

Article

Building an Academic Climate to Enhance Student Performance in Higher Education

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Abstract

A positive academic climate is critical for improving learning outcomes and advancing sustainable development in higher education. Most existing studies examine individual dimensions of academic climate, while systematic and integrated research frameworks remain relatively limited. This study proposed and validated a comprehensive academic climate construction scheme integrating institutional norms, cultural immersion, interest cultivation, and innovation practice. A quasi-experimental design was adopted, with academic performance data from nine foundational courses being compared to three-year aggregated baseline data. Statistical analyses examined failure rates, make-up examination pass rates, and average scores. Results showed significant reductions in failure rates, notable increases in make-up pass rates and average scores across all courses ($p < 0.05$). The coordinated, systemic academic climate intervention effectively enhanced student academic performance. Practically, the proposed four-dimensional scheme provides a replicable, operable approach for higher education institutions to optimize disciplinary talent cultivation, foster students' lifelong learning capacity, and advance the practice of sustainable higher education.

Keywords: climate; performance; sustainability; norms; immersion; motivation; innovation

1. Introduction

In recent years, advancing the quality of talent cultivation and promoting students' lifelong development have become core goals of sustainable higher education reform [1,2]. Against this background, the constructs of academic climate and student engagement have gained increasing scholarly attention in higher education research, as they are widely recognized as key environmental and behavioral variables that shape educational outcomes and sustainable learning capacity [3,4]. A growing body of evidence has confirmed that a well-structured academic climate not only improves students' immediate academic performance, but also fosters their sense of belonging, learning initiative and comprehensive competence, which are essential for long-term sustainable development [5,6].

Academic climate, first proposed by Pace in campus environment assessment research, refers to students' overall perception and psychological experience of campus academic rules, cultural atmosphere, interpersonal interactions and learning support systems [7]. After decades of theoretical evolution, the academic community has reached a basic consensus that academic climate is not a single-dimensional "learning ethos", but a comprehensive environmental system spanning institutional, cultural, interpersonal and resource dimensions [8,9]. Hart and Fellabaum (2008) conducted a qualitative content



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analysis of 118 campus climate studies and found that although the conceptualization of academic climate varies across research contexts, most studies cover institutional norms, cultural atmosphere, interpersonal support and developmental support as core components, which provides a foundational analytical framework for subsequent intervention research [7]. From a structural perspective, existing measurement tools have further refined the dimensional composition of academic climate. For example, Sanders et al. (2026) developed a 46-item campus climate scale comprising five factors: university responsiveness, community and connection, equity and belonging, campus culture and student experience, and student satisfaction, providing robust empirical support for the multidimensional attribute of academic climate [10]. Meanwhile, the Transformational Tapestry Model proposed by Rankin and Reason (2008) systematically integrates institutional policies, cultural traditions, interpersonal interactions and resource support, laying a theoretical foundation for systematic academic climate construction from a holistic perspective [11].

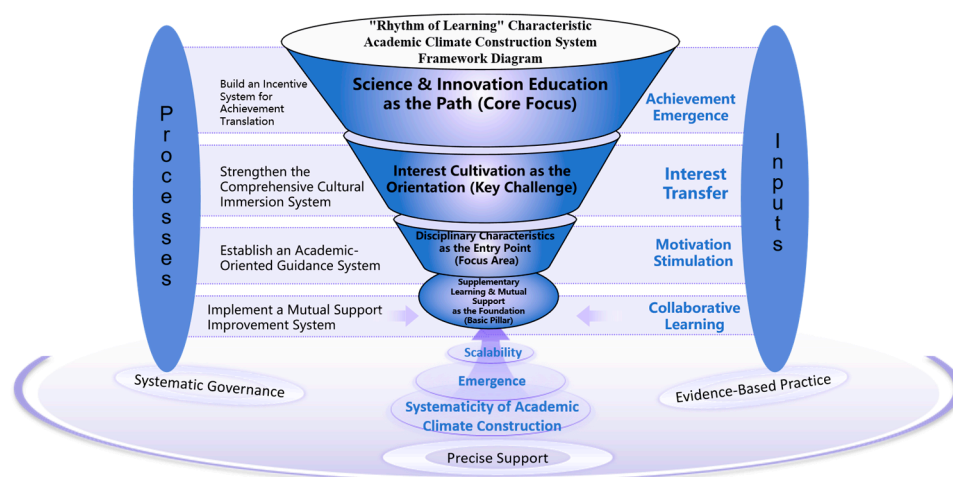
Empirical studies have consistently verified the positive predictive effect of positive academic climate on student academic outcomes [12,13]. A study by Berhanu and Sewagegn (2024) based on 412 undergraduate samples confirmed that perceived campus climate is significantly and positively correlated with academic achievement, and student engagement plays a mediating role in this relationship: a supportive academic climate promotes students' active participation in learning activities, which in turn improves their academic performance [12]. From the perspective of institutional norms, Perry et al. (2026) found that a sound academic integrity climate can effectively reduce academic misconduct behaviors and guide students to form standardized learning habits, thereby reducing academic failure risks [14]. From the interpersonal perspective, Samadieh et al. (2026) revealed that faculty support can enhance students' sense of belonging and self-efficacy by improving the campus academic climate, which ultimately contributes to better academic performance [15]. Further, self-determination theory-based research indicates that academic climate satisfies students' psychological needs for autonomy, competence and belonging, and stimulates their intrinsic learning motivation, which is a core mechanism for sustained improvement in academic performance [16,17]. In addition, studies targeting STEM disciplines have further confirmed that discipline-specific academic climate construction has a more significant promoting effect on students' professional identity and academic persistence, highlighting the necessity of developing targeted academic climate schemes combined with disciplinary characteristics [18,19].

