

Confirmatory Factor Analysis and Second-Order Structure of the Attitude towards the Pedagogical Formation of Prospective Teachers Inventory: Evidence from a Standardisation Study in Tripura, India

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Abstract:

Attitudes formed during initial teacher preparation shape how prospective teachers engage with their pedagogical formation and, ultimately, how they teach. This study examined the factorial validity and higher-order structure of the Attitude towards the Pedagogical Formation of Prospective Teachers Inventory, a 32-item measure comprising four dimensions: Professional Commitment and Value, Child-Centred and Instructional Practices, Relevance and Necessity of the Programme, and Personal Efficacy and Adaptability. The inventory was administered to 345 prospective teachers drawn by proportionate simple random sampling from a population of 1410 trainees enrolled in eight teacher education institutions of Tripura, India. Confirmatory factor analysis showed that all 32 items loaded significantly on their intended factors ($p < .001$), and the four-factor model achieved a reasonable approximate fit, with RMSEA = .076 and SRMR = .053, although the comparative fit indices remained below conventional thresholds (CFI = .823, TLI = .808). The four factors were very strongly intercorrelated ($r = .815$ to $.913$), so a second-order model was tested in which the four dimensions loaded on a general attitude factor. The second-order model fitted the data as well as the correlated-factors model and clearly better than a single-factor model. All four standardised second-order loadings were high and significant, with Personal Efficacy and Adaptability emerging as the most influential dimension of the general attitude construct ($\gamma = .952$), followed closely by Relevance and Necessity of the Programme ($\gamma = .945$) and Child-Centred and Instructional Practices ($\gamma = .943$), while Professional Commitment and Value contributed comparatively least ($\gamma = .900$). Implications for teacher education practice and for further refinement of the inventory are discussed.

Keywords: attitude, pedagogical formation, prospective teachers, confirmatory factor analysis, second-order factor model, teacher education, India

1. Introduction

The quality of any system of school education can rise no higher than the quality of its teachers, and the quality of teachers is forged, to a large extent, during their initial preparation. Pedagogical formation, understood as the organised programme of professional courses, practicum experiences and school engagement through which prospective teachers acquire the knowledge, skills and dispositions of teaching, is therefore a central concern of educational policy and research. In India, the National Education Policy 2020 has placed renewed emphasis on rigorous, practice-oriented teacher preparation and on restoring the status and integrity of teacher education institutions (Government of India, 2020). Whether these programmes achieve their aims depends not only on their curriculum and staffing but also on the attitudes with which trainees approach them.

Attitude has long been recognised as one of the most influential constructs in social psychology. Allport (1935) described it as a mental and neural state of readiness, organised through experience, that exerts a directive influence on behaviour, and later theorists have conceptualised attitude as a psychological tendency expressed by evaluating a particular entity with some degree of favour or disfavour (Eagly & Chaiken, 1993). In the context of teacher preparation, the entity being evaluated is the pedagogical formation programme itself: its professional value, its instructional approaches, its relevance to the work of teaching and the trainee's own capacity to benefit from it. Richardson (1996) demonstrated that the attitudes and beliefs prospective teachers bring to and develop during their preparation act as filters through which programme experiences are interpreted, so that trainees with

favourable attitudes engage more deeply and translate their learning into classroom practice more readily than those with unfavourable ones.

Measuring such attitudes with precision requires instruments whose internal structure has been established through rigorous psychometric procedures. Confirmatory factor analysis (CFA) is the method of choice for this purpose because it allows a theoretically specified measurement model to be tested against observed data rather than merely explored (Brown, 2015; Kline, 2016). Where the dimensions of an instrument prove to be strongly intercorrelated, higher-order factor modelling offers a further and theoretically important step: it tests whether the dimensions can be understood as facets of a single overarching construct and quantifies the contribution of each dimension to that construct (Chen et al., 2005; Marsh & Hocevar, 1985). The magnitude of the second-order loadings then answers a question of direct practical interest to teacher educators, namely which dimension carries the greatest weight in the overall attitude of prospective teachers towards their pedagogical formation.

