THE INFLUENCE OF INNOVATION TEAM CLIMATE AND SUPERVISOR GUIDANCE ON STUDENTS' INNOVATIVE BEHAVIOR AMONG UNDERGRADUATE STUDENTS AT QINGDAO HENGXING UNIVERSITY OF SCIENCE AND TECHNOLOGY

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ABSTRACT
This quantitative study investigated the joint predictive effects of Innovation Team Climate and Supervisor Guidance on Students' Innovative Behavior among 400 undergraduate students from Qingdao Hengxing University of Science and Technology. Data were collected using a self-reported structured questionnaire with established multi-dimensional scales and analysed via simultaneous multiple linear regression. Reliability assessment based on a pilot-test sample ($n = 30$) showed acceptable internal consistency for all constructs, and descriptive statistics were computed from the formal sample. Bivariate correlation results indicated significant positive inter-correlations among the three study variables. According to the joint simultaneous regression outcomes, Innovation Team Climate exerted a significant positive unique predictive effect on Students' Innovative Behavior ($\beta = 0.5749$, $p < 0.01$). Supervisor Guidance also significantly and positively predicted Students' Innovative Behavior ($\beta = 0.1031$, $p < 0.05$). The whole regression model explained 42.9 % of the variance in undergraduate Students' Innovative Behavior. Supplementary descriptive results from separate regression models further revealed that participative safety within innovation teams and resource-and-opportunity support from supervisors stood out as the most influential sub-dimension predictors. The findings highlight the importance of supportive team psychological atmosphere and targeted supervisory mentorship for fostering student innovative actions. Practical implications for university innovation-team administration, supervisor practice and institutional policy are discussed. Limitations include cross-sectional design, single-university sampling and exclusive self-report data, and directions for future research are proposed.
Keywords: Innovation Team Climate, Supervisor Guidance, Students' Innovative Behavior

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INTRODUCTION

Innovation talent cultivation has become an important component of higher education, particularly with the continuing transformation of practical teaching and learning. In undergraduate innovation education, supportive contextual factors are particularly important because innovation activities require team communication, knowledge exchange, idea trial, feedback, and active student participation. Anderson and West (1998) state that positive innovation team climate can strengthen student engagement and creative experiences in project environments. Innovation Team Climate (ITC), including shared vision, participative safety, task orientation, and support for innovation, may therefore influence students' Innovative Behavior (SIB). Han et al. (2022) state that effective academic supervisors perform both instructional and resource roles that support students' innovation experiences, while Zhi and Pan (2026) state that mentoring interaction and supervisor support are important for student innovation and creative performance.Despite growing research on student innovation education, limited attention has been given to the relationships among Innovation Team Climate, Supervisor Guidance, and Students' Innovative Behavior among undergraduate students in applied universities, particularly the combined predictive effects of the two contextual antecedents within one unified statistical model. Therefore, this study employed a quantitative research design involving 400 undergraduate students recruited from Qingdao Hengxing University of Science and Technology through proportionate stratified random sampling. Data were collected using a structured questionnaire and analyzed using simultaneous multiple linear regression with Jamovi, to examine the joint direct effects of Innovation Team Climate and Supervisor Guidance on Students' Innovative Behavior.

Research Objectives for this study are following.

1) To examine the influence of innovation team climate on students' innovative behavior in university innovation teams at Qingdao Hengxing University of Science and Technology.

2) To investigate the influence of supervisor guidance on students' innovative behavior in university innovation teams at Qingdao Hengxing University of Science and Technology.

Research Hypotheses

H1: Innovation team climate has a significant influence on students' innovative behavior in university innovation teams at Qingdao Hengxing University of Science and Technology.

H2: Supervisor guidance has a significant influence on students' innovative behavior in university innovation teams at Qingdao Hengxing University of Science and Technology.

LITERATURE REVIEWS

Innovation Team Climate in Higher-Education Student Teams

Innovation Team Climate refers to shared team-level psychological perceptions regarding internal environments and the extent to which new ideas and creative attempts are encouraged within collaborative groups. These perceptions include vision, participative safety, task orientation, and support for innovation (Anderson & West, 1998). Effective student innovation teams require not only individual creative talent but also a supportive psychological atmosphere that enables knowledge exchange, risk-taking, and collaborative improvement. West (1990) states that team innovation outcomes depend heavily on these four collective climate dimensions rather than merely the sum of individual creativity. Such team-level conditions may therefore influence undergraduate Students' Innovative Behavior.

