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Exploring the Relationship between Learning Environment and Academic Performance in Chinese Vocational Schools: The Mediating Role of Student Satisfaction

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Abstract

This study aims to explore the impact and mechanisms of the Learning Environment in Chinese vocational colleges on students' Academic Performance, with a particular focus on the mediating role of Student Satisfaction. Through empirical analysis, the study identifies the direct influence of the Learning Environment on students' Academic Performance and elucidates the mediating role of Student Satisfaction between Learning Environment and Academic Performance. A quantitative research methodology was employed utilizing Structural Equation Modeling (SEM) for data analysis. Data was collected via an online questionnaire survey targeting 700 students from 10 vocational colleges in Shandong Province, China. Descriptive statistical analysis results indicated that the scores for various aspects of the Learning Environment (physical environment, social environment, and teaching environment), as well as Student Satisfaction and Academic Performance, were relatively high. Correlation analysis results revealed a significant positive relationship between the Learning Environment and Academic Performance. Structural Equation Modeling analysis and Bootstrap mediation effect test results demonstrated that Student Satisfaction partially mediates the relationship between Learning Environment and Academic Performance. Based on the results of the research, it can be concluded that optimizing the Learning Environment and enhancing Student Satisfaction are crucial for improving students' Academic Performance in vocational colleges.

Keywords: Learning environment; Academic performance; Student satisfaction; Structural equation modeling.

1. Introduction

In today's rapidly changing global economic environment, vocational education is regarded as a vital pathway for cultivating skilled talent and driving economic development (Xu *et al.*, 2021). As China's economy continues to grow, the demand for high-quality technical personnel has significantly increased, positioning vocational colleges as increasingly important players within the education system (Liu *et al.*, 2019). However, despite the rising status and importance of vocational education, effectively enhancing the Academic Performance of students in vocational colleges remains a crucial issue that needs to be addressed (Wang *et al.*, 2020). Academic Performance not only impacts students' personal career development and quality of life but also plays a significant role in the economic and technological advancement of society (Zhang *et al.*, 2022). Therefore, a thorough investigation into the factors

influencing the Academic Performance of vocational college students is of substantial theoretical and practical significance.

Among the numerous factors affecting Academic Performance, Learning Environment and Student Satisfaction have garnered considerable attention (Closs *et al.*, 2022). The Learning Environment encompasses multiple aspects, including the physical environment, teaching resources, teacher-student relationships, and school management (Li *et al.*, 2021). These factors collectively influence students' learning attitudes, behaviors, and academic achievements. Moreover, Student Satisfaction, as an essential psychological perception, reflects students' overall evaluation of the Learning Environment and the educational process. It may serve as a mediating factor between Learning Environment and Academic Performance (Gao *et al.*, 2020). Consequently, this study aims to answer the following questions: How does the Learning Environment impact the Academic Performance of vocational college students? What mediating role does Student Satisfaction play between Learning Environment and Academic Performance?

The primary objective of this study is to explore the impact and mechanisms of the Learning Environment on students' Academic Performance in vocational colleges, with a particular focus on the mediating role of Student Satisfaction. Through empirical analysis, this study aims to: (1) identify the direct influence of the Learning Environment on students' Academic Performance, and (2) elucidate the mediating role of Student Satisfaction between Learning Environment and Academic Performance. The findings will provide scientific evidence for educational management and policy-making in vocational colleges to enhance students' academic achievements and educational quality.

This study employs a quantitative research methodology, utilizing Structural Equation Modeling (SEM) for data analysis. First, a literature review was conducted to identify the research variables and hypotheses. Subsequently, a survey questionnaire was designed to collect data. The data analysis includes descriptive statistics, correlation analysis, and SEM to test the research hypotheses and analyze the relationships between variables.

This paper is organized into six sections. The first section, the introduction, outlines the research background, research questions, research objectives, significance, and an overview of the research methodology. The second section, the literature review, reviews relevant studies in the field and proposes research hypotheses. The third section, research methodology, details the research design, sample and data collection, variable measurement, and data analysis methods. The fourth section, research results, presents the descriptive statistical results and SEM analysis results. The fifth section, discussion, interprets the main findings, explores their theoretical contributions and practical implications, and discusses the study's limitations and future research directions. The sixth section, conclusion, summarizes the key findings of the study and offers corresponding policy recommendations.