From the perspective of educational practice, existing research has explored multiple pathways to improve academic climate from three levels: institutional governance, pedagogical innovation and environmental optimization [20,21]. At the institutional level, universities have strengthened academic management systems and early warning mechanisms to standardize students' learning behaviors and reduce academic risks [14]. Perry et al. (2026) confirmed through an empirical study of 2329 undergraduates that a sound institutional academic integrity climate can effectively regulate students' academic behaviors, reduce academic misconduct and related academic failure risks, highlighting the foundational role of institutional norms in shaping positive academic development environments [14]. At the pedagogical level, student-centered teaching approaches such as inquiry-based learning and interdisciplinary teaching are widely used to stimulate students' learning interest and active participation [2,22]. At the environmental level, both physical learning spaces and digital academic environments play an important role in shaping academic climate. For example, building discipline-specific cultural venues and carrying out rich academic activities can subtly internalize positive academic values into students' conscious behaviors; the construction of a digital campus climate also expands the coverage and accessibility of academic support resources [23,24].

Despite the above progress, there are still notable gaps in current research on academic climate construction. First, most existing studies focus on isolated dimensions of academic climate, such as diversity climate, mental health climate or teaching climate, and few studies construct a systematic intervention framework integrating institutional norms, cultural cultivation, motivation stimulation and practical support from the perspective of overall academic performance improvement [7,25]. A systematic review by Lee et al. (2025) of 551 higher education institutions found that most campus climate assessments focus on single domains such as sexual misconduct or diversity equity, and comprehensive assessment and intervention systems targeting academic development are relatively scarce [25]. Second, existing empirical studies are mostly cross-sectional correlation studies, and quasi-experimental evidence based on systematic intervention practice is relatively insufficient, making it difficult to clearly verify the causal effect of academic climate construction on academic performance improvement [12]. Third, most existing practice cases are developed based on general education scenarios, and targeted research combined with the characteristics of chemistry and chemical engineering disciplines is relatively limited, which restricts the replicability and practical guidance of relevant schemes in engineering education contexts [18]. Furthermore, existing literature has long focused on the climate experience of specific student groups, while systematic research targeting overall academic performance improvement and sustainable learning ability cultivation remains relatively insufficient [26]. A growing body of literature has recognized the importance of academic climate and explored diverse pathways for improvement, and most relevant investigations focus on single or limited dimensions and integrated cross-dimensional research frameworks that examine the synergistic effects of multiple factors remain relatively scarce.

Notably, academic climate construction is inherently a complex and systemic endeavor, involving institutional policies, teaching practices, environmental conditions, and student development processes. Existing scholarly work has generated valuable insights into the individual impacts of institutional governance, campus culture and learning support on student learning outcomes. However, most studies have explored these elements separately rather than within a unified integrative framework. There remains a lack of systematic research that conceptualizes academic climate construction as a coordinated, dynamic system and investigates how multiple factors interact to achieve sustained improvement in higher education contexts. To address this gap, the College of Chemistry and Chemical Engineering at Central South University developed and implemented a four-dimensional comprehensive academic climate construction model—integrating institutional norms, cultural immersion, interest cultivation, and innovation practice—based on its disciplinary characteristics and talent cultivation goals (see Scheme 1). This student-centered model places academic development at its core, is guided by value orientation, and promotes academic climate construction through multidimensional and all-round collaborative efforts. This study carries both significant theoretical value and practical implications for the fields of sustainable higher education governance and academic culture construction. Theoretically, existing studies on university academic culture mostly focus on individual student behaviors, classroom management or simple experience summary, while insufficient attention has been paid to the joint effects of student goal development, faculty incentive mechanisms and cross-departmental organizational coordination. This research fills the above research gaps by constructing a unified analytical framework that integrates multiple participant and institutional factors. Combined with educational ecology and new institutionalism theories, it enriches the theoretical application of sustainable governance in the context of resource-constrained regional universities, and provides new empirical evidence for follow-up related research on academic culture. Practically, against the back-

ground of China's All-Staff, Whole-Process and All-Round Education (Three-All Education) initiative, academic climate construction has become a key task for talent cultivation in colleges and universities. This study takes typical local undergraduate universities in western China as research objects, identifies the main dilemmas restricting the sustainable development of academic culture, and puts forward targeted optimization directions. The research findings can provide practical references for university administrators, faculty and student counselors to improve academic governance, optimize faculty evaluation systems and promote cross-departmental collaboration. Meanwhile, it also offers actionable strategies for universities with limited educational resources to build a long-term, stable and positive academic atmosphere, and helps promote the sustainable development of higher education talent cultivation.



"Rhythm of Learning" Characteristic Academic Climate Construction System Framework Diagram

Scheme 1. A four-dimensional integrated framework for academic climate construction.

This study takes this practice as an example, analyzing the content, pathways, and implementation effects of the four-dimensional framework, and providing a reference for innovation in academic climate construction at higher education institutions. The findings indicate that this coordinated approach effectively enhances student academic performance and offers a replicable model for fostering sustainable learning environments.