The present study reports the confirmatory stage of the standardisation of the Attitude towards the Pedagogical Formation of Prospective Teachers Inventory, a 32-item instrument developed for use with trainees in Indian teacher education institutions. Three objectives guided the study. The first was to verify the hypothesised four-factor structure of the inventory in a fresh standardisation sample. The second was to test whether the four dimensions are manifestations of a single higher-order attitude construct. The third was to identify, through the standardised second-order loadings, which dimension exerts the greatest influence on the overall attitude towards pedagogical formation.

2. The Inventory and Its Dimensions

The inventory consists of 32 positively keyed statements answered on a five-point Likert scale. Its four dimensions were derived from the theoretical and empirical literature on teacher attitudes and teacher preparation, and each is represented by a contiguous block of items, as summarised in Table 3.

Professional Commitment and Value (F1, items F1V1 to F1V8) captures the trainee's evaluation of teaching as a worthwhile profession and of the pedagogical formation programme as an avenue into it. Commitment of this kind reflects the affective and evaluative core of attitude described by Eagly and Chaiken (1993) and has repeatedly been linked to persistence in teacher education and to early-career retention (Richardson, 1996).

Child-Centred and Instructional Practices (F2, items F2V9 to F2V16) assesses the trainee's disposition towards learner-centred pedagogy and towards the instructional strategies promoted in the programme, such as activity-based learning, continuous assessment and inclusive classroom practice. Favourable attitudes on this dimension indicate acceptance of the pedagogical vision that contemporary programmes, and the National Education Policy 2020, seek to instil (Government of India, 2020).

Relevance and Necessity of the Programme (F3, items F3V17 to F3V23) measures the perceived usefulness of pedagogical formation for actual classroom work. Darling-Hammond (2006) identified coherence between coursework and clinical practice, and the perceived relevance of the former to the latter, as defining features of powerful teacher education programmes, making this dimension an essential component of any attitude measure in this domain.

Personal Efficacy and Adaptability (F4, items F4V24 to F4V32) reflects the trainee's confidence in being able to meet the demands of the programme and of teaching, and the willingness to adapt to new curricular and technological expectations. The dimension draws on the construct of self-efficacy (Bandura, 1997) and on teacher efficacy research showing that such beliefs are among the strongest correlates of instructional quality and professional wellbeing (Tschannen-Moran & Woolfolk Hoy, 2001).

3. Method

3.1 Population

The population for the standardisation of the inventory comprised the 1410 prospective teachers enrolled in eight teacher education institutions of Tripura, India. These institutions prepare trainees for recognised pre-service

qualifications and together represent the government, university and private sectors of teacher education in the state.

3.2 Determination of Sample Size

The minimum sample size was estimated by Slovin's formula, $n = N / (1 + Ne^2)$, where n is the required sample size, N is the population size and e is the margin of error (Tejada & Punzalan, 2012). With N equal to 1410 and e equal to 0.05, the formula yields n equal to 312. To guard against non-response, ten per cent was added to this figure, giving a target sample of 344. In the event, complete responses were obtained from 345 prospective teachers, and all 345 were retained for analysis. The obtained sample also satisfies the guideline of MacCallum et al. (1996) that samples in the range of 300 to 400 provide adequate power for tests of close fit in models of this size. The determination of the sample is summarised in Table 1 and the institution-wise distribution in Table 2. Within institutions, trainees were selected by simple random sampling in proportion to institutional strength.

