KeAi
CHINESE ROOTS
GLOBAL IMPACT

International Journal of Innovation Studies

THE EFFECT OF NEURO COGNITIVE STRATEGY ON TEACHING PROFICIENCY AMONG B.ED. STUDENTS: A STRUCTURAL EQUATION MODELING APPROACH

K. Sudha
Ph.D Research Scholar, School of Education, Tamil Nadu Open University, Chennai-15, India

P. Pandia Vadivu
Associate Professor, School of Education, Tamil Nadu Open University, Chennai-15, India

Abstract
The present paper develops a full research framework for examining the effect of neuro cognitive strategy on teaching proficiency among Bachelor of Education (B.Ed.) students through Structural Equation Modeling (SEM). The study is grounded in the questionnaire provided in the PDF issued by Tamil Nadu Open University, which contains a personal data sheet and a 60-item Teaching Proficiency Questionnaire. The instrument conceptualizes teaching proficiency through five latent dimensions: communication skills, classroom management and listening, collaboration and professional interaction, adaptability and teaching methods, and patience and professional attitude. Because the questionnaire measures teaching proficiency but does not directly measure neuro cognitive strategy as a separate latent construct, the most defensible SEM specification is a model in which neuro cognitive strategy is treated as an observed exogenous intervention variable and teaching proficiency is modeled as a second-order latent endogenous construct reflected by the five first-order dimensions. This paper presents the theoretical foundation, conceptual model, hypotheses, SEM-based methodology, measurement and structural specifications, model-fit criteria, and educational implications. The paper argues that neuro cognitive strategy is likely to improve the pedagogic readiness of B.Ed. students by enhancing clarity of instruction, classroom responsiveness, collaborative behavior, adaptive teaching, and professional attitude. The study contributes to teacher education research by integrating brain-based instructional logic with latent-variable modeling, thereby offering a rigorous framework for evaluating intervention effects in pre-service teacher preparation.

Keywords: structural equation modeling, neuro cognitive strategy, teaching proficiency, B.Ed. students, teacher education, confirmatory factor analysis, conceptual framework

1. Introduction

Teacher education has a decisive influence on the future quality of schooling because the professional dispositions and instructional competencies of teachers are cultivated during the pre-service stage. In B.Ed. programs, student-teachers are expected not only to learn educational theory but also to demonstrate classroom-ready competencies such as communication, classroom management, adaptability, collaboration, emotional balance, and professional conduct. These competencies jointly form the broader construct of teaching proficiency.

In contemporary educational research, there is growing interest in approaches that connect classroom practice with the science of learning. Neuro cognitive strategy refers to instructional planning and pedagogic execution informed by cognitive and brain-based principles such as attention, memory, motivation, multisensory input, emotional regulation, patterning, reinforcement, and reflective engagement. These strategies are expected to improve not only student learning outcomes but also the teaching behavior of pre-service teachers who are trained to use them.

The questionnaire in the provided PDF, titled "The Effect of Neuro Cognitive Strategy on Teaching Proficiency among B.Ed. Students", offers a strong empirical base for studying this relationship. The instrument includes 60 teaching proficiency items organized under five dimensions. This multidimensional structure makes the questionnaire particularly suitable for Structural Equation Modeling, because SEM can simultaneously examine latent constructs, measurement quality, and causal paths between variables. Unlike simpler statistical procedures that only compare total scores, SEM allows the researcher to validate the dimensional structure of teaching proficiency and test whether neuro cognitive strategy significantly predicts the higher-order proficiency construct.

This paper therefore reframes the questionnaire-based study into a full SEM-oriented research paper. It presents a conceptual model in which exposure to neuro cognitive strategy predicts teaching proficiency as a second-order latent variable reflected through five first-order domains measured by the 60 items in the questionnaire.

2. Background and Rationale

Pre-service teachers often experience a gap between theoretical instruction and classroom practice. Many student-teachers understand lesson planning in principle but struggle with clear explanation, student engagement, differentiated instruction, classroom control, and patient response to learner difficulties. Teacher education programs need pedagogic approaches that are psychologically informed and practically actionable.

