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Data-Driven Analysis of EFL Teaching Factors: Classroom Environment and Collaboration Effects on Students' Performance: A Study at Secondary Schools of Guiyang City, China

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Abstract. This study aims to establish and validate a theoretical framework to examine the effects of the English as a Foreign Language (EFL) classroom environment and collaborative learning on students' performance. Through rigorous data analysis, this research seeks to enhance understanding of how these factors influence student outcomes in English language learning. A quantitative research design was employed, using a questionnaire to collect data from 293 English teachers at secondary schools across the Nanming District, Guiyang City. The data were analyzed using SmartPLS for structural equation modeling. The results indicate that both the EFL classroom environment and collaborative learning have statistically significant positive relationships with student performance ($p < 0.05$). These findings underscore the importance of fostering a supportive classroom atmosphere and implementing collaborative learning strategies to enhance educational outcomes. Based on the results, it is recommended that education authorities encourage English teachers to adopt collaborative learning methods and update their pedagogical skills to better facilitate student engagement and performance. Additionally, schools should be equipped

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with essential teaching resources and effective classroom environments to support the teaching-learning process.

Keywords: behavioral; cognitive and emotional performance; collaborative learning; English as a Foreign Language classroom environment; physical and social environment; student performance; SmartPLS

1. Introduction

The development of society has necessitated higher requirements for English teaching. Students must truly apply the language to communication and understand the differences between Eastern and Western cultures (Omidvar & Meihami, 2025). Presently, in many Chinese classrooms, English is taught in a non-native environment as a foreign language (EFL) (Kamila et al., 2025). However, in the traditional teacher-centered classroom that has been maintained in China, teachers usually adopt the "duck-filling" teaching method, and students tend to receive information passively, making it difficult for them to carry out practical components of learning English (Q. Zhang, 2025).

As a result, it is difficult for students to experience the fun of learning English in the classroom and appreciate the value of language learning through a cooperative approach to obtaining and processing information, analyzing and solving problems, and developing thinking and expression skills (Ton-Nu & Newton, 2025). This situation makes it easy for students to lose interest in learning English or be under-motivated. This situation can further lead to a serious weakening of students' creativity and communicative competence.

In this case, teachers need to adapt to the developments of the times, innovate educational and teaching concepts, and integrate collaborative learning into the teaching process (Kundu & Bej, 2025), and encourage students to actively carry out learning exchanges and interactions (Fan & Xie, 2025). A tense classroom atmosphere can dampen students' motivation and limit their performance, while a positive classroom environment can motivate students to participate in teaching activities to improve their enthusiasm and performance. This study investigates whether the EFL classroom environment and collaborative learning positively influence student performance in secondary school EFL classrooms in Guiyang City.

1.1 The Problem Statement

There are still some problems in creating a relaxed and enjoyable collaborative learning classroom environment in English teaching in China (Guzman et al., 2025). These problems include the disadvantages of the traditional English classroom may rely too heavily on textbooks and teacher lectures and have outdated equipment and lack modern teaching tools (Bhandari & Bhandari, 2024), teaching methods, and a dull or slow teaching rhythm. The influence of students' motivation and poor performance in English language teaching in an EFL environment is particularly pronounced in the backward secondary school environment of Guiyang.

1.1.1 Teaching Disadvantages of the Traditional Classroom

In long-standing traditional classroom teaching, the teacher is the center of teaching, and everything is aimed at accomplishing teaching goals or tasks. In this model, the teacher usually adopts a didactic approach that emphasizes the transmission of knowledge rather than active exploration by students (Ezeaku & Okoye, 2025).

Traditional classrooms may rely too heavily on textbooks and teacher lectures, neglecting individual differences and the development of students' practical application skills. Students may develop a passive attitude toward English learning in such an environment and lack the motivation and ability to learn independently (Osegbue, 2025). In addition, traditional assessment systems tend to emphasize the memorization of grammar and vocabulary rather than the actual use of the language, which may lead to students' difficulties in applying English flexibly in actual communication. As a result, traditional classroom teaching of EFL in China is considered to be lagging behind cooperative learning.

Collaborative learning emphasizes interaction and collaboration among students and can promote the development of critical thinking and problem-solving skills (Ang et al., 2025). In contrast, traditional teaching methods may limit students' engagement and motivation, thus influencing their English learning performance. Although some students can perform well under traditional teaching methods, in the long run, traditional teacher-centered classroom teaching in China is not conducive to the healthy growth of students.

Collaborative learning has long been recognized as a teaching method that maximizes the benefits of mutual learning (H. Liu & Chu, 2024). This approach not only promotes knowledge sharing among students but also enhances their social skills and teamwork. As a result, collaborative learning has become the preferred method for reforming teaching strategies in many countries. Through group work, students can understand and master knowledge from different perspectives, and this diversified learning style helps develop their critical thinking and problem-solving skills (Y. Zhang & Jiang, 2025). This study will investigate whether collaborative learning positively influences student performance in secondary school EFL classrooms in Guiyang City (C. Wang et al., 2025)

1.1.2 Dull Classroom Environment

In many Chinese classrooms, a dreary atmosphere tends to dominate the teaching and learning environment (Al-Murtadha, 2025). Much of the cause of this phenomenon is closely related to traditional teaching methods. In these classrooms, teachers tend to use more conservative means of imparting knowledge, emphasizing lectures and rote memorization rather than stimulating students' creativity and critical thinking skills. This style of teaching may seem too monotonous and boring for students who desire to have fun learning and challenge themselves to understand the world (A. Wang & Yang, 2025).