2. Theoretical Foundations and Research Hypotheses

2.1. Study Concept

Academic climate is a core concept for evaluating the quality of university educational environments. First proposed by Pace in campus environment assessment research, it refers to students' overall perception and psychological experience of campus academic rules, cultural atmosphere, interpersonal interactions and learning support, and acts as a critical environmental variable that shapes students' academic engagement, learning outcomes and long-term development. After decades of theoretical evolution and empirical validation, academia has reached a basic consensus: academic climate is far more than a simple "learning ethos". It is a comprehensive environmental system spanning institutional, cultural, interpersonal and resource dimensions. Its core connotation can be broken down into four dimensions:

The institutional norm dimension covers the rule system and enforcement intensity of university academic management, assessment standards, academic integrity and training procedures, and serves as the institutional foundation of academic climate.

The cultural immersion dimension refers to the diversity of on-campus academic activities, the penetration of disciplinary spirit and the overall scholarly atmosphere, and constitutes the cultural core of academic climate.

The interpersonal support dimension involves the quality and frequency of teacher-student and peer interactions, as well as faculty guidance for students' academic progress and personal growth, and functions as the interpersonal bond of academic climate.

The developmental support dimension includes growth platforms provided by universities such as research participation, practical training and interest expansion, and provides the resource guarantee for academic climate.

In this study, academic climate specifically refers to a systematic educational environment designed for undergraduate talent cultivation in chemistry and chemical engineering. Centered on improving students' academic performance and long-term development capacity, it integrates four implementation paths: institutional norms, cultural immersion, interest cultivation and innovative practice. Through coordinated interaction of multiple elements, it fosters a positive and enduring academic growth environment, ultimately delivering simultaneous improvement in students' academic quality and comprehensive competence.

2.2. Study Questions

Against the background of identified research gaps in integrated academic climate construction and sustainable higher education, this study develops a systematic academic climate scheme encompassing four dimensions and conducts a quasi-experimental investigation with chemistry and chemical engineering undergraduates. This study focuses on three interrelated core research questions: Does the systematic academic climate scheme integrating institutional norms, cultural immersion, interest cultivation and innovative practice exert a statistically significant positive effect on undergraduates' academic performance, as evaluated by average course scores, course failure rates and make-up examination pass rates?

2.3. Research Hypotheses

Grounded in student engagement theory and empirical findings on academic climate, this study proposes one main hypothesis and four sub-hypotheses.

2.3.1. Main Hypothesis

The implementation of the four-dimensional systematic academic climate scheme can significantly improve the overall academic performance of undergraduates.

2.3.2. Sub-Hypotheses

H1. *Students in the intervention group who receive the academic climate intervention achieve significantly higher average course scores than students in the baseline group.*

H2. *Students in the intervention group exhibit a significantly lower course failure rate and a significantly higher make-up examination pass rate compared with students in the baseline group.*

H3. *All four dimensions of the academic climate scheme exert positive predictive effects on students' academic performance, and there is a synergistic interaction effect among the dimensions.*

H4. *The academic climate scheme fosters students' intrinsic learning motivation and lifelong learning capacity, which aligns with the core objectives of sustainable higher education and delivers long-term educational value.*

3. Materials and Methods

3.1. Research Design

A quasi-experimental design was employed in this study to evaluate the effectiveness of a systematically implemented academic climate construction program in higher education [27]. The intervention effect was examined by comparing academic performance indicators after the implementation of the scheme with the aggregated baseline data collected over the previous three academic years.

3.2. Data Collection

Academic performance data were obtained from nine core foundational courses, namely: College Physics, Analytical Chemistry, Probability Theory and Mathematical Statistics, Advanced Mathematics, Principles of Chemical Engineering, Physical Chemistry, Linear Algebra, Inorganic Chemistry, and Organic Chemistry. For clarity in graphical presentation, these courses were coded as A–I.

Two data groups were established:

Baseline group: Aggregated academic records from the three academic years before the implementation of the academic climate construction scheme.

Intervention group: Academic records from the academic year immediately following the implementation.

All data were derived from official university academic archives, guaranteeing data reliability and accuracy. Both the baseline group and the intervention group are full-time undergraduates admitted through regular college admission, with no changes in admission policies, training programs and course assessment standards during the study period. Details on sample sizes, specific majors, and course enrollment timing are available in Figure S1.

3.3. Outcome Indicators

Three indicators were employed to quantify the effectiveness of the academic climate intervention. All three indicators were computed separately for both the baseline group and the intervention group to enable systematic between-group comparisons:

Failure rate: The percentage of students who failed the final examination.

Make-up examination pass rate: The percentage of students who passed the make-up examination after failing the initial assessment.

Average score: The mean examination score of all students enrolled in each course.

3.4. Statistical Analysis

Statistical analyses were conducted to examine the significance of differences between the baseline and intervention groups.

Chi-square (χ^2) tests were applied to compare failure rates and make-up examination pass rates, as these are categorical variables. The underlying assumptions of the chi-square test, including minimum expected cell frequencies, were checked before analysis.

Independent-samples *t*-tests were used to compare average scores, a continuous variable, between the two groups.

Significance levels were defined as:

*** $p < 0.001$

** $p < 0.01$

* $p < 0.05$

ns: not significant ($p \geq 0.05$)

Cohen's *d* statistic was adopted to calculate the effect size of mean score differences between the baseline group and the intervention group [28]. The interpretation of effect

magnitudes followed the widely recognized conventional criteria: a *d* value of approximately 0.2 represents a small effect, 0.5 represents a medium effect, and 0.8 or higher represents a large effect.

All statistical procedures were performed to verify whether the academic climate construction intervention contributed to significant improvements in student academic performance.