2. Literature Review and Theoretical Foundation

2.1. Theoretical Foundation of Learning Environment

The Learning Environment encompasses all factors and conditions in the educational process that influence students' learning activities and Academic Performance. Based on educational and psychological theories, the Learning Environment can be categorized into three aspects: physical environment, social environment, and teaching environment (Crowe, 2023). The physical environment includes classroom layout, facilities, and teaching resources; the social environment comprises teacher-student relationships, peer relationships, and campus culture; the teaching environment covers teaching methods, curriculum design, and teacher quality (Omar and Awang, 2023).

The Ecological Systems Theory posits that individual development is affected by multi-level, multi-factor environments, with micro-systems and meso-systems playing crucial roles in students' learning and development. According to this theory, various aspects of the Learning Environment interact in complex ways to influence students' learning behaviors and Academic Performance (Nikolaev, 2022).

2.2. Research on Academic Performance

Academic Performance is generally considered an essential indicator of students' learning outcomes, encompassing knowledge acquisition, skill development, and academic achievements (Istiqomah and Hasanati, 2022). It reflects not only students' learning abilities and efforts but also the quality of teaching, school management, and family educational support (Agbofa, 2023).

Existing research indicates that Academic Performance is influenced by a combination of factors. Teaching methods and quality directly impact students' learning outcomes, while school management and resource allocation indirectly enhance Academic Performance by improving the Learning Environment (Alam and Islam, 2022). Additionally, internal factors such as students' learning motivation, strategies, and habits are also crucial determinants of Academic Performance (Al-Tameemi *et al.*, 2023).

2.3. Research on the Relationship between Learning Environment and Academic Performance

The relationship between Learning Environment and Academic Performance has been extensively studied and validated. Numerous studies have demonstrated that a positive Learning Environment can significantly improve students' Academic Performance (Torres-Zapata *et al.*, 2022). Factors such as classroom layout and facilities, the richness of teaching resources, and teacher support and attention positively affect students' learning outcomes (Sahni, 2023). Furthermore, a positive campus culture and good teacher-student relationships have been shown to enhance students' learning motivation and academic achievements (Ge, 2021).

However, some research suggests that the influence of Learning Environment on Academic Performance is not direct and straightforward but rather mediated by various factors and complex interaction mechanisms (Sabir *et al.*,

2022). Therefore, further exploration of the mediating mechanisms between Learning Environment and Academic Performance is essential for a deeper understanding of their relationship.

2.4. The Mediating Role of Student Satisfaction in the Relationship between Learning Environment and Academic Performance

Student Satisfaction refers to students' overall evaluation and perception of their Learning Environment, reflecting their subjective experience of the school, teachers, and educational process (Fathan, 2022). Research has shown that Student Satisfaction plays a crucial mediating role between Learning Environment and Academic Performance (Sabir *et al.*, 2022). Specifically, a good Learning Environment can enhance students' satisfaction, and highly satisfied students are more likely to exhibit positive learning attitudes and behaviors, leading to better academic achievements (Dinh *et al.*, 2022).

Previous studies have found that factors such as teaching quality, teacher-student interaction, and curriculum design improve Academic Performance by enhancing Student Satisfaction (Giner and Gil, 2022). Additionally, campus culture and social support are considered important factors that indirectly affect Academic Performance by increasing Student Satisfaction (Feret, 2023).

2.5. Research Hypotheses

Based on the literature review and theoretical foundation, this study proposes the following hypotheses:

- Hypothesis 1: The Learning Environment has a significant positive impact on the Academic Performance of vocational college students.
- Hypothesis 2: The Learning Environment has a significant positive impact on Student Satisfaction.
- Hypothesis 3: Student Satisfaction has a significant positive impact on Academic Performance.
- Hypothesis 4: Student Satisfaction mediates the relationship between Learning Environment and Academic Performance.