Strobel et al. (2022) state that meta-analytic evidence confirms team innovation climate positively predicts team-related creative performance across multiple contexts. Cox (2026) further notes that shared team vision strengthens learning-from-mistakes processes within Chinese undergraduate innovation-training programs. These findings indicate that the quality of intra-team psychological environment substantially shapes how students engage in creative activities. Vision provides collective goals for group participants. Participative safety

encourages members to express incomplete or conflicting ideas without fear of negative evaluation. Task orientation maintains high performance standards and reflective improvement. Support for innovation delivers practical resources and emotional encouragement for trial-and-error practice. In university settings, these four dimensions work jointly to create conditions for idea generation and implementation.

Nevertheless, much existing team-climate research focuses on organizational employees or postgraduate research groups. Less discussion has targeted applied-science undergraduate student innovation teams, where team members often lack prior collaborative research experience. Consequently, Innovation Team Climate represents a key contextual factor deserving further empirical attention for undergraduate innovation education.

Supervisor Guidance in Undergraduate Innovation Practice

Supervisor Guidance refers to systematic multifaceted mentor support provided during student project-based innovation activities. It includes professional and technical guidance, feedback and performance guidance, autonomy support, and resource and opportunity support (Zhi & Pan, 2026). Rooted in Self-Determination Theory (Deci & Ryan, 2000), high-quality mentorship satisfies students' psychological needs for competence, relatedness, and autonomy and may further facilitate innovative behavioral engagement.

Han et al. (2022) state that academic supervisors perform both instructional and resource-brokering roles that support students' innovation experiences, while Chang et al. (2025) state that supervisory support demonstrates positive correlations with learner creativity in Chinese higher-education samples. Professional and technical guidance helps undergraduates resolve domain-specific technical obstacles. Feedback and performance guidance offers evaluative suggestions for iterative improvement of project work. Autonomy support respects students' space for independent decision-making instead of excessive intervention. Resource and opportunity support connects learners with equipment, competitions, academic exchange channels and research platforms.

Prior meta-analytic results are mostly based on postgraduate student datasets. For undergraduates in applied-science universities, how these four dimensions of supervisor guidance function together to predict innovative behavior still requires more empirical evidence. Effective mentorship does not equal complete control; balanced support and appropriate autonomy are both essential for student innovation development. Therefore, Supervisor Guidance constitutes another critical antecedent for understanding undergraduate innovative outcomes.

Students' Innovative Behavior

Students' Innovative Behavior describes multi-stage observable behavioral processes in learning and project contexts, covering idea exploration, idea generation, idea promotion, and idea implementation (De Jong & Den Hartog, 2010; Kleysen & Street, 2001). It focuses on actual behavioral performance instead of static creative potential or personality traits. Scott and Bruce (1994) point out that innovative behavior proceeds from problem recognition to idea realization. Idea exploration means actively discovering practical problems and improvement opportunities. Idea generation refers to producing novel and feasible solutions. Idea promotion represents communicating and advocating ideas to gain peer or mentor support. Idea implementation means transforming creative proposals into tangible outputs and prototypes. Saengpanya et al. (2025) state that the four-dimensional measurement framework shows satisfactory reliability and validity in Asian undergraduate samples.

Although many studies discuss creativity and innovation talent cultivation in Chinese universities, a number of investigations treat innovation as a general ability. Fewer empirical studies examine the complete multi-stage behavioral process among applied-science undergraduates. Individual innovative actions are not formed in isolation; they are continuously shaped by team environmental conditions and mentor support resources. This makes it

meaningful to investigate how team-level climate and supervisor-provided support jointly relate to Students' Innovative Behavior.

Research Gap and Conceptual Framework

Previous research demonstrates the importance of team-level psychological atmosphere and faculty mentorship for creative development in higher education. Strobel et al. (2022) state that innovation team climate benefits group creative outputs. Chang et al. (2025) state that supervisor support correlates positively with student creativity. De Jong and Den Hartog (2010) establish the multidimensional measurement foundation for innovative behavior.

