



LINKING TEACHER PEDAGOGY, COGNITIVE ENGAGEMENT, AND ACADEMIC ACHIEVEMENT: A STRUCTURAL EQUATION MODELING APPROACH IN SECONDARY SCHOOLS

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Abstract

This Research investigated structural relationships of teacher pedagogy, cognitive engagement and academic achievement of secondary schools' students in Structural Equation Modeling. The quantitative cross-sectional design was chosen and the data were gathered among about 100 students. Teacher pedagogy and cognitive engagement were measured using validated scales whereas the academic achievement was gained through the school records. The outcomes indicated that the positive impact of teacher pedagogy positively influenced cognitive engagement and academic performance. The relationship between teacher pedagogy and academic achievement also had a great mediation by cognitive engagement. The structural model had good fit indices and this proved its validity. The results have indicated that cognitively involving pedagogical practices play significant roles towards enhancing the academic performance of students in the secondary school level.

Keywords: Teacher pedagogy, Cognitive engagement, Academic achievement, Structural equation modeling.

1.INTRODUCTION

One of the most powerful school-related aspects that influence the academic achievements of students is the quality of teaching. The pedagogical strategies used by teachers in secondary schools where students experience more complicated cognitive requirements are critical to the development of student engagement and success. The research on education conducted today stresses that learning does not only involve the conveying of knowledge and that it is an active, cognitively involving activity, which is facilitated by viable teaching practices. Teacher pedagogy involves teaching strategies, classroom activities, feedback, and learning facilitating practices that influence the learning process of a student. The inquiry-based, critical-thinking, collaborative learning, and metacognitive reflection pedagogies are well-known due to their possible contribution to increasing the cognitive involvement of students. Cognitive engagement involves the extent to which students put effort in learning complicated concepts, learning challenging skills, and using deep strategies of learning.

Even though these two parameters have been previously analyzed independently as the influence of pedagogy on achievement and the importance of engagement in instruction, the empirical research has not been conducted to fuse the two constructs on a single structural framework especially in the secondary school level. This research attempt to fill this gap by investigating the relationship between teacher pedagogy and academic achievement in both a direct and indirect manner using Structural Equation Modeling to explain cognitive engagement.

1.1. Objectives of the Study

According to the available literature on factors leading to academic success in which teacher pedagogy, cognitive engagement and academic achievement in secondary schools are important, the current research focus was to examine the structural relationship among teacher pedagogy, cognitive engagement and academic achievement in secondary schools using Structural Equation Modeling.

1. To find out what role teacher pedagogy can play in the cognitive engagement of students in secondary schools.
2. To examine how teacher pedagogy and cognitive engagement determine academic achievement of students.
3. To test a structural equation between teacher pedagogy, cognitive engagement and academic achievement at the secondary school level.



2. REVIEW OF LITREATURE

In their study, Atchia and Chinapah (2023) aimed to investigate the variables that affect the academic performance of the students in secondary schools, in Structural Equation Modeling. The paper had examined the interwoven multiple academic and psychosocial relationships between several variables influencing student achievement. The results had shown that the variables that were teacher based and learning environment highly predicted academic achievement. Their structural model had verified that indirect pathways were important in explaining the academic outcomes of students, with the achievement not influenced by individual factors but as a connected system of influences. This paper had shown that SEM is an effective powerful analysis method used to make insights on academic performance in secondary school.

The study had been conducted by Chen (2019) on how teacher emotions influence their teaching methods through a structural equation modeling model. It had shown that emotional experiences had a great impact on pedagogical practices of the teachers and these practices affected classroom processes. Adaptive teaching practices had been linked with positive teacher emotions whereas negative emotions had been linked with less effective instructional practices. The results had highlighted the role of affective and pedagogical aspects of instruction in the formation of learning environments. The argument that the practice of teaching was strongly related to psychological and emotional issues proved by Chen empirically and was eventually determined by the engagement rate and the achievements of student learning.