In addition, China's large population base puts a lot of pressure on the education system. Teachers may have to carry a heavy workload while dealing with an

increasing number of students, which will undoubtedly influence their ability to implement more modern and student-centered teaching strategies. Teachers may not have enough time and resources to explore new methods that can improve their teaching effectiveness, thus making the classroom environment rigid and lackluster (Ramzan et al., 2025).

In many Chinese schools, there are still some problems with the physical environment and facilities. On the one hand, classrooms are often overcrowded, with too many students and not enough space, resulting in poor interaction and difficulty concentrating for students. On the other hand, many schools have outdated equipment and lack modern teaching tools. Teachers must rely on traditional blackboards and chalk to teach and cannot use multimedia resources to enrich the teaching content. Problems with the physical environment and facilities can further lead to dull classrooms and poor teaching and learning outcomes (Ding et al., 2025).

A study by Cutrim Schmid (2024) pointed out that a dull teaching environment makes it difficult for students to feel the joy and importance of learning English and may instead cause resistance. Therefore, changing this situation has become an urgent goal. A stressful and tense classroom atmosphere may inhibit students' motivation and limit their performance, while a positive classroom environment can encourage students to participate in teaching and learning activities, thus enhancing motivation and student performance .

Therefore, a positive classroom environment is considered to be the foundation of an optimized classroom and one of the most important ways to promote effective teaching and learning and improve students' performance (Mirzayeva, 2025). Although some studies have shown that classroom environment and collaborative learning have a positive influence on EFL students' performance, most of these studies have been conducted in a Western cultural context. The educational environment in China is very different from that in the West, which may influence how and to what extent the above factors affect students' performance.

Therefore, there is a research gap in whether cooperative learning can positively influence students' performance in the Chinese educational environment, which needs to be further researched and analyzed in the context of local EFL teaching and learning in China (H. Liu et al., 2025a). The research question for this study was: What is the relationship between EFL classroom environment, collaborative learning, and students' performance at secondary schools in Guiyang City, China? Therefore, the following hypotheses were formulated.

1.1.3 Research Hypotheses

H1: The EFL classroom environment has a significant impact on students' performance at secondary schools in Guiyang City, China.

H2: Collaborative learning has a significant impact on students' performance at secondary schools in Guiyang City, China.

2. Literature Review: Description of Variables

2.1 EFL Classroom Environment

As a subordinate concept of classroom environment, the English classroom environment subtly affects learners' language learning efficiency. Scholars (Zhang & Hwang, 2023) regard it as a social psychological factor in the classroom, which is the perception or feeling of students or teachers about the classroom that has a potential impact on students' development. The humanistic environment theory proposed by Moos (Pongpanich et al., 2025) defines the foreign language classroom environment as "all social psychological factors that exist in the foreign language classroom teaching process and affect the development of teaching activities and their quality and efficiency" (H. Wang et al., 2024).

This study defines the English classroom environment as the sum of many physical, social, and psychological factors that exist in the foreign language teaching process and affect the development of foreign language teaching activities and their quality and effectiveness (H. Liu et al. 2025b). The EFL classroom environment in this study is mainly divided into physical, social, and psychological environments. The physical environment provides the material basis for the smooth progress of teaching activities, mainly including the natural environment and related teaching equipment.

The social environment mainly refers to the interaction between teachers and students and the interaction among students in teaching activities, including the relationships between teachers and students and among students. The psychological environment refers to the personality, psychological characteristics, and state of classroom participants, namely, teachers and students (G. L. Liu et al., 2025).

2.2 Collaborative Learning

Collaborative learning is one of the most extensive and fruitful areas in educational theory, research, and practice (Alzubi et al., 2024). Dr. Sharan (1994) defines collaborative learning as a general term for all methods used to organize and promote classroom teaching.

The basic characteristic of all methods adopted by learners in the learning process is collaboration. While Mohammed et al. (2025) believe that collaborative learning is "a classroom technology that encourages students to carry out various learning activities in the form of groups or small teams, which helps to learn certain materials and rewards students for their achievements or performance throughout the course (P.15)", Ma et al. (2025) believe that collaborative learning is fundamentally a teaching method. Students are divided into different groups to study and complete the work assigned by the teacher. In each group, students need to do some work that requires collaboration and mutual help.

In this study (Fisher et al., 2024), collaborative learning is a classroom teaching model designed in the context of English classrooms, based on the connotations and learning methods of English classrooms and collaborative learning, with the support of information technology. Learners internalize knowledge in a

personalized collaborative learning environment, with sharing, refutation, negotiation, and discussion as the main learning forms. This teaching model emphasizes the elements of learners' group goals, common tasks, multi-person collaboration, personal responsibility, and common change and development. Its purpose is to allow learning groups to jointly undertake various learning tasks in the process of knowledge accumulation and internalization, so as to achieve common development and progress (Guo & Wang, 2025).

2.3 Students' Performance

Modern psychology believes that behavioral performance is the overt activity of a single or a group of organisms. Dewaele et al. (2023) pointed out that behavioral performance refers not only to the overt response of individual activities but also to the individual's internal thinking activities, problem-solving ability, and emotional attitudes.