3. Research Methods

3.1. Research Design

This study employs a quantitative research methodology to explore the impact of the Learning Environment on students' Academic Performance in Chinese vocational colleges and to analyze the mediating role of Student Satisfaction. Structural Equation Modeling (SEM) is utilized for data analysis (Figure 1) to test the research hypotheses.

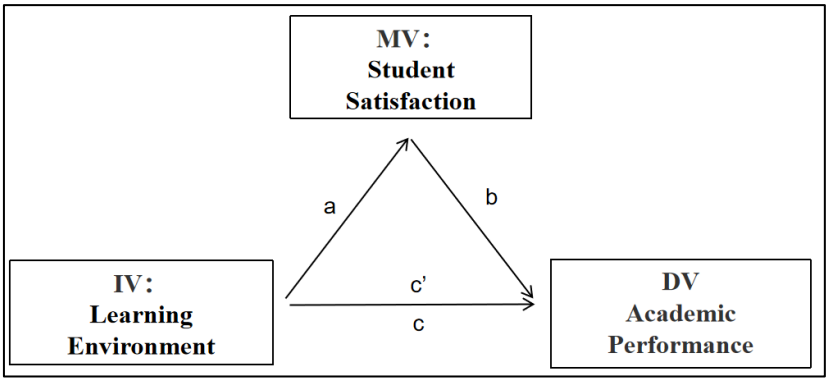

Figure-1. Structural model of Learning Environment affecting Academic Performance

3.2. Research Sample and Data Collection

3.2.1. Research Subjects and Sample Selection

This study targets 700 students from 10 vocational colleges in Shandong Province, China. Using random sampling, 70 students were selected from each college to ensure the sample's representativeness and generalizability.

3.2.2. Data Collection Method

Data were collected through an online questionnaire survey. The questionnaire included items related to Learning Environment, Student Satisfaction, and Academic Performance. Prior to formal use, a small-scale pilot survey was conducted to ensure clarity and validity of the questions. The survey data were collected via an online platform, ensuring participants' anonymity and the reliability of the data.

3.3. Variable Measurement

3.3.1. Measurement of Learning Environment Variables

The Learning Environment variables encompass three aspects: physical environment, social environment, and teaching environment. The physical environment examines classroom layout, facilities, and teaching resources; the social environment includes teacher-student relationships, peer relationships, and campus culture; the teaching

environment covers teaching methods, curriculum design, and teacher quality. Each aspect is measured using multiple items on a Likert five-point scale (1= strongly disagree, 5 = strongly agree).

3.3.2. Measurement of Academic Performance Variables

The Academic Performance variable is measured through students' academic achievements, knowledge acquisition, and skill development. The questionnaire includes several items related to Academic Performance, also scored on a Likert five-point scale.

3.3.3. Measurement of Student Satisfaction Variables

Student Satisfaction is measured through students' overall evaluation of school management, teaching quality, curriculum structure, and facilities. The questionnaire contains several items reflecting Student Satisfaction, rated on a Likert five-point scale.

3.4. Data Analysis Methods

3.4.1. Descriptive Statistical Analysis

Descriptive statistical analysis is conducted to understand the basic characteristics of the sample and the distribution of the main variables. Descriptive statistics include measures such as mean, standard deviation, frequency, and percentage.

3.4.2. Reliability and Validity Analysis

To ensure the reliability and validity of the scales, the study uses SPSS software for analysis. Reliability analysis employs Cronbach's Alpha coefficient to test the internal consistency of the scales. Validity analysis uses Confirmatory Factor Analysis (CFA) to assess the structural validity of the scales.

3.4.3. Structural Equation Modeling Analysis

Based on the reliability and validity analysis, Structural Equation Modeling (SEM) is used to test the research hypotheses. A path model including Learning Environment, Student Satisfaction, and Academic Performance is constructed, and AMOS software is used for model fitting and path analysis.

3.4.4. Mediation Effect Test

To test the mediating role of Student Satisfaction between Learning Environment and Academic Performance, the Bootstrap method is employed. By calculating the standard error and confidence interval of the mediation effect, the significance of the mediation effect is determined.

By employing the above methods, this study systematically analyzes the Learning Environment, Student Satisfaction, and Academic Performance of vocational college students in Shandong Province, providing theoretical basis and empirical support for the improvement of vocational education.