3.5. Validity and Reliability

First, it should be clarified that the baseline group and the intervention group are not the same cohort of students, and this study did not adopt a four-year longitudinal tracking design for a single student cohort. To minimize potential bias caused by individual differences and subjective factors across different cohorts, a series of control measures were adopted. The college's admission policies, talent training programs, and overall student demographic structure remained stable throughout the study period. The course content, assessment criteria and teaching arrangements for all nine foundational courses were consistent across all cohorts, and the use of three-year aggregated baseline data further smoothed minor annual fluctuations in student characteristics and academic performance, effectively enhancing the comparability between the two groups. Nevertheless, it is acknowledged that the influence of individual subjective factors on performance differences cannot be completely eliminated, which is a common limitation of quasi-experimental designs in educational practice research.

In terms of internal validity, all core data were extracted from the official university academic archives, which guarantees the authenticity and accuracy of the research data. Data collected from nine foundational courses covering different difficulty levels and knowledge domains effectively reduce the bias caused by the attributes of a single course, and ensure the generalizability of the conclusion regarding the intervention effect.

4. Results

This chapter first presents the specific implementation details of the four-dimensional academic climate intervention adopted in this study (as an example, a portion of the actual Academic Climate Building Activity Plan is presented in Table S1), and then reports the quantitative results of the intervention effect based on the academic performance data of nine core foundational courses.

4.1. Implementation of the Four-Dimensional Academic Climate Intervention

Targeted at the talent cultivation characteristics of chemistry and chemical engineering disciplines, this study constructed and implemented a systematic academic climate scheme covering four complementary dimensions. The design of each dimension is grounded in classical campus climate theoretical frameworks [20,24], and the specific measures are tailored to the actual situation of the college.

4.1.1. Institutional Norms: The Institutional Foundation for Academic Climate

Institutional norms provide fundamental assurance for building a positive academic climate by guiding, constraining, and motivating student learning behavior [20]. As a core component of the campus climate system, standardized institutional rules can set clear behavioral expectations for students and form a stable bottom-line guarantee for learning order.

First, a sound academic management system was developed. A series of regulations were formulated and revised, including classroom teaching standards, early academic warning, learning behavior supervision, and academic ethics, forming a closed-loop management mechanism: normative guidance, process supervision, early warning intervention,

and outcome feedback. For students with learning difficulties, a hierarchical early warning and targeted tutoring mechanism was implemented to provide personalized support and help them overcome academic challenges.

Second, systematic implementation and supervision were strengthened. Regular classroom inspections, learning behavior checks, and academic performance analyses were conducted to identify and resolve problems in a timely manner, ensuring full implementation of the system. Through routine and targeted guidance, students developed good learning habits and academic ethics, laying a solid institutional foundation for academic climate construction.

4.1.2. Cultural Immersion: Creating a Strong Academic Atmosphere

Cultural immersion serves as a key approach to shaping academic climate, exerting subtle educational influences through environmental and cultural cues. Rich academic and cultural activities were carried out, and academic atmosphere construction was integrated into all aspects of education and teaching.

Various academic and cultural events were regularly held, including academic forums, expert lectures, senior student sharing sessions, and academic culture festivals. Distinguished experts, scholars, and outstanding alumni were invited to interact with students, broadening academic horizons and stimulating academic interest. Peer academic communication and mutual assistance were encouraged, forming a strong learning atmosphere featuring mutual help, learning, catching up, and surpassing one another.

Physical learning environments, such as academic corridors, cultural walls, and dedicated study rooms, were constructed to highlight disciplinary characteristics. Academic culture was promoted through online and offline channels, internalizing academic norms and learning initiative into conscious student behavior.

4.1.3. Interest Cultivation: Stimulating Intrinsic Learning Motivation

Learning interest is the intrinsic driving force for academic learning and knowledge exploration, which is critical for improving learning outcomes and sustainable academic development. Guided by a student-centered principle, diverse measures were adopted to stimulate internal learning motivation.

Professional guidance and academic enlightenment were strengthened. Professional cognition education, academic planning guidance, and career development counseling were provided according to grade and major characteristics, helping students clarify learning goals and development directions. A teacher–student pairing system was implemented, where faculty members provided academic and research supervision to stimulate interest in professional learning and scientific exploration.

Teaching and assessment methods were innovated. Heuristic, discussion-based, and research-oriented teaching approaches were adopted to enhance interactivity and engagement. Assessment was optimized to focus more on learning processes, practical ability, and innovative thinking, promoting the shift from passive reception to active learning.

4.1.4. Innovative Practice: Improving Comprehensive Learning Quality

Innovative practice is an important carrier for integrating learning effects and enhancing comprehensive quality, supporting the organic integration of knowledge acquisition, ability training, and quality improvement. Great emphasis was placed on practical and innovative competence, and a sound practice and innovation platform was established.

A multi-level practice and innovation system was constructed by integrating experimental teaching, scientific research training, discipline competitions, and social practice. This progressive system covers basic skills, comprehensive application, and innovative research. Students were encouraged to participate in research projects, discipline compe-

titions, and innovation and entrepreneurship activities to enhance practical ability and innovative thinking.

Practice and innovation platforms were improved based on professional laboratories, engineering training centers, and off-campus practice bases. Cooperation with enterprises and research institutions was strengthened to expand practical channels, enabling students to apply professional knowledge to real-world problems and improve abilities in solving complex issues and serving society.

4.2. Data Analysis

Nine core foundational courses reflecting undergraduate professional competence and potential for advanced study were selected as tracking indicators. After implementing the academic climate construction scheme, all nine courses showed consistent improvements in failure rate, make-up examination pass rate, and average score.