Table 1 Determination of the Standardisation Sample

Particular	Value
Population: prospective teachers in eight teacher education institutions of Tripura (N)	1410
Margin of error (e)	0.05
Minimum sample by Slovin's formula, $n = N / (1 + Ne^2)$	312
Addition of ten per cent for possible non-response	$312 + 31 = 343$ (rounded to 344)
Target sample	344
Complete responses obtained and analysed	345

Table 2 Institution-Wise Population and Sample

Sl. No.	Teacher Education Institution in Tripura	Estimated Population	Estimated Sample
1	Bhavans B.Ed College (Anandanagar)	200	49
2	Bhavans B.Ed College (Narasingarh)	200	49
3	ICFAI University	200	49
4	IASE Kunjaban	300	73
5	Holy Cross College	100	24
6	College of Teacher Education	200	49
7	Tripura University	100	24
8	Sanskrit University	110	28
	Total	1410	345

3.3 Instrument

The Attitude towards the Pedagogical Formation of Prospective Teachers Inventory contains 32 items distributed over four dimensions as shown in Table 3. Responses are recorded on a five-point Likert scale, and higher scores indicate a more favourable attitude towards pedagogical formation.

Table 3

Dimensions of the Attitude towards the Pedagogical Formation of Prospective Teachers Inventory

Factor	Name	Items	Number of Items
F1	Professional Commitment and Value	F1V1 to F1V8	8
F2	Child-Centred and Instructional Practices	F2V9 to F2V16	8
F3	Relevance and Necessity of the Programme	F3V17 to F3V23	7
F4	Personal Efficacy and Adaptability	F4V24 to F4V32	9
Total	Whole inventory	F1V1 to F4V32	32

3.4 Data Collection

The inventory was administered to the selected trainees in their institutions during working hours, after the purpose of the study had been explained and informed consent obtained. Respondents were assured that their answers would be used solely for research, that no answer was right or wrong, and that their identity would remain confidential. No time limit was imposed; respondents generally completed the inventory within fifteen to twenty minutes.

3.5 Data Analysis

Analyses were conducted in jamovi Version 2.7 (The jamovi project, 2025), which implements the lavaan package (Rosseel, 2012) in the R statistical environment (R Core Team, 2025). Three measurement models were estimated by maximum likelihood: Model 1, the hypothesised four-factor model with correlated factors; Model 2, a second-order model in which the four first-order factors load on a single general factor labelled Attitude towards Pedagogical Formation; and Model 3, a single-factor model in which all 32 items load directly on one factor. Factor variances were fixed at unity to identify the first-order models, and full information maximum likelihood was used to accommodate a negligible number of missing responses (four data points out of 11040). Model fit was appraised with the chi-square test, the ratio of chi-square to degrees of freedom, the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation (RMSEA) with its 90 per cent confidence interval, and the standardised root mean square residual (SRMR). Values of CFI and TLI of .90 or above, RMSEA of .08 or below and SRMR of .08 or below were taken to indicate acceptable approximate fit, with stricter values of .95, .06 and .06 indicating close fit (Browne & Cudeck, 1993; Hu & Bentler, 1999). Competing models were compared with the chi-square difference test and with the Bayesian information criterion (BIC), following Kline (2016).

4. Results**4.1 First-Order Measurement Model**

Table 4 presents the factor loadings of the four-factor model. Every one of the 32 items loaded significantly on its intended factor (all $p < .001$), confirming that each item is a meaningful indicator of its dimension. The loadings ranged from 0.382 to 0.719. Most items showed loadings between 0.50 and 0.72, a satisfactory range for attitude

inventories of this length, although five items (F3V20, F2V14, F3V22, F4V24 and F3V18) fell below 0.50 and are noted below as candidates for refinement in future revisions of the inventory.