Neuro cognitive strategy is relevant in this context because it emphasizes how learning is influenced by prior knowledge, emotion, sensory richness, attention span, repetition, social interaction, and feedback. These elements are also closely aligned with core domains of effective teaching. A trainee who uses neuro cognitively informed strategies is more likely to organize content meaningfully, maintain student attention, respond flexibly, encourage active participation, and support different learners more patiently.

The significance of the present paper lies in three major areas. First, it extends teacher education research by connecting neuro cognitive strategy with observable professional competencies. Second, it treats teaching proficiency as a latent multidimensional construct rather than a crude total score. Third, it demonstrates how SEM can strengthen educational research design by validating the questionnaire structure before testing the causal effect of the intervention.

3. Theoretical Foundation

The conceptual logic of the study draws support from multiple strands of educational theory.

Vygotsky's sociocultural theory explains that higher mental functions develop through mediated interaction, language, and social participation. This supports pedagogies that encourage dialogue, scaffolding, and collaborative learning. In teacher education, these ideas align with communication competence, responsive listening, and collaboration.

Shulman's concept of pedagogical reasoning and pedagogical content knowledge explains that effective teaching requires more than possessing subject knowledge. Teachers must transform knowledge into forms that learners can understand. This idea supports the questionnaire dimensions of explanation, adaptability, and appropriate teaching methods.

Brain-based and neuro cognitive educational perspectives, especially those advanced by Jensen and by the learning sciences literature, emphasize the role of attention, emotion, memory, feedback, and active processing in meaningful learning. Such principles justify the assumption that neuro cognitive strategy can influence the day-to-day instructional conduct of pre-service teachers.

Hattie's work on visible learning highlights the importance of teacher clarity, feedback, learning intentions, and relational trust, all of which resonate with the questionnaire items. Marzano's instructional framework further supports the centrality of communication, classroom management, engagement, and professional reflection in teacher effectiveness.

Taken together, these frameworks suggest that neuro cognitive strategy should not be viewed as a narrow technique but as an intervention that can positively affect the broader latent construct of teaching proficiency.

4. Review of Related Literature

Research on teacher effectiveness consistently shows that classroom success depends on a cluster of interconnected competencies rather than a single trait. Communication clarity, instructional variety, classroom organization, student engagement, emotional regulation, collegial behavior, and feedback practices repeatedly emerge as central indicators of effective teaching.

Studies rooted in brain-based learning have argued that instructional methods become more powerful when they align with how learners attend, encode, and retrieve information. Strategies that activate prior knowledge, involve multisensory input, encourage participation, and connect content with real-life contexts tend to produce deeper engagement. In teacher preparation, these strategies can also shape the behavior of the student-teacher by increasing pedagogic confidence and reflective control.

The questionnaire in the supplied PDF operationalizes teaching proficiency across five domains:

1. Communication Skills
2. Classroom Management and Listening
3. Collaboration and Professional Interaction
4. Adaptability and Teaching Methods
5. Patience and Professional Attitude

From a measurement perspective, this structure is highly suitable for CFA and SEM. The five domains can be validated as first-order latent factors, while overall teaching proficiency can be modeled as a second-order factor. The structural part of the model can then test whether exposure to neuro cognitive strategy predicts this second-order construct.

Methodologically, Anderson and Gerbing recommended a two-step approach in SEM: first validate the measurement model, then estimate the structural model. Fornell and Larcker emphasized convergent and discriminant validity in latent-variable research. Hu and Bentler

proposed fit criteria that remain widely used when evaluating SEM adequacy. These contributions provide the methodological backbone for the present study.