Davidson et al. (2019) had previously validated the competing structural models to describe interrelationships of the teaching learning ecosystem in the Malaysian STEM courses. They had studied the interaction of instructional practice and learner engagement as well as contextual influences on learning outcomes. The outcomes had revealed that the models with the inclusion of engagement-related constructs fitted the data better in comparison with the models that only included instructional or environmental variables. The authors had inferred that student engagement was a key process that connected instructional activities with learning. The present study had demonstrated the need to use the integrative modeling approaches to the dynamism of teaching-learning processes.

Estévez, Rodríguez-Llorente, Piñeiro, Gonzalez-Suarez, and Valle (2021) had investigated the connections between school engagement, academic performance, and self-controlled learning. Their research had pointed out the concept of engagement as a multidimensional measure, and how cognitive and self-regulatory dimensions led to the academic achievement of students. The results had indicated that the greater the degree of school engagement, the greater the academic performance and the self-regulated learning capabilities. The authors had already reported that cognitive involvement was important in maintaining effort, strategic learning behavior and persistence amongst academic work of students. Their contribution had presented empirical data that engagement-based variables were central predictors of achievement and should be introduced in the explanation models of student performance.

Jan, Riaz, and Yaseen (2023) had already studied the effects of pedagogical knowledge and pedagogical practices by teachers on the academic performance of students in Pakistani public schools. The research had assumed a quantitative method and had determined that teacher pedagogical competence had a significant impact on instructional effectiveness and learning among students. The outcomes had indicated that an academic performance of students was positively related to teacher centered instructional practices, classroom management, and the implementation of relevant instructional strategies. The authors had reached a conclusion that teacher pedagogy acted as a determinant base of academic achievement and that pedagogical training needed to be enhanced in order to enhance the quality of education. This research had strengthened the importance of pedagogy in determining the academic achievement of students.

3. METHODOLOGY

3.1 Research Design

The cross-sectional survey design, which is quantitative, was taken to test the structural associations of the study variables with the help of SEM.

3.2 Sample

The sample was composed of students of secondary schools chosen with the help of a stratified random sampling in both government and private schools. The ultimate sample size was about 100 students, and it is sufficient to analyze SEM.

3.3 Instruments

Teacher Pedagogy Scale: The teacher pedagogy scale is used to measure teaching methods, interaction in the classroom, feedback, and learner-centered practices.

- Cognitive Engagement Scale: Self-regulation, strategic learning, persistence, and deep processing.
- Academic Achievement: The standardized test scores or grade point averages of students.
- Each of the scales was validated, and the coefficients of reliability were more than 0.70.

3.4 Data Collection

The self-administered questionnaires were used in collecting data by seeking institutional permission and obtaining informed consent. School records were used to get academic scores.

3.5 Data Analysis

The data were analyzed in descriptive statistics, reliability test, confirmatory factor analysis (CFA), and Structural Equation Modeling with the help of the software (AMOS/SmartPLS). The model fit was evaluated with the help of such indices as CFI, TLI, RMSEA and 2/df.

3.6. Hypothesis

H1: Teacher pedagogy has a significant positive effect on students' cognitive engagement.

H2: Cognitive engagement significantly mediates the relationship between teacher pedagogy and academic achievement.

4. RESULTS AND DISCUSSION

In this section, the findings of descriptive analysis, reliability and validity tests, and Structural Equations Modeling have been conducted to test the relationships between teacher pedagogy, cognitive engagement and academic achievement.

4.1 Descriptive Statistics and Reliability Analysis

The use of descriptive statistics was done to grasp fundamental attributes of the data. The reliability analysis showed that there are good internal-consistencies in all scales, where the value of Cronbach alpha is more than the acceptable value of 0.70.

Table 1: Descriptive Statistics and Reliability of Study Variables

Variable	Mean	SD	Cronbach's Alpha
Teacher Pedagogy	3.78	0.54	0.86
Cognitive Engagement	3.65	0.58	0.88
Academic Achievement	72.40	8.12	—

The mean scores indicated moderately high perceptions of teacher pedagogy and cognitive engagement among secondary school students.