There is no consensus on the definition of students' classroom performance. Modern psychology describes behavior as the explicit activity of organisms, including both observable actions and internal cognitive processes (Sanjani, 2024). Classroom performance can be categorized into significant and non-significant behaviors and static versus dynamic learning behaviors. This study classifies students' classroom performance into three dimensions: behavioral performance (observable actions), cognitive performance (use of cognitive strategies), and emotional performance (interest and value perception in learning).

2.4 Reviewing Each Variable Critically

2.4.1 EFL classroom environment

Research on the impact of the classroom environment on students' performance is not uncommon, and there are many research findings. The EFL classroom environment, as an external factor—that is, the place where students receive education and teachers work and teach—includes school infrastructure, teachers' teaching methods, school culture, the spirit of collaboration, and other factors, which all have a comprehensive impact on student performance. Fradana and Suwarta (2025) analyzed factors external to the student, such as school context, and found through quantitative research that when students are supported by the school and teachers, they tend to perform more positively.

Two studies by Fraser (1994, 1986) demonstrated that the quality of the school classroom environment is a determining factor in student learning, with the research results providing convincing evidence (Bensalem et al., 2025). Although previous studies have included the above factors as components of the school environment's impact on student behavior, the summarized findings remain incomplete. Additionally, the underlying reasons for the correlation between school environment and student performance vary across studies, and student performance itself has yet to be fully analyzed.

2.4.2 Collaborative learning

In the process of learners' knowledge construction, knowledge is acquired through meaning construction based on certain background information under the guidance of teachers in a certain social reality situation. X. Liu et al. (2024)

discussed the theory and application methods of collaborative learning in classroom teaching environments in their book Advanced Collaborative Learning, in addition to introducing the theory and methods of collaborative learning. They also discussed curriculum design in collaborative learning and collaborative learning in non-classroom teaching environments. Wu and Li (2024) found that learners in collaborative groups were significantly better than learners receiving traditional instruction in English learning.

Different scholars have put forward different views on collaborative learning. However, due to differences in the times and national conditions, research on collaborative learning is also different. Nevertheless, there are still areas in collaborative learning that deserve further analysis. For example, what is the mechanism of how collaborative learning affects students' learning motivation in foreign language classes, and how does it affect students' performance in a collaborative learning environment? The above issues are all research gaps in the field of collaborative learning; thus, these issues are what this study will explore (Shou et al., 2024).

2.4.3 Students' performance

Performance is directly related to behavior, originating from external environmental stimuli experienced by individuals or groups. It serves as an external response to specific environmental situations (Giday & Perumal, 2024). Therefore, students' performance is inseparable from the influence of the classroom environment and can reflect the stimulating effects of that environment.

Özdemir et al. (2024) argue that classroom performance originates from the classroom environment, and students exhibit different internal and external responses due to the influence of this environment and other external factors. Patall et al. (2024a) emphasize that the classroom performance of teachers and students is mutually influential; teachers must adjust their teaching practices based on students' in-class behaviors. Classroom performance thus reflects the dynamic interaction between teachers, students, and available teaching resources.

However, the mechanisms by which these effects occur have not been thoroughly examined, and research in this area remains at theoretical stage, lacking empirical support. After reviewing existing literature, the author found that studies on English classroom performance are limited, with a lack of systematic investigation and empirical research. Most current studies rely on theoretical analysis, and in terms of research populations, they primarily focus on college students and adults. Research on the English classroom performance of middle school students is especially scarce. Therefore, this study seeks to address this gap (Wang et al., 2024).

2.5 Relationship Between Collaborative Learning and Students' Performance

Regarding cognitive performance, Y. Zhang and Darvin (2025) investigated students from different countries and proved the relationship between collaborative learning and students' classroom behavior. Kaya and Avara (2025) found that long-term collaborative learning is related to students' positive

behavior and can help improve learning efficiency. Alias et al. (2024) analyzed the relationship between collaborative learning and students' classroom behavior from the perspective of teachers. Fan and Xie (2025) explained the impact of collaborative learning on classroom performance, showing that collaborative learning can solve the problem of conflicting views among students on the same problem, which leads to reduced learning efficiency, and proposed a decentralized collaborative method. Chen (2025) analyzed the relationship between collaborative learning methods and students' classroom behavior in the mobile internet era and proved that collaborative learning can help students learn effectively.

Regarding cognitive performance, collaborative learning and students' knowledge construction are closely related. First, knowledge construction in collaborative learning is the goal of students (Derakhshan et al., 2024). It is essentially a socialized cognitive process of students; that is, the generation and evolution of knowledge are social. The knowledge generated in collaborative learning is not a personal achievement, but a community cognitive product that students finally construct through conversation, criticism, reflection, negotiation, problem solving, and conflict resolution.

Regarding cognitive performance, the psychological state (emotion, consciousness, etc.) of learners at different stages in the collaborative learning process is related to their learning outcomes and development (Rustandi, 2025). Interaction between learners can have a greater impact on the quality of teaching. The form of interaction can be a dialogue between two learners or a group discussion between multiple learners (Shen et al., 2024).

2.6 Relationship Between EFL Classroom Environment and Students' Performance

Environmental psychologists widely agree that environment and behavioral performance are inseparable (Akbarovna, 2024). This perspective traces back to Lewin's (1936) field theory, which emphasized the dynamic interplay between individuals and their environment. As such, the classroom environment is a crucial factor influencing students' classroom performance. For instance, Padron et al. (2024) highlighted that a supportive classroom environment contributes to improved student behavior, while confirming a significant correlation between classroom settings and student behavior, with notable behavioral differences across different learning environments.