4. Research Results

4.1. Descriptive Statistics Results

This study selected 10 vocational colleges in Shandong Province with a total of 700 students as the research subjects. Through random sampling method, 70 students from each institution were selected as the survey sample. The following are the results of descriptive statistical analysis of sample data.

Statistical analysis was conducted on the basic information of 700 valid students (Table 1), including gender, grade and major distribution. Gender distribution: boys accounted for 51.4% (360 people), and girls accounted for 48.6% (340 people). Grade distribution: 33.0% (231 people) are in first grade, 34.3% (240 people) are in second grade, and 32.7% (229 people) are in third grade. Distribution of majors: engineering and technology accounted for 34% (236 people), economics and management accounted for 29% (203 people), art accounted for 21% (148 people), and other categories accounted for 16% (113 people).

Table-1. Frequency statistics for the total sample

Category	Subcategory	Number of Students	Percentage	Valid percentage
Gender	Male	360	51.40%	51.40%
	Female	340	48.60%	48.60%
Grade Level	First Year	231	33.00%	33.00%
	Second Year	240	34.30%	34.30%
	Third Year	229	32.70%	32.70%
Major	Engineering	236	34.00%	34.00%
	Economics and Management	203	29.00%	29.00%
	Arts	148	21.00%	21.00%
	Others	113	16.00%	16.00%

The descriptive analysis results show (Table 2) that the mean scores of all aspects of Learning Environment (physical environment, social environment, teaching environment) are all high, indicating that the surveyed students

have a good overall evaluation of the Learning Environment of vocational colleges. At the same time, the mean scores of Student Satisfaction and Academic Performance are also at a high level, indicating that students are generally satisfied with the school and the educational process and have achieved good academic results.

Through correlation analysis, it was found that there is a significant positive correlation between Learning Environment and Academic Performance ($r=0.58$, $p<0.01$), indicating that Learning Environment has a direct positive impact on Academic Performance.The correlation coefficients between the physical environment, social environment, teaching environment and Academic Performance are 0.52, 0.56 and 0.57 respectively, all reaching significant levels ($p<0.01$), indicating that these three aspects of Learning Environment have an important impact on Academic Performance.

Table-2. Descriptive analysis of the total sample

Feature items	Variable	M	SD	R
Learning Environment	physical environment	4.02	0.65	0.48
	social environment	3.89	0.7	
	Teaching environment	3.95	0.68	
Student Satisfaction	School management satisfaction	3.9	0.72	0.62
	teacher satisfaction	3.93	0.69	
	course satisfaction	4.26	0.77	
	Satisfaction with school facilities	3.91	0.7	
Academic Performance	academic performance	3.85	0.73	/
	knowledge mastery	3.88	0.72	
	skills development	3.87	0.71	

4.2. Reliability and Validity Analysis

In this study, SPSS 27 software was used to perform reliability and validity analyses of the questionnaire (Table 3). The initial step involved assessing the internal consistency by calculating Cronbach’ s alpha coefficient to evaluate the reliability of the questionnaire. The results indicate excellent reliability for each variable: the reliability of the Learning Environment is 0.878, Student Satisfaction is 0.881, and Academic Performance is 0.892. According to standard evaluations, Cronbach’s alpha coefficients between 0.65 and 0.70 are considered acceptable, between 0.70 and 0.80 are considered good, and between 0.80 and 0.90 are considered excellent (Laurencelle, 2021). Thus, our questionnaire demonstrates outstanding reliability overall, ensuring high reliability.

To further assess the validity of the questionnaire, we conducted an Exploratory Factor Analysis (EFA). The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy reached 0.801, significantly above the threshold of 0.6, indicating that the sample data is highly suitable for factor analysis. Bartlett's test of sphericity showed a significance level close to zero, indicating statistical significance, which further supports the validity of the questionnaire.

These analyses confirm that the questionnaire used in this study is both reliable and valid, providing a solid foundation for the subsequent Structural Equation Modeling (SEM) and hypothesis testing.