Despite these findings, limited research has simultaneously examined Innovation Team Climate and Supervisor Guidance as two parallel contextual predictors of Students' Innovative Behavior among applied-science undergraduate students in China. Most existing literature investigates either team climate or supervisor support separately in isolated regression models, ignoring shared variance between the two predictors. Many empirical samples concentrate on postgraduate populations, while undergraduate innovation-team participants remain understudied. Therefore, the present study investigates the direct predictive relationships among these three constructs within one simultaneous regression model. Specifically, it examines whether Innovation Team Climate influences Students' Innovative Behavior, and whether Supervisor Guidance influences Students' Innovative Behavior when both predictors are included jointly. Based on this literature, the conceptual framework is presented in Figure 1.

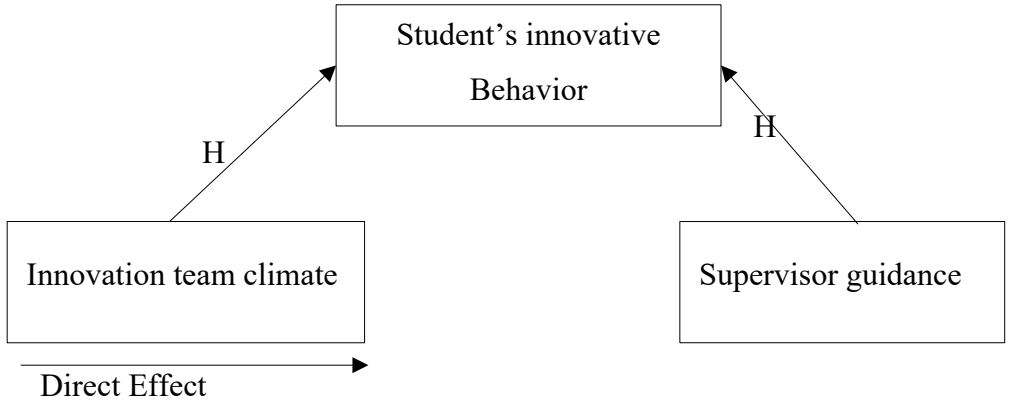


Figure 1 Conceptual Framework adapted from Team Climate Inventory Theory (Anderson & West, 1998) and Self-Determination Theory (Deci & Ryan, 2000).

RESEARCH METHODOLOGY

This study adopted a quantitative research approach to examine the joint influence of innovation team climate and supervisor guidance on students' innovative behavior within a simultaneous multiple regression framework. A total of 400 participants were recruited from undergraduate students at Qingdao Hengxing University of Science and Technology. Participants were selected using proportionate stratified random sampling techniques based on academic-year distribution across the university.

Data were collected using a structured questionnaire comprising four sections: demographic information; Innovation Team Climate measured by 16 items covering vision, participative safety, task orientation, and support for innovation; Supervisor Guidance measured by 16 items assessing professional and technical guidance, feedback and performance guidance, autonomy support, and resource and opportunity support; and Students' Innovative Behavior measured by 16 items evaluating idea exploration, idea generation, idea promotion, and idea implementation. All items were rated on a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

The questionnaire was adapted from established published scales: the Innovation Team Climate scale was adapted from the Team Climate Inventory developed by Anderson and West (1998); the Supervisor Guidance scale drew upon instruments from Zhi and Pan (2026) and Han et al. (2022); and the Students' Innovative Behavior scale was adapted from Kleysen and Street (2001) and De Jong and Den Hartog (2010). The draft questionnaire was reviewed by supervisors and subject-matter experts to evaluate content completeness, construct alignment, item wording clarity, and contextual appropriateness, followed by revision according to expert feedback.

A pilot study involving 30 undergraduate students produced an overall Cronbach's alpha coefficient of 0.939) Sub-dimension Cronbach's alpha values ranged from 0.637 to 0.849) Some sub-dimensions showed marginal reliability values in pilot testing, so corresponding item refinement had been completed before formal survey distribution (Polit & Beck, 2021).