In terms of the physical environment, McVey (2024) reported that factors such as temperature, lighting, color schemes, classroom layout, and seating arrangements are significantly associated with students' cognitive recognition, behavioral engagement, and emotional responses. Similarly, Solhi (2024) found that the volume of a teacher's voice is correlated with attention levels; louder delivery attracted student focus, while quieter tones led to distraction.

Regarding the classroom social environment, Yang et al. (2024) found a positive relationship between social context and foreign language learning performance. Cirocki et al. (2019) observed that while autonomous learning among high school

students was moderate, task orientation within a supportive classroom strongly predicted their independent learning and performance. Yoon (2008) emphasized the teacher's role in managing students' behavior and facilitating a productive classroom, noting that enthusiastic, friendly, and disciplined teachers are perceived as more effective. These findings are reinforced by Guo et al. (2023) who argued that teachers' behavioral characteristics and emotional interactions significantly shape the classroom atmosphere.

On the topic of the psychological classroom environment, Fraser (2025) asserted that the emotional tone or atmosphere of a classroom is closely related to student outcomes. Chan et al. (2024) highlighted that teachers' behavioral practices in the classroom directly impact students' emotional performance. When teachers use appropriate and supportive behavioral strategies, students tend to exhibit higher learning motivation and are more willing to participate. Supporting this, Z. Feng et al. (2024) examined 8th-grade students and found that the psychosocial classroom environment, particularly the promotion of mutual respect and interaction by teachers, was positively correlated with improvements in students' emotional expression and performance from 7th to 8th grade.

3. Research Methodology

3.1 Conceptual Framework of the Study

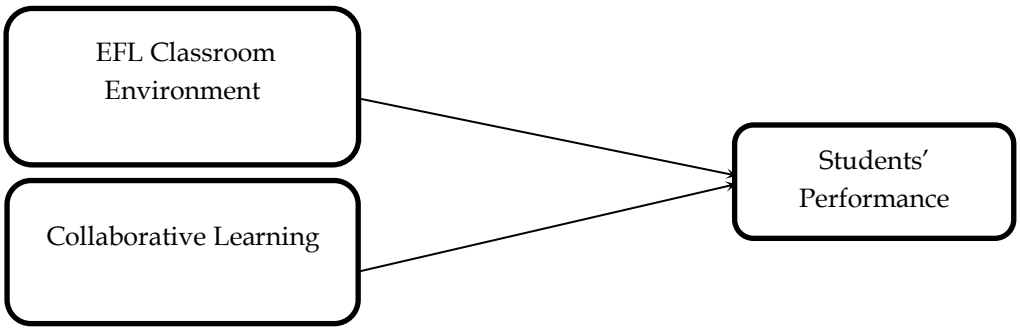

Figure 1: Conceptual Framework

3.2 Research Method

The quantitative research method encompasses an array of methodologies aimed at systematically exploring social phenomena (Mertens, 2024). This approach involves using statistical or numerical data to methodically investigate various aspects of social phenomena. This study uses a questionnaire survey to collect data on the EFL classroom environment and collaborative learning, and designs and fills in corresponding scales based on the participants' own perceptions and feedback, including teaching resources and methods, teacher-student interaction, classroom atmosphere, etc.

3.3 Study Population

The study population for this research included English teachers from 24 public secondary schools, 17 private secondary schools, and four standard secondary schools in the Nanming District, Guiyang City. As of 2024, there were a total of 1,186 English teachers (The Ministry of Education, Guiyang, China, 2024). In the context of this study, the selection involved 19 street offices within the Nanming

District. Each street office designated a secondary school within its jurisdiction. From each selected school, a cohort of 16 English-specializing teachers was chosen as the study participants. Consequently, the total number of individuals participating in the survey was expected to reach 293 participants.

3.4 Sampling Design

Simple random sampling is characterized by every element in the population having an equal chance of being included as a subject in the sample. In contrast to simple random sampling, Zikmund et al. (2024) underline the alternatives of probability sampling methods. In this study, the sampling strategy was designed to prevent subject-based influence. Control variables, like age, gender, and years of teaching experience, were incorporated. The study employed the simple random sampling method under a probability sampling design because this study focused on all English teachers in the Nanming District, Guiyang City, China.

3.5 Designing the Questionnaire

The impact of the EFL classroom environment and collaborative learning on EFL students' performance scale consisted of two parts. Part A aimed to define the demographic data related to the respondents, specifically including four items: age, gender, teaching experience, and education level. Part B was the main body of the questionnaire, which was used to measure how the EFL classroom environment and collaborative learning affected EFL students' performance. The questions in the questionnaire were divided into three aspects: teaching strategies and school environment factors and students' classroom performance.

3.6 Questionnaire Constructs

The Likert scale provides a convenient way to measure unobservable constructs. Its development process has been described in detail by Dauzón-Ledesma and Izquierdo (2023). Research has shown that a five-point scale can provide more accurate feedback on research data; therefore, a five-point scale (from strongly disagree = 1 to strongly agree = 5) was used in the questionnaire to collect data from participants in this study.