5. Research Gap

Although teacher education research has addressed instructional competency, classroom management, and reflective practice, fewer studies have modeled teaching proficiency through SEM in the context of neuro cognitive strategy. Many studies rely on simple mean comparisons or descriptive analysis without validating the latent structure of the construct being measured. The present paper addresses this gap by proposing a second-order SEM framework that is closely aligned with the actual questionnaire structure found in the PDF.

6. Statement of the Problem

The problem of the study may be stated as follows:

To examine, through Structural Equation Modeling, the effect of neuro cognitive strategy on teaching proficiency among B.Ed. students.

7. Conceptualization of Variables

7.1 Exogenous Variable

Neuro Cognitive Strategy (NCS): In the present SEM specification, neuro cognitive strategy is treated as an observed exogenous variable representing intervention exposure. Students who receive teaching-learning input through neuro cognitive strategy may be coded as `1`, while students in the conventional or comparison condition may be coded as `0`. This specification is appropriate because the questionnaire in the PDF does not contain separate items that directly measure neuro cognitive strategy as a latent construct.

7.2 Endogenous Variable

Teaching Proficiency (TP): Teaching proficiency is modeled as a second-order latent construct reflected by five first-order latent dimensions:

- Communication Skills (CS)
- Classroom Management and Listening (CML)
- Collaboration and Professional Interaction (CPI)
- Adaptability and Teaching Methods (ATM)
- Patience and Professional Attitude (PPA)

Each first-order factor is measured by 12 observed items from the questionnaire.

8. Conceptual Framework

The SEM-based framework treats neuro cognitive strategy as the causal input and teaching proficiency as the latent outcome. The intervention is assumed to influence the overall teaching proficiency of B.Ed. students. Teaching proficiency is not directly observed; rather, it is manifested through the five domains measured by the questionnaire.

This specification is academically advantageous for four reasons:

- It respects the actual structure of the questionnaire.
- It separates the measurement model from the structural effect.
- It allows testing of construct validity before hypothesis testing.
- It models teaching proficiency as a multidimensional higher-order construct.