The questionnaire was distributed to undergraduates at the target university. Participation was voluntary, anonymous, and confidential, with informed consent obtained from all respondents. Questionnaires with substantial missing values or careless response patterns were excluded; 400 valid responses were retained for analysis.

The analysis will compute regression coefficients for each predictor variable and evaluate their statistical significance at the 0.05 significance level. Before running multiple regression, key regression assumptions including normality, linearity, homoscedasticity, error independence, and multicollinearity will be checked to verify model fitness.

Unstandardized and standardized regression coefficients, t-statistics, p-values, coefficient of determination R^2, adjusted R^2, and the overall F-test will be reported to interpret the analytical outcomes.

RESEARCH RESULTS

Respondent Demographic Characteristics

A total of 400 undergraduate students participated in this study. Of the respondents, 220 (55.0%) were female and 180 (45.0%) were male, indicating a relatively balanced gender distribution. Regarding academic year, 152 (38.0%) participants were first-year students, followed by 134 (33.5%) who were second-year students, 65 (16.3%) who were third-year students and 49 (12.3%) who were fourth-year students. The participants represented different fields of study and innovation training backgrounds, reflecting the applied undergraduate education characteristics at Qingdao Hengxing University of Science and Technology. However, major or training-group differences were not directly compared or statistically tested. Therefore, the demographic diversity of the sample should not be interpreted as evidence of group differences.

Reliability, Descriptive Statistics and Correlation Analysis

Prior to hypothesis testing, reliability and descriptive statistics for the three main constructs were evaluated. Cronbach's α coefficients from the pilot-test sample (n = 30) were used to assess internal consistency; all α values exceeded 0.70, indicating acceptable reliability. Means and standard deviations (SD) were calculated using the formal sample of 400 participants. Mean scores ranged from 3.75 to 3.80, suggesting respondents held generally positive perceptions of the measured variables. Content validity was ensured by adapting validated scales and expert review prior to questionnaire administration. Table 1 presents reliability and descriptive statistics for all constructs. Pearson bivariate correlation analysis was conducted to test pairwise associations. Innovation Team Climate and Supervisor Guidance showed significant positive correlations with Students' Innovative Behavior, and the two predictors were also positively correlated with one another. These correlation results provided preliminary empirical support for the proposed hypotheses and laid a foundation for the following regression analysis.

Table 1 Reliability and Descriptive Statistics of Main Constructs

Construct	Cronbach's α	**MEAN**	**SD**	Assessment
Innovation Team Climate	0.882	3.80	0.683	Acceptable
Supervisor Guidance	0.876	3.75	0.738	Acceptable
Students' Innovative Behavior	0.879	3.80	0.704	Acceptable

Note. α = Cronbach's alpha. Reliability estimates are from the pilot sample (n = 30), while means and SD are based on the formal sample (n = 400). All α > 0.70, with adequate reliability and content validity from expert review and adapted scales.

Following assessment of reliability, descriptive statistics and bivariate correlations, the structural model was assessed using multiple linear regression. For descriptive reference, two separate regression models were run. Model 1 included the four dimensions of Innovation Team Climate as predictors, producing R^2=0.277) Model 2 included the four dimensions of Supervisor Guidance as predictors, producing R^2=0.331) These separate-model R^2 values are presented for descriptive background only. Hypothesis testing was conducted based exclusively on the joint simultaneous regression model presented in Table 2, which accounts for shared variance between the two predictors.

Table 2 Joint Simultaneous Regression Model Predicting Students' Innovative Behavior

Predictor	**b**	**SE**	**t**	**p-value**	**β**	**Tolerance**	**VIF**
Intercept	1.124	0.217	5.18	< .001			
Innovation Team Climate	0.591	0.086	6.832	< .001	0.5749	0.642	1.557
Supervisor Guidance	0.118	0.055	2.147	0.032	0.1031	0.642	1.557

Model summary: R = 0.655, R^2 = 0.429, Adjusted R^2 = 0.426, F = 148.7, p < .001) Tolerance and VIF values indicate no serious multicollinearity in this joint simultaneous regression model. The two predictors jointly explain 42.9% of the variance in Students' Innovative Behavior.