Table-3. Reliability and validity analysis results

Variable name	After deleting the item Cronbach's coefficient	Cronbach's coefficient	KMO	Bartlett
Learning Environment	0.878	0.883	0.801	P=0.000***
Student Satisfaction	0.881	0.894		A-χ^2=3176.852
Academic Performance	0.892	0.906		DF=6

4.3. Mediation Model Test

In order to gain an in-depth understanding of how Learning Environment and Student Satisfaction predict Academic Performance, this study performed regression analysis based on correlation analysis, using Learning Environment and Student Satisfaction as predictor variables and Academic Performance as the outcome variable. Detailed statistical data are shown in Table 4.

Table-4. Regression analysis of the relationship between variables in the model

Variable	Model 1 DV:Academic Performance		Model 2 DV:Student Satisfaction		Model 3 DV:Academic Performance	
	β	t	β	t	β	t
Learning Environment	0.784	43.516***	0.799	44.946***	0.181	7.666***
Student Satisfaction					0.756	29.655***
R^2	0.728		0.861		0.879	
F	1893.628		2020.126		2561.264	

$P^{*}<0.05$, $P^{**}<0.01$,$P^{***}=0.00$

Table 4 shows that in Model 1, the Learning Environment, as a predictor variable, has a significant positive predictive effect on students' Academic Performance (β=0.784, t=43.516, p<0.001), explaining 72.8% of the variance. The main effect value is c=0.784, laying the groundwork for further analysis.

In Model 2, the Learning Environment continues to be a predictor variable, while Student Satisfaction is the outcome variable. The analysis indicates that the Learning Environment has a significant positive impact on Student Satisfaction (β=0.799, t=44.946, p<0.001), explaining 86.1% of the variance; the first part of the mediation effect value is a=0.799, providing the basis for the third step of the analysis.

In Model 3, when both the Learning Environment and Student Satisfaction serve as predictor variables, and Academic Performance is the outcome variable, the results show that the Learning Environment has a significant positive effect on Academic Performance (β=0.181, t=7.666, p<0.001). Simultaneously, Student Satisfaction also has a significant positive effect on Academic Performance (β=0.756, t=29.655, p<0.001), explaining 87.9% of the variance. The second part of the mediation effect value is b=0.756, and the main effect value is c'=0.181.

Through the three stages of verification, we can confirm the path relationships between the model and variables. The analysis demonstrates that the mediation effect of "Student Satisfaction" is effective. In the first stage of the analysis, the main effect regression coefficient is c=0.784. In the second stage, the effect value of the first part of the mediation model is a=0.799. In the third stage, the effect value of the second part of the mediation model is b=0.756, with c'=0.181. The proportion of the indirect effect value to the total effect value is 0.770, establishing a partial mediation effect (Figure 2).

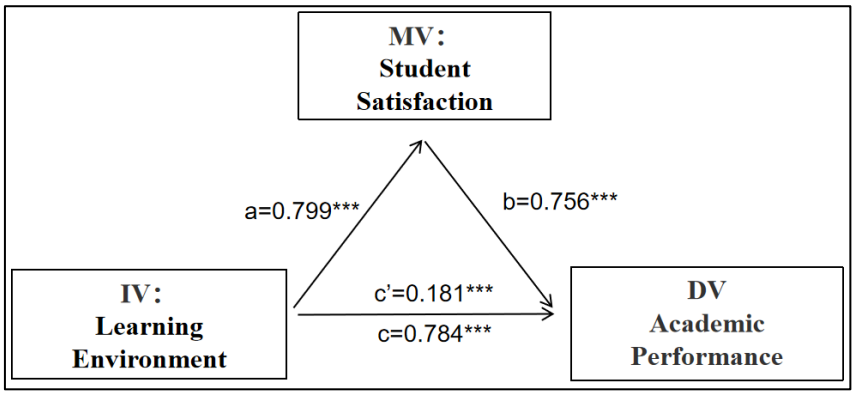

Figure-2. The mediation route of Student Satisfaction

To further investigate the mediation effect of Student Satisfaction, this study employed the Bootstrap technique to test the mediation effect. In this process, we selected Model 4 as the testing method and set a sample size of 5000. Within the 95% confidence interval, we assessed the significance of the mediation effect. The specific results of the test are presented in detail in Table 5.