3.7 Data Collection

The data collection phase of this study was expected to last approximately one month. Given the heavy workload of English teachers in Nanming District, Guiyang City, and the large number of schools from which data were collected, a large amount of time must be allocated for teachers to carefully participate in the questionnaire (Konarasinghe, 2023). To facilitate the data collection process, the researchers used electronic distribution methods, such as WeChat, email, Questionnaire Star, and other platforms. Participants were directed to a dedicated web page and provided their informed consent, among other basic ethical considerations, before proceeding with the distribution of the questionnaire. Participants for this study were drawn from an existing roster, and the selection process was random to avoid any bias.

3.8 Data Analysis: Statistical Method

Yadewani and Duraipandi (2024) give an overview of the two methods that are often used for statistical analysis.

- Descriptive statistical analysis: Perform descriptive statistical analysis on the collected data, including calculating means, standard deviations, and frequency distributions, to understand sample characteristics and variable distributions.
- Correlation analysis (hypothesis testing): Use correlation analysis methods to explore the relationships between classroom environment, collaborative learning, and EFL students' performance.

Since this study used a quantitative research method and the data that was collected from a survey using a questionnaire is numeric, the researchers could adopt certain methods of data analysis. In this study, these were the Statistical Package for the Social Sciences (SPSS) 26 and SmartPLS (Ma et al., 2025). It must be noted that each method of data analysis was used for a specific purpose, and that was to understand the data structure and validate the research hypotheses, which are discussed in Section 2.3.

The SPSS 26 software was used to create tables for frequency analysis, descriptive analysis, correlation analysis, and reliability and validity analysis. This study chose the PLS algorithm to calculate the model parameters' estimates. Model validation denotes the process of systematically evaluating whether the hypotheses expressed by the structural model are supported by the data or not. It estimates means for exogenous variables and intercepts in regression equations.

The reasons for choosing PLS as the statistical means for testing structural equation models were as follows: PLS makes fewer demands regarding sample size than other methods; PLS can handle both reflective and formative constructs; PLS is better suited for theory development than for theory testing; and PLS is especially useful for prediction. In SmartPLS, the researchers could draw models graphically using simple drawing tools. SmartPLS quickly performed the computations for PLS-SEM and displayed the results (Rogers & Barboza, 2024).

4. Ethical Considerations

Throughout the progression of this study, including questionnaire design, data analysis, and writing processes, the researchers remained steadfast in their commitment to upholding academic norms and adhering to the university's ethical requirements. During the questionnaire survey process, it was most important to transparently communicate the purpose of the study and the scope of data used to research participants. Before participating in the survey, respondents were clearly informed that their participation was voluntary. It is important to emphasize that all questionnaires were administered anonymously and were only given to the participants after written consent.

Therefore, the data or information obtained from the study did not violate the privacy or rights of any individual. The researcher had strict measures in place to protect the confidentiality of all data and information collected. Furthermore, during the data analysis phase, the original data were strictly adhered to. The experimental data were not altered, manipulated, or falsified in any way (Guo &

Wang, 2025). This commitment to accuracy ensured that the statistics and analyses conducted faithfully reflected the original data, thereby ensuring the integrity and trustworthiness of the research. Full compliance with these ethical principles and academic norms formed the cornerstone of this study, instilling trust in the research process and affirming the authenticity of the results.

5. Reliability and Validity of the Questionnaire

Reliability refers to the consistency of results obtained when the same thing is measured repeatedly, reflecting the stability of the measurement instrument and the true degree of the measured characteristics. In quantitative research, for reliability testing, Özdemir et al. (2024) suggest that researchers express the reliability of a test by examining internal consistency using Cronbach's alpha. Internal consistency describes the extent to which all items in a test measure the same concept or construct, and Cronbach's alpha is used to estimate the proportion of systematic or consistent variance in a set of test scores, which ranges from 0 to 1 (Gong et al., 2024).

Many studies report acceptable alpha values ranging from 0.70 to 0.95, which means that if the final test alpha value is greater than or equal to 0.7, the questionnaire has good reliability. This study used the SPSS software tool to test the reliability of the questionnaire by calculating Cronbach's alpha value at the end of the questionnaire. Validity generally refers to the validity and correctness of a questionnaire. At present, validity testing is mainly implemented by constructing validity indicators (Streiner et al., 2024).

5.1 Demographic Information

There were 153 male participants, accounting for 52.22% of the total sample, and 140 female participants, accounting for 47.78% of the total sample. The age distribution was wide, with those under 30 years old accounting for 24.23%; those aged 31-40 accounting for 52.22%; those aged 41-50 accounting for 17.41%; and those aged 51 and above accounting for 6.14%. In terms of educational background, 28.33% of the respondents had a high school or technical secondary school degree (including vocational education); 45.73% had a bachelor's degree; 16.04% had a master's degree; and 3.41% had a doctorate.

In terms of monthly income, the income distribution of participants was quite wide. Among them, those with a monthly income between 2001 and 5000 account for 52.90%; those with a monthly income between 5001 and 10000 account for 32.76%; and those with a monthly income exceeding 10000 account for 6.83%.In terms of work experience, 54.27% of the respondents had less than five years of experience; 26.28% had worked for five to less than 10 years; 16.04% had worked for 10 to 15 years; and 3.41% had worked for 15 years or more.