Failure rates were significantly reduced in all courses (Figure 1). Advanced Mathematics showed the largest decrease (13.5 percentage points), followed by Physical Chemistry (approximately 10 percentage points), and Analytical Chemistry showed the smallest decrease (1 percentage point). The intervention was consistently associated with lower failure rates, especially for courses with initially high failure rates.

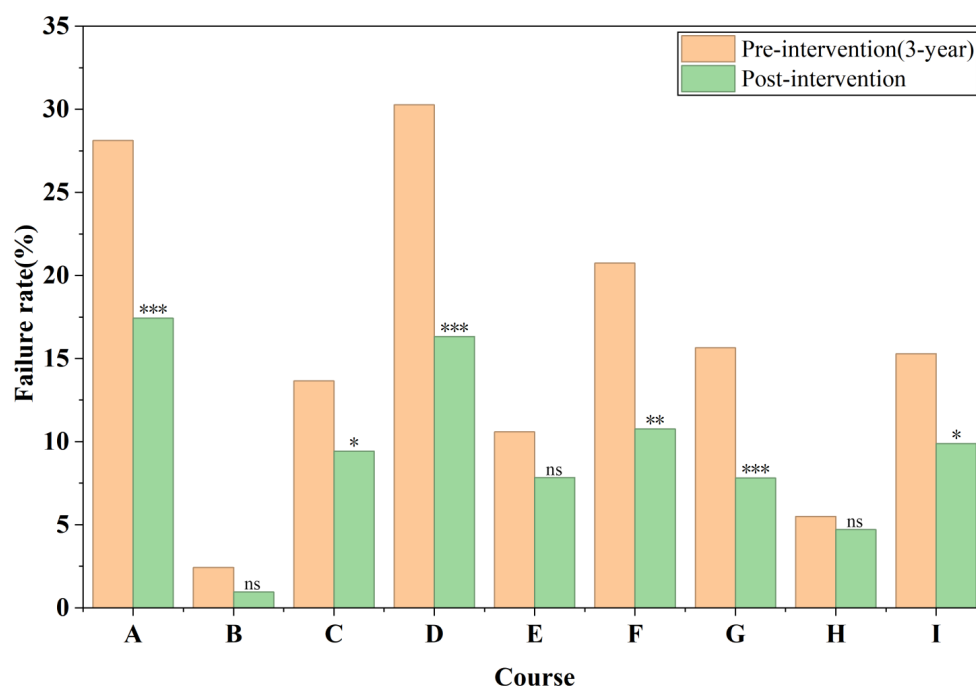


Figure 1. Changes in failure rates of the nine monitored courses before and after the implementation of the Comprehensive Academic Climate Scheme. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns: not significant ($p \geq 0.05$).

Make-up examination pass rates increased across all courses (Figure 2). Probability Theory and Mathematical Statistics showed the largest increase (approximately 23 percentage points), and Physical Chemistry showed the smallest increase (approximately 12 percentage points), indicating widespread improvement in remedial academic performance.

Average scores increased in nearly all courses (Figure 3). The largest improvement was observed in Probability Theory and Mathematical Statistics (7 points), followed by Analytical Chemistry (4 points), and Linear Algebra showed the smallest increase. As shown in the results, the average scores of all nine courses increased significantly after the implementation of the academic climate scheme (all $p < 0.05$). The effect sizes (Cohen's d)

ranged from 0.23 to 0.50, with eight courses showing small effects and one course showing a medium effect (shown in Table S2). The results indicate that the systematic academic climate intervention has a stable and positive impact on students' academic performance, which is consistent with the practical characteristics of holistic educational environment interventions in higher education.

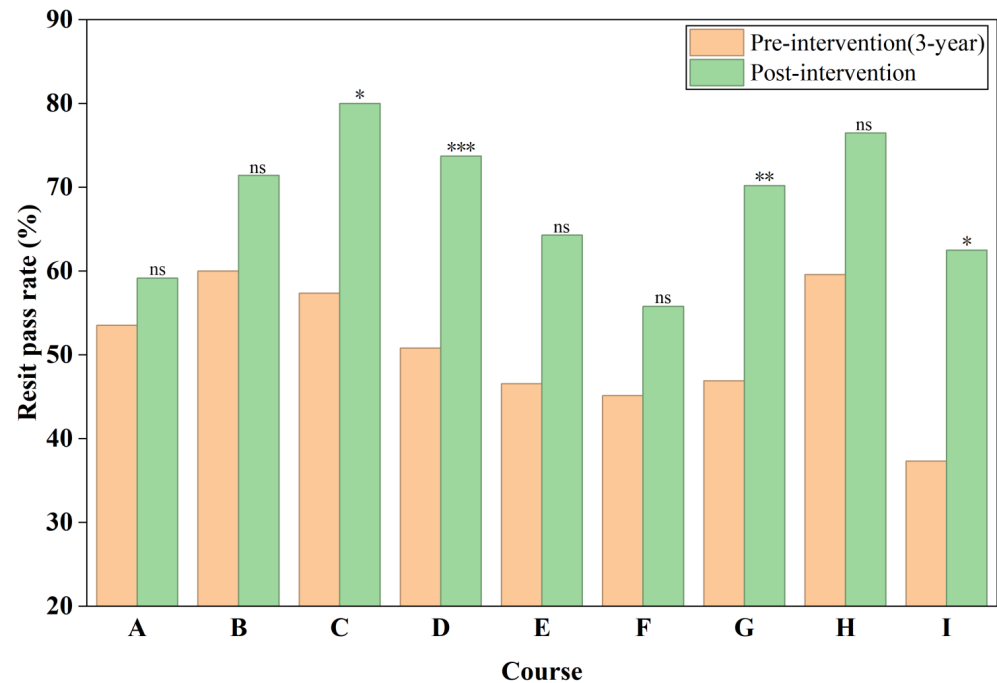


Figure 2. Changes in make-up examination pass rates of the nine monitored courses before and after the implementation of the Comprehensive Academic Climate Scheme. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns: not significant ($p \geq 0.05$).