Table-5. Mediation effect analysis of Student Satisfaction

Impact path	Effect	Boot SE	Boot95% LLCI	Boot 95% ULCI	Ratio of total effect
Total effect	0.784	0.180	0.0023	0.748	
Direct effect	0.181	0.0236	0.0012	0.135	
Indirect effect	0.603	0.090	0.484	0.831	77.0%

From Table 5, it can be seen that "Student Satisfaction" has a partial mediation effect between "Learning Environment" and "Academic Performance." The indirect effect, within the 95% confidence interval, is [0.484, 0.831], which does not include zero, indicating that the mediation effect is significant.

5. Discussion

5.1. Main Findings and Discussion

The empirical analysis results of this study indicate that the Learning Environment has a significant positive impact on the Academic Performance of vocational college students. Specifically, various aspects such as the physical environment, social environment, and teaching environment all play important positive roles in Academic Performance. This suggests that a well-designed classroom layout and facilities, harmonious teacher-student and peer relationships, and effective teaching methods and curriculum design can all enhance students' academic achievements, knowledge acquisition, and skill development. These findings are consistent with existing research and further validate the importance of the Learning Environment on Academic Performance.

Additionally, the results show that Student Satisfaction has a significant mediating effect between the Learning Environment and Academic Performance. Specifically, a good Learning Environment can increase students' satisfaction with school management, teaching quality, curriculum structure, and facilities. Satisfied students are more likely to exhibit positive learning attitudes and behaviors, leading to better academic outcomes. The mediating effect of Student Satisfaction was confirmed through structural equation modeling and Bootstrap mediation effect

testing. This finding highlights the importance of enhancing Student Satisfaction in the process of improving Academic Performance.

5.2. Theoretical Contributions

This study makes several important theoretical contributions to the existing literature. Firstly, it systematically explores the direct impact of the Learning Environment on Academic Performance, verifying the significant role of various aspects of the Learning Environment (physical, social, and teaching environments) in improving students' Academic Performance. Secondly, it further elucidates the mediating role of Student Satisfaction between the Learning Environment and Academic Performance, providing new perspectives and empirical support for understanding this relationship. These findings enrich the theoretical framework concerning the relationships between the Learning Environment, Student Satisfaction, and Academic Performance, aiding a more comprehensive understanding of the mechanisms influencing students' Academic Performance.

5.3. Practical Implications

The findings of this study have important practical implications. Firstly, vocational college administrators and education policymakers can enhance students' Academic Performance by optimizing the Learning Environment. Measures such as improving classroom facilities and equipment, strengthening teacher-student interactions, and optimizing curriculum design can effectively improve learning outcomes. Secondly, improving Student Satisfaction is also a crucial pathway to enhancing Academic Performance. Vocational colleges should pay attention to student feedback on school management, teaching quality, and curriculum structure, continuously improving to boost student satisfaction and learning enthusiasm.

5.3. Research Limitations and Future Directions

Despite the meaningful findings, this study has some limitations. Firstly, the research sample is limited to 10 vocational colleges in Shandong Province, which may restrict the representativeness of the findings. Future research could expand the sample scope to include more regions and schools. Secondly, this study uses cross-sectional data for analysis, which cannot fully reveal the causal relationships between the Learning Environment, Student Satisfaction, and Academic Performance. Future research could use longitudinal data for further validation. Additionally, future studies could explore other factors that might influence Academic Performance, such as students' learning motivation and family background.

6. Conclusion

Based on the results of the research, this study empirically explored the impact of the Learning Environment on the Academic Performance of vocational college students and analyzed the mediating role of Student Satisfaction. The results indicate that various aspects of the Learning Environment significantly positively influence Academic Performance, with Student Satisfaction playing a partial mediating role in this process. These findings not only enrich theoretical research but also provide empirical support for optimizing the Learning Environment and improving education quality in vocational colleges. It is recommended that vocational colleges focus on improving classroom layout and facilities, creating a conducive learning atmosphere, enhancing teacher-student interactions, and fostering a harmonious campus culture. By strengthening teacher training, improving teachers' teaching quality and curriculum design abilities, and ensuring teaching quality, student Academic Performance can be promoted.

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