The joint regression results showed that Innovation Team Climate (β = 0.5749, p < 0.001) and Supervisor Guidance (β = 0.1031, p = 0.032) significantly predicted Students' Innovative Behavior. The two predictors together explained 42.9% of the variance (R^2 = 0.429, p < .001). Tolerance and VIF values indicated no serious multicollinearity.

Hypothesis Testing: Direct Effects

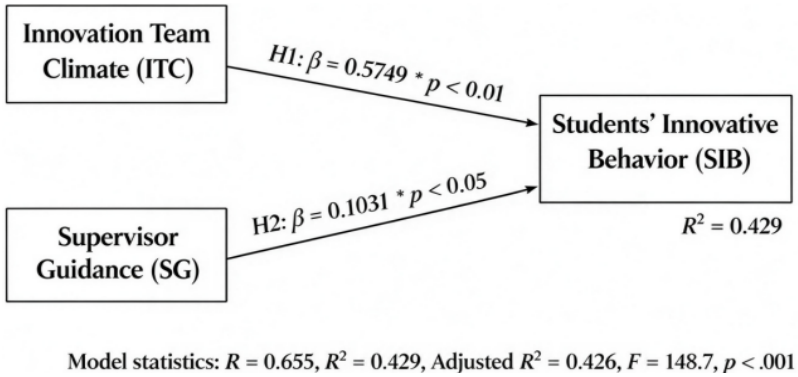
The hypothesized direct relationships were examined using the joint simultaneous multiple linear regression analysis based on data from 400 undergraduate students. The results showed that both direct relationships were positive and statistically significant. Innovation Team Climate had a significant positive effect on Students' Innovative Behavior (β = 0.5749, t = 6.832, p < .01), supporting H1) Supervisor Guidance had a significant positive effect on Students' Innovative Behavior (β = 0.1031, t = 2.147, p < .05), supporting H2) This finding indicates that participants who perceived higher levels of Innovation Team Climate and Supervisor Guidance also tended to report higher Students' Innovative Behavior.

Table 3 Summary of Direct Effects

Hypothesis	**Relationship**	**β**	**t-value**	**p-value**	**Result**
H1	ITC → SIB	0.5749	6.832	< .01	Supported
H2	SG → SIB	0.1031	2.147	< .05	Supported

Note. ITC = Innovation Team Climate; SG = Supervisor Guidance; SIB = Students' Innovative Behavior.

The hypothesis-testing results showed that both proposed hypotheses were supported in the joint simultaneous regression model. Innovation Team Climate had a significant positive effect on Students' Innovative Behavior (H1). Supervisor Guidance had a significant positive effect on Students' Innovative Behavior (H2). No indirect-effect hypothesis was proposed or tested in this research model. Figure 2 presents the finalized model with the standardized path coefficients from the joint regression.



*Note. ITC = Innovation Team Climate; SG = Supervisor Guidance; SIB = Students' Innovative Behavior. * p < 0.05, ** p < 0.01.*

Figure 2 Finalized Model.

This diagram visually presents the regression path coefficients obtained from the simultaneous joint multiple-regression model. This study does not conduct Structural Equation Modeling. Model statistics are derived from multiple linear regression output.

Hypotheses H1 and H2 at the construct-level were tested via the simultaneous joint regression using composite aggregate scores of the two predictors. Findings regarding individual sub-dimensions are derived from separate regression models and are presented for supplementary descriptive discussion only.

DISCUSSION AND CONCLUSION

Hypotheses H1 and H2 at the construct-level were tested via the simultaneous joint regression using composite aggregate scores of the two predictors. Findings regarding individual sub-dimensions are derived from separate regression models and are presented for supplementary descriptive discussion only.

The present study adopted simultaneous multiple linear regression to examine the joint predictive effects of Innovation Team Climate and Supervisor Guidance on Students' Innovative Behavior among undergraduate students at Qingdao Hengxing University of Science and Technology. Both hypotheses were statistically supported. When both predictors were entered into one unified regression model, Innovation Team Climate demonstrated a significant positive unique effect on Students' Innovative Behavior ($\beta = 0.5749$, $p < 0.01$), and Supervisor Guidance also exerted a significant positive unique effect ($\beta = 0.1031$, $p < 0.05$). The joint regression model explained 42.9 % of the variance in students' innovative behavior, indicating that team-level climate and supervisory support together constitute important contextual antecedents for undergraduate innovative behavioral performance.