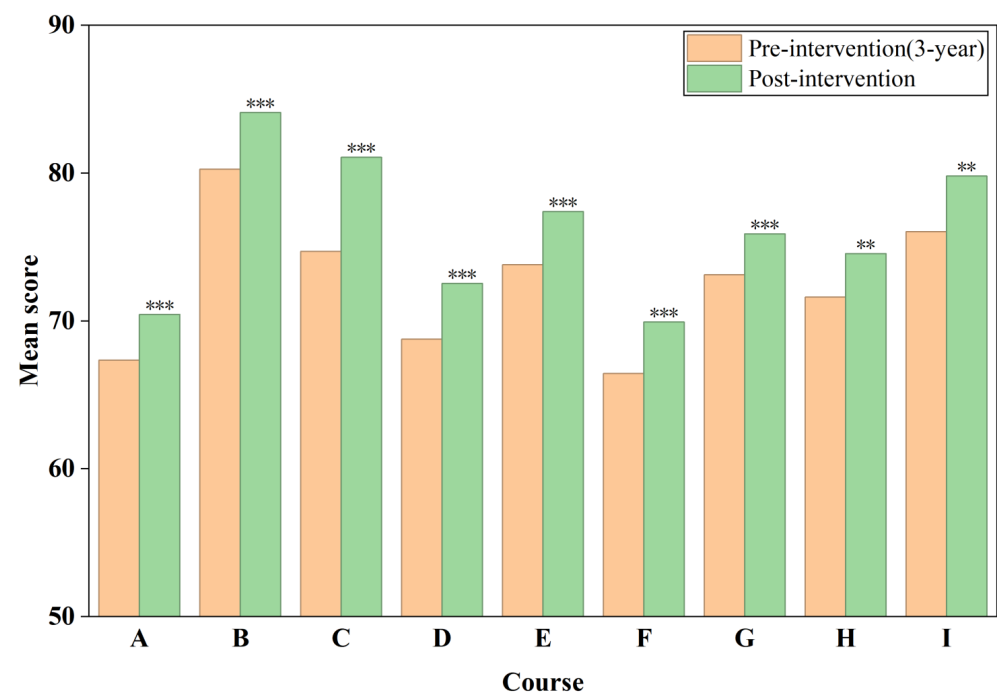


Figure 3. Changes in average scores of the nine monitored courses before and after the implementation of the Comprehensive Academic Climate Scheme. *** $p < 0.001$, ** $p < 0.01$.

Overall, the academic climate construction scheme was consistently associated with improved student academic performance across disciplines, and the intervention effect was validated in multiple foundational courses.

5. Discussion

5.1. Effectiveness of Systematic Academic Climate Construction

The present findings demonstrate that a systematically implemented academic climate construction program significantly improves student academic performance across nine foundational courses. The consistent reductions in failure rates, enhanced make-up examination pass rates, and elevated average scores collectively confirm that the integrated intervention effectively establishes a supportive learning environment. These results align with prior literature emphasizing the pivotal role of a positive academic climate in shaping learning behaviors and academic outcomes [25,29]. Empirical studies based on multiple student groups have consistently shown that supportive campus climates can promote students' active learning engagement, which in turn drives improvements in academic achievement and reduces academic risk [25,30]. A well-structured institutional system not only regulates student conduct but also boosts learning motivation and engagement, ultimately promoting academic achievement.

Notably, the most pronounced improvements occurred in courses with initially high failure rates (e.g., Advanced Mathematics and Physical Chemistry), suggesting that systematic academic climate interventions are particularly beneficial for academically challenging courses, where students require stronger institutional support and motivational mechanisms. This finding is consistent with engineering education research indicating that targeted, multi-dimensional climate interventions can effectively reduce attrition risks and improve academic performance in difficult foundational courses [31].

5.2. Institutional Norms as the Foundation of Academic Climate

Robust institutional governance represents the fundamental driver of the observed improvements. The closed-loop management system—encompassing normative guidance, process monitoring, early warning, targeted intervention, and feedback—effectively ensures the stability and sustainability of academic climate. These findings support existing research highlighting the importance of governance structures and academic management systems in facilitating student success [24,32]. From the perspective of new institutionalism, formal institutional norms provide clear behavioral guidelines and expectation frameworks for students, which is a prerequisite for the stable operation of the academic climate system [14].

Perry et al. (2026) confirmed that a sound institutional academic integrity climate can effectively reduce academic misconduct behaviors, guide students to form standardized learning habits, and reduce academic failure risks at the source [14]. A systematic review of first-generation student academic adjustment also showed that standardized academic management systems paired with targeted support mechanisms can significantly narrow the academic performance gap and improve overall student success rates [32].

Early warning and personalized tutoring mechanisms were especially effective in reducing academic risk, as reflected in the substantial decline in failure rates. By proactively identifying struggling students and delivering tailored support, the university established a proactive rather than reactive support system. This systematic approach underscores the necessity of integrating policy and management strategies into academic climate construction. Relevant engineering education research has also verified that institutional-level early warning and intervention systems can effectively reduce student attrition rates, which is consistent with the failure rate reduction effect observed in this study [31].