5.2 Measurement Model Reliability

The reliability indicators of the scale include Cronbach's alpha and Average Variance Extracted (AVE). Cronbach (1994) proposed a threshold value for confirmatory (explorative) research: CA >.800 or.900 (0.700). Values must not be lower than.600, which shows that the structure is acceptable. Loadings above 0.70

indicate that the construct explains more than 50% of the indicator's variance, demonstrating that the indicator exhibits a satisfactory degree of reliability.

When using PLS-SEM to estimate reflective measurement models, Cronbach's alpha is the lower limit of internal consistency reliability, while consistency reliability is the upper limit of internal consistency reliability. Therefore, researchers should consider both indicators when evaluating internal consistency reliability (Alrashidi & Alshammari, 2025). Based on research by Fornell and Larcker (1981), the AVE value should be higher than 0.5. This level or higher indicates that, on average, the construct explains (more than) 50% of the variance of its items.

Table 1 shows the reliability test results of the measurement model. The composite reliability should be greater than 0.7. The composite reliability (rho_a) and (rho_c) values are more than 0.7, indicating that this structure has "satisfactory to good" reliability levels (Kamila et al., 2025).

The results show that Cronbach's alpha of the dimensions under each variable, including physical environment, social environment, psychological environment, collaborative learning, behavioral performance, cognitive performance, and emotional performance, are 0.884, 0.888, 0.876, 0.926, 0.867, 0.859, and 0.866, all greater than 0.7. The rho_a values are 0.885, 0.890, 0.879, 0.926, 0.867, 0.862, and 0.866; the rho_c values are 0.920, 0.922, 0.938, 0.909, 0.905, and 0.894, all greater than 0.7. The AVE values are 0.627, 0.699, 0.726, 0.714, 0.725, 0.720, and 0.692, all greater than 0.5. These indicate the reliability of each variable in this study.

Table 1: Construct reliability and validity overall

		Cronbach's alpha	**Composite reliability (rho_a)**	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
EFL Classroom Environment	Physical Environment	0.884	0.885	0.920	0.742
	Social Environment	0.888	0.890	0.922	0.748
	Psychological Environment	0.876	0.879	0.915	0.729
Collaborative Learning		0.926	0.926	0.938	0.627
Students' Performance	Behavioral Performance	0.867	0.867	0.909	0.714
	Cognitive Performance	0.859	0.862	0.905	0.704
	Emotional Performance	0.866	0.866	0.894	0.713

5.3 Measure Model Validity

Discriminant validity analysis mainly uses cross-loadings, the Fornell-Larcker criterion, and the Heterotrait-monotrait ratio (HTMT). Table 2 shows the cross-loadings. The factor loadings of all measurement items of each variable in this

study are greater than 0.7, indicating that the convergent validity of each scale is good.

Table 2: Cross-loading

	PhE	SE	PyE	CL	BP	CP	EP
PhE1	0.852						
PhE2	0.843						
PhE3	0.888						
PhE4	0.861						
SE1		0.879					
SE2		0.871					
SE3		0.847					
SE4		0.863					
PyE1			0.857				
PyE2			0.866				
PyE3			0.821				
PyE4			0.870				
CL1				0.808			
CL2				0.765			
CL3				0.818			
CL4				0.812			
CL5				0.799			
CL6				0.760			
CL7				0.793			
CL8				0.795			
CL9				0.775			
BP1					0.851		
BP2					0.834		
BP3					0.850		
BP4					0.847		
CP1						0.828	
CP2						0.871	
CP3						0.808	
CP4						0.847	
EP1							0.836
EP2							0.847
EP3							0.837
EP4							0.857

The criterion of Fornell-Larcker: on the diagonal in the table, the square roots of the AVE values are greater than the values below the diagonal (Palacios-Hidalgo & Huertas-Abril, 2025). Table 3 shows the Fornell-Larcker criterion.

Table 3: Fornell-Larcker criterion

	CE	PhE	SE	PyE	CL	SP*	BP	CP	EP
CE	1.000								
PhE	0.779	0.861							
SE	0.758	0.411	0.865						
PyE	0.711	0.335	0.282	0.854					
CL	0.604	0.448	0.479	0.430	0.792				
SP	0.603	0.489	0.507	0.354	0.614	1.000			
BP	0.510	0.373	0.440	0.330	0.504	0.722	0.845		
CP	0.369	0.289	0.367	0.168	0.387	0.741	0.290	0.839	
EP	0.440	0.409	0.302	0.275	0.453	0.730	0.268	0.348	0.844

*SP: Student Performance

The HTMT criterion is defined as the mean value of the indicator correlations across constructs relative to the (geometric) mean of the average correlations of indicators measuring the same construct. However, Bunmy et al. (2025) suggest that when the constructs in the path model are conceptually more distinct, researchers should consider 0.85 as the threshold for HTMT. Table 4 shows the validity test results of the measurement model. The maximum HTMT value of this study is 0.828, indicating that there is sufficient discrimination between the variables; that is, the discriminant validity of the variables in this study is tested by the Fornell-Larcker criterion and Heterotrait-monotrait ratio (HTMT).