9. Conceptual Diagram

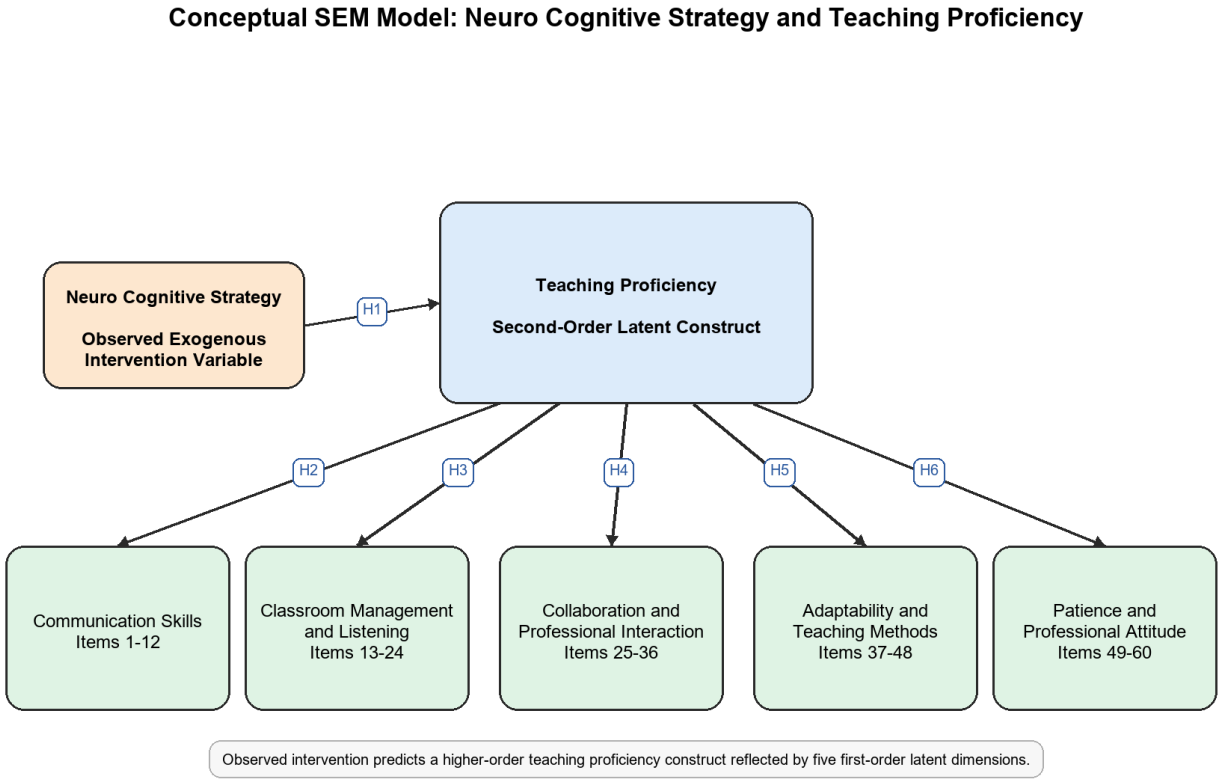

Figure 1. Proposed Structural Equation Model of the effect of neuro cognitive strategy on teaching proficiency among B.Ed. students.

10. Research Objectives

The study may be guided by the following objectives:

- To validate the factor structure of the Teaching Proficiency Questionnaire using confirmatory factor analysis.
- To examine whether teaching proficiency is best represented as a second-order latent construct reflected by five first-order dimensions.
- To test the effect of neuro cognitive strategy on overall teaching proficiency among B.Ed. students.
- To estimate the contribution of each first-order dimension to the higher-order construct of teaching proficiency.
- To assess the reliability, convergent validity, and discriminant validity of the SEM measurement model.
- To examine whether selected background variables may later be used as grouping or control variables in extended SEM analysis.

11. Research Hypotheses

The following hypotheses may be framed:

****H1:** Neuro cognitive strategy has a significant positive direct effect on teaching proficiency among B.Ed. students.

****H2:** Communication Skills loads positively and significantly on the latent construct of Teaching Proficiency.

H3: Classroom Management and Listening loads positively and significantly on the latent construct of Teaching Proficiency.
H4: Collaboration and Professional Interaction loads positively and significantly on the latent construct of Teaching Proficiency.
H5: Adaptability and Teaching Methods loads positively and significantly on the latent construct of Teaching Proficiency.
H6: Patience and Professional Attitude loads positively and significantly on the latent construct of Teaching Proficiency.
If the researcher wishes to conduct multigroup SEM later, additional hypotheses may compare the model across gender, medium of instruction, type of management, or college location.

12. Methodology

12.1 Research Design

The study is best designed as a quantitative explanatory study with an intervention component. A pre-test-post-test control group design is ideal if the researcher wants to establish stronger causal inference. For SEM, the post-intervention dataset may be used to test the structural model, while change scores or repeated-measures SEM may be considered in advanced designs.

12.2 Population

The population may consist of B.Ed. students enrolled in colleges of education affiliated with the relevant university or teacher education institutions selected for the study.

12.3 Sample

SEM generally requires a reasonably large sample, especially when working with item-level indicators. Since the questionnaire contains 60 observed indicators and five latent factors, a sample of at least 300 is advisable, while 400 or more would provide stronger estimation stability for covariance-based SEM. If the researcher intends to use item parcels or dimension scores, the model can be simplified, but the item-level approach is psychometrically richer.

12.4 Sampling Technique

Depending on feasibility, the researcher may use stratified random sampling, simple random sampling, or purposive sampling across colleges that represent urban and rural locations, different management types, and Tamil and English medium contexts.

12.5 Dimensional Structure of the Instrument

Latent factor	Item range	Number of items
Communication Skills	1-12	12
Classroom Management and Listening	13-24	12
Collaboration and Professional Interaction	25-36	12
Adaptability and Teaching Methods	37-48	12
Patience and Professional Attitude	49-60	12

12.6 Data Collection Procedure

The following sequence may be adopted:

- Identify the participating B.Ed. colleges and student-teachers.