Table 4 Factor Loadings of the Four-Factor Confirmatory Model (N = 345)

Factor	Indicator	Estimate	SE	z	p
Professional Commitment and Value (F1)	F1V1	0.629	0.047	13.28	< .001
	F1V2	0.586	0.044	13.45	< .001
	F1V3	0.719	0.043	16.91	< .001
	F1V4	0.622	0.047	13.36	< .001
	F1V5	0.617	0.047	13.15	< .001
	F1V6	0.602	0.051	11.73	< .001
	F1V7	0.571	0.089	6.40	< .001
	F1V8	0.587	0.043	13.65	< .001
Child-Centred and Instructional Practices (F2)	F2V9	0.560	0.042	13.48	< .001
	F2V10	0.518	0.047	10.92	< .001
	F2V11	0.661	0.043	15.32	< .001
	F2V12	0.647	0.044	14.76	< .001
	F2V13	0.676	0.044	15.43	< .001
	F2V14	0.419	0.097	4.32	< .001
	F2V15	0.593	0.047	12.76	< .001
	F2V16	0.527	0.043	12.31	< .001
Relevance and Necessity of the Programme (F3)	F3V17	0.658	0.044	14.95	< .001
	F3V18	0.499	0.098	5.07	< .001
	F3V19	0.693	0.043	15.99	< .001
	F3V20	0.382	0.043	8.82	< .001
	F3V21	0.656	0.042	15.79	< .001
	F3V22	0.469	0.042	11.19	< .001
	F3V23	0.568	0.045	12.51	< .001

Factor	Indicator	Estimate	SE	z	p
Personal Efficacy and Adaptability (F4)	F4V24	0.495	0.042	11.81	< .001
	F4V25	0.576	0.044	12.99	< .001
	F4V26	0.593	0.040	14.94	< .001
	F4V27	0.654	0.047	13.87	< .001
	F4V28	0.525	0.042	12.63	< .001
	F4V29	0.537	0.043	12.45	< .001
	F4V30	0.529	0.039	13.60	< .001
	F4V31	0.553	0.045	12.24	< .001
	F4V32	0.613	0.050	12.31	< .001

Note. Factor variances were fixed at unity for identification. All estimates are maximum likelihood estimates.

4.2 Factor Correlations

Because the factor variances were fixed at unity, the estimated factor covariances in Table 5 are interpretable as correlations. All six correlations were positive, very large and statistically significant, ranging from .815 between Professional Commitment and Value and Relevance and Necessity of the Programme to .913 between Child-Centred and Instructional Practices and Relevance and Necessity of the Programme. Correlations of this magnitude exceed the .85 benchmark commonly used to flag limited discriminant validity between factors (Brown, 2015; Kline, 2016). Rather than indicating a flaw in the instrument, such a pattern is the classic signature of a strong general factor underlying the dimensions, and it motivated the formal test of a second-order structure.

Table 5 Correlations among the Four First-Order Factors

Factor Pair	Estimate	SE	z	p
F1 with F2	0.855	0.025	34.3	< .001
F1 with F3	0.815	0.029	28.2	< .001
F1 with F4	0.882	0.022	39.9	< .001
F2 with F3	0.913	0.021	43.3	< .001
F2 with F4	0.874	0.023	37.8	< .001
F3 with F4	0.904	0.022	42.0	< .001

4.3 Model Fit and Model Comparison

Table 6 reports the fit of the three competing models. For the four-factor model the exact-fit chi-square test was significant, $\chi^2(458) = 1382.016$, $p < .001$, an expected outcome at this sample size, and attention therefore turns

to the approximate fit indices. The ratio of chi-square to degrees of freedom was 3.02, at the boundary of the conventional criterion of 3. The RMSEA of .076, with a 90 per cent confidence interval of .072 to .081, and the SRMR of .053 both satisfied the .08 criterion for acceptable approximate fit, while the CFI of .823 and TLI of .808 fell short of the .90 criterion. The overall picture is therefore one of partial support: the residual-based and parsimony-corrected indices indicate an acceptable approximation, while the incremental indices indicate room for improvement in the measurement model.