From a theoretical perspective, the significant predictive role of Innovation Team Climate supports the core proposition of Team Climate Inventory theory (Anderson & West, 1998). In the separate descriptive regression model, participative safety emerged as the strongest sub-dimension predictor. This suggests that psychological safety which allows students to express immature or divergent ideas is the foundational condition for triggering innovative behaviors within undergraduate project teams. Vision and task orientation also showed

meaningful predictive contributions. By contrast, support for innovation lost its unique statistical significance in multivariate analysis, which can be attributed to high inter-dimension correlation. In real-world student teams, theoretically distinct climate dimensions overlap empirically, and shared variance absorbs its independent explanatory power. This finding reminds educators that simply setting innovation goals cannot produce behavioral improvements without a safe interpersonal atmosphere for idea exchange.

Consistent with Self-Determination Theory (Deci & Ryan, 2000), Supervisor Guidance positively predicted undergraduate Students' Innovative Behavior in the joint model. Among its four sub-dimensions (analysed in separate descriptive regression), only resource and opportunity support showed a unique significant effect. Most applied-science undergraduates can acquire basic technical knowledge through coursework and peer collaboration. Therefore, what they urgently need from supervisors is external project resources, competition access and academic exchange platforms rather than repeated technical instruction alone. This result echoes existing research noting the prominent benefits of resource-oriented mentorship for undergraduates with moderate innovation capacity (Zhi & Pan, 2026). Other sub-dimensions including professional-technical guidance, feedback-performance guidance and autonomy support displayed significant bivariate correlations but no unique direct predictive effects after controlling for other factors. This implies that these mentoring components may operate through indirect psychological pathways instead of direct unique effects and should not be discarded in daily supervisory practice.

This study yields several practical implications for university innovation-team administrators, supervisors and educational management departments. For student innovation-team management, priority should be placed on building participative psychological safety in group norms and team training activities. Innovation objectives and high-quality task standards cannot bring observable innovative outcomes if team members fear expressing different opinions. For supervisors, beyond conventional technical instruction and performance feedback, mentors should act as resource brokers to connect undergraduates with competitions, research projects, experimental facilities and external collaborative opportunities. At the institutional level, universities may set-up special undergraduate innovation funds, unified competition registration channels and inter-school exchange platforms to reduce supervisors' burden of resource coordination. In addition, the measurement scales used in this research can serve as periodic assessment tools to monitor the operational status of student innovation teams. Curriculum designers are encouraged to integrate teamwork-climate training into project-oriented courses and focus on the full multi-stage innovative behavioral process instead of only final innovation outputs.

Several important limitations of this research should be acknowledged. First, this study employed a cross-sectional questionnaire design and relied exclusively on student self-report data, which may introduce common-method bias. No objective indicators such as innovation-competition awards or expert project evaluation scores were collected for multi-source triangulation. Second, participants were recruited only from a single applied-science university in Qingdao. Therefore, these findings cannot be generalized to comprehensive universities, vocational colleges or higher-education institutions in other regions of China, and conclusions are restricted to the sampled undergraduate group. Third, this study only tested direct construct-level relationships within the joint regression model. Mediating and moderating variables such as creative self-efficacy, intrinsic motivation and team size were not incorporated in the analytical framework.

Overall, this study confirms that both Innovation Team Climate and Supervisor Guidance are vital contextual factors shaping Students' Innovative Behavior for sampled applied-science undergraduates. Participative safety within teams and supervisor-provided resource-and-opportunity support stand out as the most influential sub-dimension predictors.

This research supplements empirical evidence for Chinese undergraduate innovation-team research, where existing literature has heavily focused on postgraduate samples. Future research may adopt longitudinal or quasi-experimental intervention designs, expand sampling across multiple institutions, employ multi-source evaluation data, test potential mediating and moderating mechanisms, and conduct qualitative interviews to further unpack psychological and practical processes behind undergraduate innovative behavior.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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