- Administer the intervention based on neuro cognitive strategy to the experimental group.
- Retain the conventional mode for the comparison group where applicable.
- Administer the Teaching Proficiency Questionnaire after the intervention or in both pre-test and post-test format depending on the design.
- Code the intervention variable as observed exogenous input for SEM.
- Enter responses into a statistical software package capable of CFA and SEM, such as AMOS, LISREL, Mplus, R `lavaan`, or SmartPLS where theoretically appropriate.

13. SEM Specification

13.1 Measurement Model

The measurement model consists of five first-order latent variables measured by their respective questionnaire items. The first-order factors are then specified as indicators of one second-order latent construct, Teaching Proficiency.

At the measurement level, the model tests whether:

- items load significantly on their intended dimensions,
- each dimension exhibits adequate internal consistency,
- the five dimensions are empirically distinguishable yet related,
- the second-order structure is supported by the data.

13.2 Structural Model

The structural component specifies a direct path from Neuro Cognitive Strategy to Teaching Proficiency:

`NCS -> TP`

This path represents the central claim of the study: B.Ed. students exposed to neuro cognitive strategy are expected to show higher latent teaching proficiency than those in the comparison condition.

14. Data Analysis Plan

The SEM analysis may proceed in the following stages.

14.1 Preliminary Screening

Before running SEM, the researcher should examine:

- missing values,
- outliers,
- normality,
- linearity,
- multicollinearity,
- response coding accuracy,
- reverse-scored items.

14.2 Descriptive Analysis

Means, standard deviations, skewness, and kurtosis may be computed for all items and factor scores.

14.3 Reliability Analysis

Reliability may be assessed through:

- Cronbach's alpha,
- Composite Reliability (CR),
- indicator loadings.

Acceptable thresholds generally include CR values above 0.70 and standardized loadings preferably above 0.50, with stronger preference for values above 0.70 where theoretically reasonable.

14.4 Convergent Validity

Convergent validity may be established through:

- significant standardized factor loadings,
- Average Variance Extracted (AVE) values above 0.50,
- conceptual consistency of indicators within each dimension.

14.5 Discriminant Validity

Discriminant validity may be assessed through the Fornell-Larcker criterion, where the square root of AVE for each construct should exceed its correlations with other constructs.

14.6 Overall Model Fit

The following fit indices may be reported:

- Chi-square to degrees of freedom ratio (`χ2/df`)
- Comparative Fit Index (`CFI`)
- Tucker-Lewis Index (`TLI`)
- Root Mean Square Error of Approximation (`RMSEA`)
- Standardized Root Mean Square Residual (`SRMR`)

Commonly reported benchmarks include:

- `χ2/df < 3.00`
- `CFI >= 0.90` and preferably `>= 0.95`
- `TLI >= 0.90` and preferably `>= 0.95`
- `RMSEA <= 0.08` and preferably `<= 0.06`
- `SRMR <= 0.08`

These values should be interpreted as guidelines rather than rigid rules.

14.7 Structural Path Testing

The direct effect of Neuro Cognitive Strategy on Teaching Proficiency should be evaluated through:

- standardized path coefficient (`beta`),
- critical ratio or `z` value,
- `p` value,
- confidence intervals where supported.

If the path is positive and significant, the main hypothesis of the study is supported.

15. Model Interpretation Framework

The interpretation of the SEM results should proceed at two levels.

15.1 Measurement Interpretation

If all five first-order factors load strongly on the second-order construct, the study confirms that teaching proficiency among B.Ed. students is a multidimensional but coherent latent construct. This would validate the questionnaire structure embedded in the PDF.

15.2 Structural Interpretation

If the path from neuro cognitive strategy to teaching proficiency is significant and positive, the result may be interpreted to mean that exposure to neuro cognitively informed training or instruction improves the professional competence of student-teachers. In practical terms, this would imply improvement in lesson clarity, responsiveness to students, collaborative behavior, instructional flexibility, and emotional patience in classroom settings.