Table 4: Heterotrait-monotrait ratio (HTMT)

	CE	PhE	SE	PyE	CL	SP	BP	CP	EP
CE									
PhE	0.828								
SE	0.803	0.462							
PyE	0.759	0.380	0.315						
CL	0.627	0.494	0.525	0.478					
SP	0.603	0.520	0.539	0.378	0.636				
BP	0.547	0.426	0.501	0.380	0.562	0.775			
CP	0.397	0.332	0.420	0.192	0.431	0.798	0.333		
EP	0.472	0.467	0.344	0.315	0.503	0.784	0.308	0.404	

5.4 Coefficient of Determination

The first basic criterion for evaluating a PLS structural equation model is the coefficient of determination (R^2) for each Endogenous Latent Variable. R^2 measures the relationship between the explained variance of the Latent Variable and its total variance. These values should be high enough so that the model has a minimum level of explanatory power (Ezeaku & Okoye, 2025). At the same time, we can consider values around 0.670 to be substantial, values around 0.333 to be average, and values of 0.190 and below to be weak.

Table 5 shows the explanatory power R^2 of the model. The results show that the explanatory power R^2 of the independent variables, including EFL classroom environment, collaborative learning, and student performance, for the dependent

variable is 0.462, indicating that these variables can explain 46.2% of the variation in students' performance.

Table 5: Coefficient of determination (R^2)

	R-square	R-square adjusted
SP	0.462	0.458

5.5 Effect Size

Researchers can assess the effect size of each path in the structural equation model using Cohen's f^2 (Cohen, 1988). The f2 is obtained by the inclusion and exclusion of model constructs (one by one). Just how useful each construct is for the adjustment model is evaluated. Y. Zhang and Darvin (2025) suggest that f-square (effect size) values of 0.020, 0.150, and 0.350 indicate the predictor variable's low, medium, or large effect in the structural model. Effect size values of less than 0.02 indicate that there is no effect. The effect size of each variable in this study is shown in Table 6. Each hypothesized effect value is greater than 0.020. This shows that the model effect strength is sufficient.

Table 6: Effect size (f^2)

	SP
CE	0.055
CL	0.030

5.6 Predictive Relevance

The predictive relevance's relative impact can be assessed using the measure Q^2. Ren and Pan (2025) believe that the Q^2 statistic is a measure of the predictive relevance of a block of manifest variables. A tested model has more predictive relevance the higher the Q^2, and modifications to a model may be evaluated by comparing the Q^2 values. The proposed threshold value is $Q^2 > 0$.

Table 7 shows the results of the Q2 test, where the Q2 value of the endogenous variable of EFL Student Performance (SP) is 0.507, indicating that the Q2 values of all endogenous latent variables are greater than 0, which proves that the exogenous latent variables in this research model have predictive relevance to the endogenous latent variables.

Table 7: Predictive relevance (Q^2)

	SSO	SSE	Q^2 (=1-SSE/SSO)
CE	293	293	-
CL	2637	2637	-
SP	293	144.486	0.507

5.7 Structural Model Assessment

Model-related indicators are shown in Figure 2.

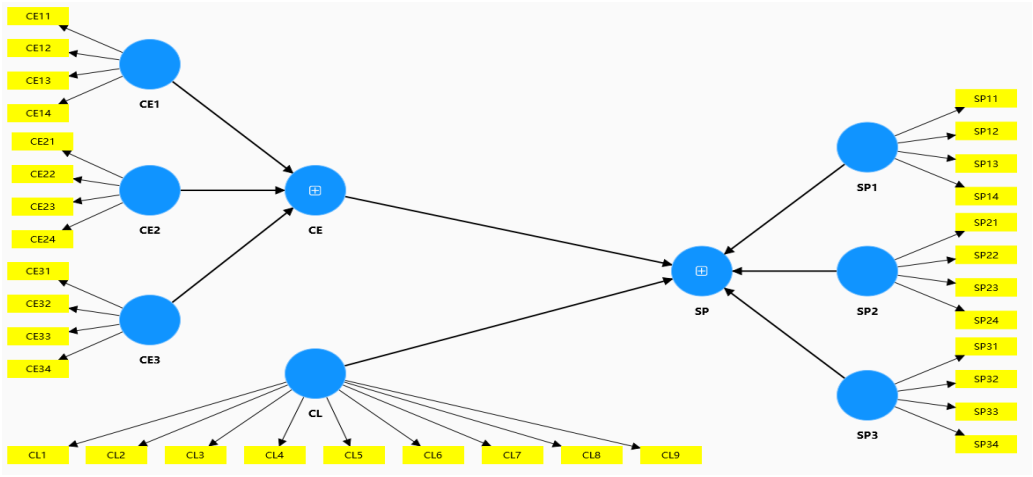

Figure 2: The structural mode

5.8 Hypothesis Testing

Researchers can monitor the loadings of reflective indicators to assess indicator reliability. In general, it is assumed that the LV explains at least 50% of the variance of each indicator. Therefore, indicator loadings should be at least significant at the 0.050 level and greater than 0.707. Chin (1998b) suggests that the p-value should be significant at the 0.050 level, and the t-value should be higher than 1.960.

Direct relationships are shown in Table 8, and all relationships are significant. The path coefficient of EFL classroom environment on students' performance is 0.192, t=3.886>1.96, p=0.000<0.001. It shows that the EFL classroom environment has a significant positive impact on students' performance; that is, the research hypothesis H1 is supported. The path coefficient of collaborative learning on students' performance is 0.195, t=4.596>1.96, p=0.000<0.001, indicating that collaborative learning has a significant positive impact on students' performance; that is, the research hypothesis H2 is supported.