5.3. Cultural Immersion and Enhanced Academic Engagement

Cultural immersion represents another critical pillar of effective academic climate development. Regular academic forums, expert lectures, peer-sharing sessions, and academic culture festivals enriched the learning environment and stimulated student interest. In addition, physical learning spaces, including academic corridors and dedicated study zones, subtly internalized academic norms.

These results are consistent with social-cultural learning theories, which posit that learning is embedded within social and environmental contexts. A strong academic culture enhances belonging and collective identity, encouraging active academic participation. Sanders et al. (2026) identified campus culture and student experience as a core dimension of campus climate, which directly affects students' sense of belonging and academic participation willingness [10]. Stafford et al. (2025) further confirmed that perceived peer support and classroom comfort, as components of cultural atmosphere, are significantly positively correlated with first-year undergraduates' academic performance [33].

Thus, the findings highlight the value of integrating physical space and cultural dimensions when building sustainable academic environments [15,20]. Brandli et al. (2024) also emphasized that immersive climate learning activities can promote students' deep participation and internalize academic values into spontaneous behavioral habits, which is an important mechanism for cultural immersion to exert long-term effects [2].

5.4. Interest Cultivation as an Intrinsic Motivator

This study confirms that nurturing intrinsic learning interest is essential for sustaining academic engagement. Professional orientation, academic planning, career counseling, and faculty mentoring effectively clarified learning goals and strengthened disciplinary identity. Furthermore, student-centered pedagogies—including inquiry-based and discussion-oriented instruction—enhanced classroom interaction and promoted active learning.

The significant improvements in average scores across most courses provide empirical support for the role of intrinsic motivation in academic success. These findings align with self-determination theory, which identifies autonomy, competence and belonging as key psychological needs that drive sustained engagement and learning [3]. Prananto et al. (2025) systematically sorted out the mechanism path of teacher support affecting student engagement, and confirmed that meeting students' basic psychological needs is a core intermediary link to stimulate intrinsic learning motivation [3]. Safta and Suditu (2025) further found that perceived academic autonomy is significantly positively correlated with academic success, and giving students appropriate decision-making freedom in the learning process can effectively improve their academic performance [34].

This study's practice of a professional guidance and mentoring system precisely responds to the psychological needs of students' autonomy and competence, thus effectively stimulating their internal learning drive and promoting the continuous improvement of academic performance.

5.5. Innovative Practice and Comprehensive Learning Quality

Innovative and practice-oriented learning represents a vital component of holistic learning quality improvement. The establishment of a multi-level practical innovation system allowed students to integrate theoretical knowledge with real-world applications. Participation in scientific research, disciplinary competitions, and industry-academia cooperation strengthened practical skills and enhanced problem-solving and creative thinking abilities.

Codony et al. (2025) verified through empirical research that the combination of positive academic climate and active learning methods such as problem-based learning can

significantly improve students' engagement level, and the two have a synergistic promoting effect [35]. This finding provides theoretical support for the design idea of this study to promote learning quality improvement through innovative practice paths under the overall framework of academic climate construction.

Such experiential learning opportunities are highly consistent with the goals of education for sustainable development, which emphasizes competencies for addressing complex social challenges [1,17]. Accordingly, innovation-oriented practice not only improves academic performance but also cultivates sustainability-relevant capabilities.

5.6. Synergistic Effects of the Integrated Academic Climate System

A key contribution of this study is the empirical validation of synergistic effects among the four dimensions: institutional norms, cultural immersion, interest cultivation, and innovative practice. These components operate interactively rather than independently, forming a comprehensive and sustainable academic climate system. The statistically significant improvements across all nine courses provide robust evidence that coordinated, multi-dimensional interventions are more effective than fragmented, single-dimensional approaches.

The theoretical rationality of combining these four dimensions is supported by classical campus climate frameworks. Hart and Fellabaum (2008) pointed out through content analysis of a large number of campus climate studies that a complete academic climate system should cover institutional rules, cultural atmosphere, interpersonal support and development resources, which correspond to the four dimensions constructed in this study [7]. Rankin et al. (2016) further verified through large-sample empirical research that multiple dimensions of campus climate jointly affect student academic outcomes, and the coordinated improvement of multiple dimensions can produce a superimposed effect greater than the sum of single-dimensional effects [36].

Specifically, institutional norms provide bottom-line constraints and system guarantees for student learning behavior, cultural immersion creates a pervasive environmental atmosphere and collective identity, interest cultivation stimulates internal motivation and active learning willingness, and innovative practice provides a landing carrier for knowledge application and ability improvement. The four dimensions form a closed-loop logic of "constraint-immersion-motivation-practice", which interact and reinforce each other, jointly promoting the continuous improvement of students' academic performance. This integrated perspective addresses a major gap in existing literature, which commonly examines isolated aspects of academic climate without considering combined effects. By conceptualizing academic climate construction as a dynamic, interconnected system, this study offers a more comprehensive framework for understanding and enhancing learning outcomes in higher education.

5.7. Long-Term Sustainability of Intervention Outcomes

In terms of the long-term sustainability of the intervention effects, this study holds that the academic performance improvement brought by the four-dimensional systematic scheme has lasting value rather than a short-term temporary effect, which can be explained from three levels: individual psychology, group culture and institutional mechanism.