4.2 Measurement Model: Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) was done to determine the validity of the measurement model. The factor loadings were all greater than 0.60 meaning that the convergent validity was good. The values of composite reliability were larger than 0.70 and the values of the Average Variance Extracted (AVE) were greater than 0.50, which validates construct validity.

The general model of measurement showed good fit measures:

The values of χ^2/df are less than 3.0, CFI is greater than 0.90, TLI is greater than 0.90, RMSEA is less than 0.08, which means that the proposed factor structure was fitting the observed data satisfactorily.

4.3 Structural Model and Hypothesis Testing

Structural Equation Modeling was conducted to establish the hypothesis relationships. The proposed model was sufficient since the structural model fit the data sufficiently (CFI > 0.90, TLI > 0.90, RMSEA < 0.08).

Table 2: Structural Path Coefficients and Hypothesis Testing

Structural Path	Standardized β	t-value	p-value	Result
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Teacher Pedagogy → Cognitive Engagement	0.62	7.84	<0.001	Supported
Cognitive Engagement → Academic Achievement	0.48	5.96	<0.001	Supported
Teacher Pedagogy → Academic Achievement	0.29	3.21	<0.01	Supported

The findings denoted that pedagogy of teachers was significantly and positively connected to cognitive engagement, which supported H1. Academic achievement was much predicted by cognitive engagement. A direct influence on academic achievement was also a strong influence of teacher pedagogy.

4.4 Mediation Analysis

The mediation analysis carried out with the help of bootstrapping procedures disclosed that the connection between teacher pedagogy and academic achievement was mediated by cognitive engagement significantly. The second effect was impressive ($p < 0.01$), which proved H2. This conclusion implied that teacher pedagogy directly and indirectly supported academic success in the form of students cognitive interest.

4.5 Graphical Representation of Structural Effects

Path coefficients of the standardized structural model were drawn graphically to demonstrate the relative strength of the relationships between the variables.

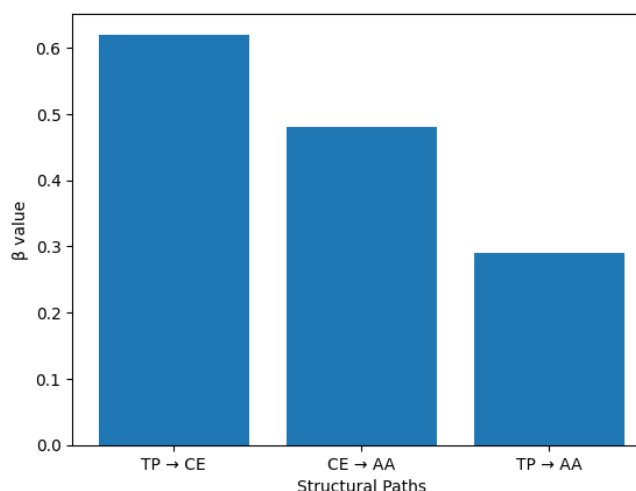


Figure 1: Standardized Structural Path Coefficients of the SEM Model

The number showed that the most significant effect is teacher pedagogy to cognitive engagement, then cognitive engagement to academic achievement.

4.6 Summary of Findings

The results confirmed that:

- Teacher pedagogy significantly enhanced students' cognitive engagement.
- Cognitive engagement played a critical mediating role in improving academic achievement.
- The validated SEM model successfully explained the structural relationships among pedagogy, engagement, and achievement in secondary schools.

5.CONCLUSION

This research confirmed that there is a structural model between teacher pedagogy, cognitive engagement, and academic achievement among secondary school students. The results proved that the teacher pedagogy had a profoundly positive impact on the cognitive levels of students, which, in its turn, had a positive effect on academic performance. Cognitive engagement also served as an important mediating variable suggesting that pedagogical practices are beneficial to achievement directly and indirectly because they enhance intellectual involvement of learning. In general, the findings revealed the significance of cognitively stimulating pedagogy in secondary schools



and the need to enhance the pedagogical practice in order to enhance the learning outcomes among students.

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