Table 8: Hypothesis Result for Direct Relationship

	Path	**T-value**	**P-value**	**Result**
H1	EFL Classroom Environment -> Students' Performance	3.886	0.000	Supported
H2	Collaborative Learning -> Students' Performance	4.596	0.000	Supported

6. Discussion

This study aimed to determine the impact of EFL classroom environments and collaborative learning on student performance in secondary schools in Nanming District, Guiyang, China. The results show that the EFL classroom environment (physical environment, social environment, and psychological environment) and

collaborative learning have a positive impact on student performance. An effective classroom environment is not a stand-alone aspect of good teaching.

Good teaching methods and classroom environment techniques work together to foster high-quality instruction in the classroom and have a favorable effect on students' performance (Zou et al., 2025). A good physical environment will make students feel fresh and stimulate their interest in learning (Li et al., 2024). Friendly teacher-student relationships can promote communication, encouraging students to participate more in class and express themselves actively; teachers must understand the psychological needs of students in the classroom. This study supports previous studies by Y. Zhang and Jiang (2025), who found that the EFL classroom environment can improve students' performance.

Collaborative learning positively affects students' classroom performance in several ways. Behaviorally, it increases student participation. Cognitively, it facilitates knowledge construction, improves communication skills, and enhances critical thinking and problem-solving abilities through interaction and negotiation. Emotionally, collaborative learning fosters peer support, strengthening learners' motivation and enthusiasm for learning (Egitim, 2025). The findings of this study confirm that collaborative learning positively influences students' cognitive, behavioral, and emotional dimensions, contributing to a more enriching classroom experience and better overall performance in English classes (Alzubi et al., 2025).

In addition, in today's English learning, EFL classroom environments and collaborative learning play a key role in students' performance. The EFL classroom environment can help students mobilize positive learning emotions and let students feel the joy of learning English, thereby improving their performance. Collaborative learning can greatly improve learners' participation in English classrooms and allow learners to actively construct their own English knowledge learning. Therefore, teachers should pay attention to students' learning environment in English classes and use collaborative learning methods to make students more proactive in English learning.

7. Limitations and Suggestions for Future Research

Despite the understanding offered, this study has a few limitations that should be considered by future research. First, future studies may consider analyzing the research model in different contexts and testing its validity and applicability in other countries. This would help determine the generalizability of the model developed in this study (H. Liu et al., 2024).

Second, this study only examines different types of teaching methods used by secondary school English teachers in Nanming District, Guiyang, as well as various dimensions of the classroom environment. It does not consider other factors closely related to English learning, such as parental influence and peer influence (Mohammed et al., 2025). Therefore, the findings of this study may have certain limitations. To address this, it is recommended that future studies conduct longitudinal research and include other groups involved in English education. In

addition, researchers could apply a contextual analysis method to better understand the complex relationships between variables (Lau & Shea, 2024).

Third, this study focuses solely on the influence of EFL classroom environments and collaborative learning on students' performance. However, many other variables may also affect student outcomes. Future studies could examine various teaching methods and their effectiveness in improving students' performance. These approaches could be further developed through the inclusion of more variables and contextual case studies to provide richer insights and actionable strategies for improving English teaching outcomes (Solhi, 2024).

8. Recommendations

Based on the findings, this study provides the following recommendations for English teachers in the Nanming District, Guiyang, China:

- The government education department should ensure that schools are equipped with essential teaching tools and provide effective classroom environments. This will facilitate both teaching and learning, ultimately leading to improved student performance.
- The education department should support and encourage English teachers to regularly participate in professional seminars and conferences to improve their teaching abilities and personal development, stay updated with current knowledge, and acquire relevant teaching skills. This will help them deliver content more effectively to students.
- Schools should provide more platforms for teaching research and communication among English teachers. Teachers should actively learn new teaching methods and update their teaching concepts to align with the evolving demands of talent development in the modern era. This could enhance the quality of instruction and help students achieve better academic outcomes.

9. Conclusion

In this study, conceivable executive elements included EFL classroom environments, collaborative learning, and students' performance. So far, this study is one of the few in the Chinese context to explore such connections. Therefore, this research attempted to enrich the current body of knowledge by analyzing and understanding the influence of these independent variables on students' performance.

First, this study enriches and expands the academic content on classroom environments and collaborative learning. It provides academic support for further research in these areas and addresses the lack of studies on the impact of English teachers on student performance in previous research. The research results help teachers better incorporate students' classroom performance into the regular evaluation of teaching effectiveness (Shahzad et al., 2025).

Second, this study contributes to the current body of knowledge by enhancing our understanding of student performance, as it is the first study to examine this specific arrangement of variables. Since the participants are teachers, the study

emphasizes the evaluation of teaching effectiveness (Wahdania et al., 2025). This research expands the exploration of classroom environment, collaborative learning, and influencing students' English classroom performance in the Nanming District, Guiyang, China. Third, this study conducted a quantitative analysis of all research variables within the proposed research model. It demonstrated that classroom environments and collaborative learning have a significant positive impact on English classroom performance (Kostøl, 2025). Finally, this study fills a research gap in current literature.

Many studies on various dimensions of student performance are focused within a two-dimensional framework of classroom environments, often emphasizing the physical or psychological environment (Sampurna & Susanto, 2025). However, few studies have examined the impact of the classroom social environment on students' cognitive performance. This study addressed this overlooked aspect by analyzing student cognitive performance (Ang et al., 2025).

10. References

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