16. Discussion

The proposed SEM model offers a more rigorous analytical route than simple score comparison because it recognizes that teaching proficiency is not directly observable. Instead, it emerges through multiple dimensions of pedagogic behavior. Modeling these dimensions as latent variables helps reduce measurement error and provides stronger construct validity.

From an educational standpoint, the model assumes that neuro cognitive strategy improves teaching proficiency because it helps student-teachers teach in ways that are cognitively supportive and emotionally intelligent. Such trainees are expected to state lesson objectives clearly, vary examples, encourage participation, manage time, listen attentively, adapt methods, collaborate with peers, and remain patient with diverse learners.

If supported empirically, the findings would strengthen the case for integrating neuro cognitive principles into teacher education curricula. Rather than treating teacher preparation as a purely theoretical course of study, institutions could use neuro cognitive strategy to build practical, measurable, and research-validated teaching competence.

17. Educational Implications

The study has several implications for policy and practice:

- Teacher education programs can integrate neuro cognitive strategy into pedagogy courses, demonstration lessons, and internship supervision.
- The Teaching Proficiency Questionnaire can be used as a validated multidimensional assessment tool for student-teachers.
- SEM-based validation strengthens the scientific credibility of teacher education research.
- Colleges of education can use the five proficiency domains to design targeted training modules.
- Future intervention studies can expand the model by adding mediators such as self-efficacy, reflective practice, or motivation.

18. Limitations

The proposed study has several limitations:

- The current questionnaire directly measures only teaching proficiency; it does not include a separate latent scale for neuro cognitive strategy.
- If self-report alone is used, common method bias and social desirability may affect responses.
- Item-level SEM with 60 indicators requires a comparatively large sample.
- The study may be context-specific to the institutions and population sampled.

19. Suggestions for Future Research

Future researchers may:

- Develop and validate a separate Neuro Cognitive Strategy Scale and estimate a full latent-to-latent SEM.
- Use multigroup SEM to compare the model across gender, medium of instruction, or institutional type.
- Include classroom observation as an external criterion variable.
- Test mediating variables such as teaching self-efficacy or reflective practice.
- Use longitudinal SEM to examine sustained effects over time.

20. Conclusion

This paper demonstrates that the questionnaire provided in the PDF can be converted into a rigorous SEM-based research framework for studying the effect of neuro cognitive strategy on teaching proficiency among B.Ed. students. The most defensible model, given the instrument, treats neuro cognitive strategy as an observed exogenous intervention variable and teaching proficiency as a second-order latent construct reflected by five first-order dimensions. This approach preserves the logic of the original questionnaire while substantially strengthening the analytical sophistication of the study.

The value of this model lies in both theory and method. Theoretically, it links brain-informed pedagogy with teacher competence. Methodologically, it validates the structure of teaching proficiency before estimating the intervention effect. As a result, the paper offers a strong academic foundation for a dissertation chapter, seminar paper, journal-style manuscript, or full empirical study once actual data are collected.

References

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411-423. https://doi.org/10.1037/0033-2909.103.3.411

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school: Expanded edition*. National Academy Press. https://doi.org/10.17226/9853

Dhillon, N., & Kaur, G. (2021). Self-assessment of teachers' communication style and its impact on their communication effectiveness: A study of Indian higher educational institutions. *SAGE Open, 11*(2). https://doi.org/10.1177/21582440211023173

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. https://doi.org/10.2307/3151312

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Routledge.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Jensen, E. (2005). *Teaching with the brain in mind* (2nd ed., revised). ASCD.

Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). Guilford Publications.

Marzano, R. J. (2007). *The art and science of teaching: A comprehensive framework for effective instruction*. ASCD.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review, 57*(1), 1-23. https://doi.org/10.17763/haer.57.1.j463w79r56455411

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.