The second-order model fitted the data essentially as well as the correlated-factors model. The chi-square difference test was significant, $\chi^2(2) = 12.1$, $p = .002$, but the practical loss of fit was negligible: CFI declined by only .002, RMSEA and SRMR were unchanged to two decimal places, and the BIC values of the two models were virtually identical (26348.08 against 26348.50). Because the second-order model is more parsimonious and is the only model that represents the theoretical claim of a single overarching attitude, it was retained as the preferred structure. The single-factor model, by contrast, fitted clearly worse on every index (CFI = .790, TLI = .776, RMSEA = .083, BIC = 26490.68), confirming that the four dimensions carry distinct variance and should not be collapsed into an undifferentiated scale.

Table 6 Fit Indices for the Three Competing Measurement Models (N = 345)

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR	BIC
Model 1: Four correlated factors	1382.016	458	3.02	.823	.808	.076	[.072, .081]	.053	26348.08
Model 2: Second-order model	1394.115	460	3.03	.821	.807	.077	[.072, .081]	.053	26348.50
Model 3: Single factor	1559.677	464	3.36	.790	.776	.083	[.078, .087]	.056	26490.68

4.4 Second-Order Structure and the Influence of the Dimensions

Table 7 presents the standardised loadings of the four dimensions on the second-order factor, which answer the central question of the study. All four loadings were very high and statistically significant, establishing that Professional Commitment and Value, Child-Centred and Instructional Practices, Relevance and Necessity of the Programme and Personal Efficacy and Adaptability are all strong manifestations of a single general attitude towards pedagogical formation.

Personal Efficacy and Adaptability showed the highest standardised second-order loading ($\gamma = .952$), with the general attitude factor explaining 90.6 per cent of its variance, and is therefore identified as the most influential dimension of the attitude of prospective teachers towards their pedagogical formation. It was followed very closely by Relevance and Necessity of the Programme ($\gamma = .945$, 89.3 per cent) and Child-Centred and Instructional Practices ($\gamma = .943$, 89.0 per cent), whose confidence intervals overlap almost completely with that of Personal Efficacy and Adaptability; these three dimensions are best described as jointly dominant and statistically indistinguishable in their contribution. Professional Commitment and Value contributed comparatively least ($\gamma = .900$, 81.1 per cent), and it is the only dimension whose confidence interval separates appreciably from the others. The defensible ordering, then, is that Personal Efficacy and Adaptability ranks first numerically, Professional

Commitment and Value ranks clearly last, and the remaining two dimensions occupy an intermediate position scarcely distinguishable from the first.

Table 7 Standardised Second-Order Loadings of the Four Dimensions on the General Attitude Factor

Dimension	γ	SE	z	p	95% CI	R ²
Personal Efficacy and Adaptability (F4)	0.952	0.015	63.51	< .001	[0.922, 0.981]	.906
Relevance and Necessity of the Programme (F3)	0.945	0.017	56.33	< .001	[0.912, 0.978]	.893
Child-Centred and Instructional Practices (F2)	0.943	0.016	58.62	< .001	[0.912, 0.975]	.890
Professional Commitment and Value (F1)	0.900	0.019	47.75	< .001	[0.864, 0.937]	.811

Note. γ = standardised loading of the first-order factor on the second-order factor; R² = proportion of variance in the dimension explained by the general attitude factor. Dimensions are ordered by the magnitude of γ .

5. Discussion

This study set out to verify the structure of the Attitude towards the Pedagogical Formation of Prospective Teachers Inventory and to determine which of its dimensions weighs most heavily in the overall attitude of trainees. Three findings stand out.

First, the measurement claim of the inventory received substantial, though not complete, support. All 32 items were significant indicators of their intended dimensions, and the four-factor model reached acceptable values on the RMSEA and SRMR. At the same time, the incremental fit indices remained below conventional thresholds, a result to which the handful of weakly loading items (most notably F3V20 with a loading of 0.382 and F2V14 with 0.419) very likely contributed. These items share comparatively little variance with their factors and should be the first candidates for rewording or replacement in a subsequent revision of the inventory, a course of action consistent with standard scale-development practice (Brown, 2015).

