7.3.286>.
- Freiberg-Hoffmann, A., J. B. Stover, G. De la Iglesia, and M. Fernández Liporace. 2013. "Correlaciones policóricas y tetracóricas en estudios factoriales exploratorios y confirmatorios." *Cienc Psicológicas* 7, no. 2: 151–164. <https://doi.org/10.22235/cp.v7i1.1057>.
- Gmmash, A. S., S. K. Effgen, C. Skubik-Peplaski, and J. D. Lane. 2021. "Parental Adherence to Home Activities in Early Intervention for Young Children With Delayed Motor Development." *Physical Therapy* 101, no. 4: pzab023. <https://doi.org/10.1093/ptj/pzab023>.
- McCarthy, E., and S. Guérin. 2022. "Family-Centred Care in Early Intervention: A Systematic Review of the Processes and Outcomes of Family-Centred Care and Impacting Factors." *Child: Care, Health and Development* 48, no. 1: 12901–12932. <https://doi.org/10.1111/cch.12901>.
- McMahon, S. E. 2013. "Enhancing Motor Development in Infants and Toddlers: A Multidisciplinary Process for Creating Parent Education Materials." *Newborn and Infant Nursing Reviews* 13, no. 1: 35–41. <https://doi.org/10.1053/j.nainr.2012.12.001>.
- McNamara, L., C. Morgan, and I. Novak. 2023. "Interventions for Motor Disorders in High-Risk Neonates." *Clinics in Perinatology* 50, no. 1: 121–155. <https://doi.org/10.1016/j.clp.2022.11.002>.
- Moore, T. 2012. Rethinking Early Childhood Intervention Services: Implications for Policy and Practice.
- Morgan, C., J. Darrah, A. M. Gordon, et al. 2016. "Effectiveness of Motor Interventions in Infants With Cerebral Palsy: A Systematic Review." *Developmental Medicine and Child Neurology* 58, no. 9: 900–909. <https://doi.org/10.1111/dmcn.13105>.
- Muñiz, J., and E. Fonseca-Pedrero. 2019. "Diez pasos para la construcción de un test." *COP Ppdo Astur* 31, no. 1: 7–16. <https://doi.org/10.7334/psicothema2018.291>.
- Novak, I., C. Morgan, M. Fahey, et al. 2020. "State of the Evidence Traffic Lights 2019: Systematic Review of Interventions for Preventing and Treating Children With Cerebral Palsy." *Current Neurology and Neuroscience Reports* 20, no. 2: 3. <https://doi.org/10.1007/s11910-020-1022-z>.
- Osborne, J. W. 2014. *Best Practices in Exploratory Factor Analysis*. CreateSpace Independent Publishing Platform.
- Pacheco-Molero, M., I. León-Estrada, C. Morales-Murillo, and M. Gutiérrez-Ortega. 2026. "Development and Preliminary Validation of the Parental Education in Physiotherapy Scale for Use in Spain: A Pilot Study." *European Journal of Investigation in Health Psychology and Education* 16, no. 1: 5. <https://doi.org/10.3390/ejihpe16010005>.
- Pellecchia, M., R. S. Beidas, D. S. Mandell, C. C. Cannuscio, C. J. Dunst, and A. C. Stahmer. 2020. "Parent Empowerment and Coaching in Early Intervention: Study Protocol for a Feasibility Study." *Pilot and Feasibility Studies* 6, no. 1: 22. <https://doi.org/10.1186/s40814-020-00568-3>.
- Peyton, C., T. S. Moulton, A. J. Carroll, et al. 2022. "Starting at Birth: An Integrative, State-of-the-Science Framework for Optimizing Infant Neuromotor Health." *Frontiers in Pediatrics* 9: 787196. <https://doi.org/10.3389/fped.2021.787196>.
- Rosenbaum, P. L., and M. Novak-Pavlic. 2021. "Parenting a Child With a Neurodevelopmental Disorder." *Current Developmental Disorders Reports* 8, no. 4: 212–218. <https://doi.org/10.1007/s40474-021-00240-2>.
- Trizano-Hermosilla, I., and J. M. Alvarado. 2016. "Best Alternatives to Cronbach's Alpha Reliability in Realistic Conditions: Congeneric and Asymmetrical Measurements." *Frontiers in Psychology* 7. <https://doi.org/10.3389/fpsyg.2016.00769>.
- Viladrich, C., A. Angulo-Brunet, and E. Doval. 2017. "Un viaje alrededor de alfa y omega para estimar la fiabilidad de consistencia interna." *Psicología* 33, no. 3: 755. <https://doi.org/10.6018/analesps.33.3.268401>.
- Viladrich, C., E. Doval, and E. Penelo. 2022. "Medición: Fiabilidad Y Validez." In *Lab Estad Apl Model UAB*. 15a ed.
- Vilagut, G. 2014. "Test-Retest Reliability." In *Encyclopedia of Quality of Life and Well-Being Research*, edited by A. C. Michalos: 6622–6625. Springer. https://doi.org/10.1007/978-94-007-0753-5_3001.
- Woodside, J. M., P. L. Rosenbaum, S. M. King, and G. A. King. 2001. "Family-Centered Service: Developing and Validating a Self-Assessment Tool for Pediatric Service Providers." *Children's Health Care* 30, no. 3: 237–252. https://doi.org/10.1207/S15326888CHC3003_5.