At the individual psychological level, the scheme stimulates students' intrinsic learning motivation by satisfying their basic psychological needs of autonomy, competence and belonging, and the internalized learning motivation has long-term stability [16,37]. Li et al. (2024) found through network analysis of psychosocial factors of academic success that sense of belonging and intrinsic motivation, as central variables, can drive the long-term stable operation of a series of positive learning behaviors, and are core psychological foundations for maintaining sustained academic success [37]. The interest cultivation and

mentoring measures in this study precisely act on these core psychological variables, which means that the improvement of students' learning state can be maintained for a long time after the intervention.

At the group cultural level, the cultural immersion practice has shaped a positive collective learning atmosphere and peer mutual assistance culture, and this group norm has spontaneous diffusion and inheritance characteristics. Once a positive academic culture is formed, it can continuously affect new batches of students through the transmission of peer groups, producing a long-term radiation effect [23,33]. Brandli et al. (2024) also emphasized that the cultural atmosphere formed by student participation has sustainability beyond short-term interventions, and is an important carrier for the long-term effectiveness of climate construction [2].

At the institutional mechanism level, the closed-loop academic management system constructed in this study is a normalized institutional arrangement integrated into daily talent cultivation work, rather than a temporary intervention project. With the continuous operation and iterative optimization of the system, it can continuously play a governance role and provide long-term and stable institutional support for the maintenance of academic climate [14,24]. Hassan et al. (2025) pointed out in a systematic review of sustainable higher education that institutionalized governance mechanisms are the core guarantee for the long-term effectiveness of educational interventions, which is consistent with the institutional construction practice of this study [4].

Of course, limited by the current research cycle, this study has not yet obtained long-term tracking data. In follow-up research, we will continue to track the subsequent academic performance and comprehensive development of the intervention group students, and further verify the long-term sustainability of the intervention effect.

6. Limitations

Several limitations should be acknowledged. First, this study was conducted at a single university, which may restrict the generalizability of the findings. Future research could include multiple institutions to improve external validity. Second, the analysis relied primarily on quantitative academic indicators; integrating qualitative data (e.g., student and instructor perceptions) would provide a more comprehensive understanding of the mechanisms underlying academic climate construction. Third, although the quasi-experimental design enables meaningful comparisons, longitudinal studies are needed to evaluate the long-term sustainability of intervention effects.

Future research may also adopt structural equation modeling or mixed-methods approaches to further explore interactions among institutional, cultural, pedagogical, and environmental factors in academic climate construction. In addition, investigating links between academic climate and sustainability competencies would help clarify the broader societal impacts of higher education.

7. Conclusions

This study examined the effectiveness of a systematically implemented academic climate construction program and its influence on student academic performance in higher education. By integrating four dimensions—institutional norms, cultural immersion, interest cultivation, and innovative practice—we proposed and empirically validated a comprehensive framework for enhancing academic climate at the university level. Using a quasi-experimental design, examination results from nine core foundational courses were compared with aggregated baseline data from the preceding three academic years. The results revealed significant improvements in failure rates, make-up examination pass rates, and average scores, confirming the effectiveness of the intervention.

The findings highlight the foundational role of institutional norms in shaping a positive academic climate. A closed-loop academic management system featuring guidance, monitoring, early warning, intervention, and feedback effectively regulated student learning behaviors and reduced academic risk, providing a stable and sustainable foundation.

Cultural immersion significantly contributed to a strong academic atmosphere. Through academic activities and discipline-oriented physical environments, students internalized positive academic values, which enhanced belonging and engagement.

Interest cultivation served as a key intrinsic motivator for sustainable learning. Student-centered measures, including professional guidance, faculty mentoring, and innovative teaching and assessment methods, effectively stimulated internal motivation and supported the shift from passive to active learning.

Innovative practice played a critical role in improving comprehensive learning quality. Multi-level practical platforms facilitated the application of knowledge to real problems, strengthening practical skills, creativity, and problem-solving capacity in line with sustainable education goals.

Importantly, this study demonstrates that the success of academic climate construction depends on the synergistic interaction of the four dimensions. Rather than isolated actions, institutional norms, cultural immersion, interest cultivation, and innovative practice collectively form a coordinated and dynamic system. This systematic view fills an important gap in the literature, which has typically examined components separately rather than investigating their combined effects.

7.1. Theoretical Contributions

This study contributes to the literature by proposing a systematic, holistic framework for academic climate construction in higher education. It conceptualizes academic climate as an interconnected system, expands current research, and provides empirical evidence for the effectiveness of this integrated approach. Furthermore, by linking academic climate to principles of sustainable education, the study enriches discussions on how universities can support long-term student development and sustainability competencies.

7.2. Practical Implications

For higher education institutions, targeted and multi-pronged efforts are required to build a sound academic climate. Universities should establish comprehensive academic management systems equipped with academic early warning and targeted student support mechanisms, cultivate a strong academic culture through the coordinated design of physical learning environments and academic social scenarios, implement student-centered mentoring and innovative teaching approaches to drive students' intrinsic learning motivation, and develop integrated practice and innovation platforms to foster students' comprehensive competencies. The systematic framework proposed in this study offers a scalable and transferable model for institutions aiming to improve their academic climate and advance the sustainable development of higher education.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su18147029/s1>, Figure S1. Information on majors and the number of exam participants.; Table S1. Excerpts from the 2025 "Study in Central South" Spring Semester Academic Climate Building Activity Plan.; Table S2. Pre- and Post-Intervention Mean Scores and Computed Statistical Measures.

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