Second, the four dimensions behave as facets of one construct. The very high factor correlations, the negligible practical difference in fit between the correlated-factors and second-order models, and the clearly inferior fit of the single-factor model together support a hierarchical interpretation: prospective teachers hold a single overarching attitude towards their pedagogical formation, which expresses itself through four distinguishable but tightly connected dimensions (Chen et al., 2005; Marsh & Hocevar, 1985). For users of the inventory this licenses both a total score, as an index of overall attitude, and dimension scores, provided the latter are interpreted as facets of the general construct rather than as independent traits.

Third, and centrally, Personal Efficacy and Adaptability emerged as the most influential dimension of the general attitude, followed at a statistically indistinguishable distance by Relevance and Necessity of the Programme and Child-Centred and Instructional Practices, with Professional Commitment and Value contributing least. The prominence of the efficacy dimension is theoretically coherent. Self-efficacy occupies a generative role in social cognitive theory: people approach, persist in and feel positively about activities they believe themselves capable of mastering (Bandura, 1997), and in teaching specifically, efficacy beliefs are among the strongest known correlates of engagement and instructional quality (Tschannen-Moran & Woolfolk Hoy, 2001). It is thus unsurprising that trainees' confidence in their own capacity to meet the demands of pedagogical formation should sit closest to the core of their overall attitude towards it. The near-equal weight of perceived programme relevance echoes the argument of Darling-Hammond (2006) that the felt connection between coursework and classroom practice is what gives teacher preparation its motivational force. The comparatively lower, though still very strong,

loading of Professional Commitment and Value suggests that global commitment to teaching as a career is somewhat more distal to the day-to-day evaluation of the formation programme than are efficacy, relevance and pedagogy.

For teacher education institutions, the practical implication is direct. Interventions that strengthen trainees' sense of capability and adaptability, such as graduated practicum experiences with constructive feedback, mastery experiences in microteaching and explicit support for coping with curricular and technological change, are likely to yield the largest dividends for overall attitude, because they act on the dimension most central to it. Efforts to make the relevance of coursework to classroom practice visible and to model child-centred pedagogy authentically address the two dimensions of essentially equal weight. Attitudinal work aimed solely at exhorting commitment to the profession, by contrast, targets the least central facet.

5.1 Limitations and Directions for Future Research

Four limitations deserve note. First, the incremental fit indices of the retained model fell below the .90 criterion, so the present structure should be regarded as a serviceable approximation rather than a finished measurement model; item-level refinement and re-testing are needed. Second, the second-order loadings quantify how strongly each dimension represents the general attitude, which is the standard structural meaning of influence in factor analysis, but they are not causal effects; experimental or longitudinal designs would be required to establish that changing a dimension changes overall attitude. Third, the sample, while adequate in size and drawn by probability methods, was confined to the eight teacher education institutions of a single Indian state, and cross-validation in other states and programme types is necessary before the norms are generalised. Fourth, all data were self-reported at a single point in time, so common method variance may have inflated the factor correlations to some degree. Future research should also test the measurement invariance of the second-order structure across gender, programme type and sector, following the procedures set out by Chen et al. (2005).

6. Conclusion

The Attitude towards the Pedagogical Formation of Prospective Teachers Inventory measures a single higher-order attitude expressed through four tightly connected dimensions. All items are significant indicators of their dimensions, the second-order model is the preferred representation of the data, and Personal Efficacy and Adaptability is the dimension that influences the overall attitude of prospective teachers most, followed closely by Relevance and Necessity of the Programme and Child-Centred and Instructional Practices, with Professional Commitment and Value contributing least. Teacher education institutions seeking to cultivate favourable attitudes towards pedagogical formation would do well to invest first in the experiences that build their trainees' sense of efficacy and adaptability.

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