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Data-Driven Identification and Framework Development of Factors Influencing Innovation and Entrepreneurship Vitality Among University Students

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Abstract Enhancing the enthusiasm of college students for innovation and entrepreneurship is not only a requirement for regional economic and social development but also an important channel for solving college student employment issues. This study, based on a questionnaire survey of undergraduate students, constructs measurement indicators around the innovation and entrepreneurship vitality of college students and processes and analyzes the factors influencing this vitality using the SPSSAU platform. It further explores the roles of individual student factors, family factors, environmental factors, school education, and mentor factors in the innovation and entrepreneurship vitality of college students. Targeted suggestions and measures are proposed to improve the innovation and entrepreneurship capabilities of college students. The results show that students' personal abilities and individual motivation are the core driving forces. Students' practical experience and time invested in innovation and entrepreneurship training are key to their participation in innovation and entrepreneurship. Family support and school systems play a guaranteeing role in students' enthusiasm for innovation and entrepreneurship. It is recommended that schools strengthen the creation of an innovation and entrepreneurship atmosphere and optimize the alignment between the curriculum and innovation and entrepreneurship projects.

Index Terms College students' innovation and entrepreneurship vitality, data-driven, influencing factors

I. Introduction

The "Guiding Opinions on Further Supporting College Students' Innovation and Entrepreneurship," issued by the General Office of the State Council of China in 2021, states that deepening mass entrepreneurship and innovation is a key support for implementing the innovation-driven development strategy, that college students are a main force in this effort, and that supporting their innovation and entrepreneurship is of great significance. Innovation and entrepreneurship education in higher education institutions therefore plays an important role in fostering student entrepreneurship. At the same time, "there are still many unsatisfactory aspects in the current state of innovation and entrepreneurship education in Chinese universities." [1]. Under policy incentives, university-level innovation and entrepreneurship education has continued to expand and deepen; however, "without strong support from market demand, the implementation of university innovation and entrepreneurship education policies may fail to achieve the expected effects and may not fully stimulate students' innovation and entrepreneurship vitality." [2]. In practice, gaps remain between students' real needs and the concrete policies that are actually implemented.

Innovation and entrepreneurship vitality among university students is shaped by multiple factors acting together. The role of university innovation and entrepreneurship education involves several external actors, including universities, families, society, and peers, as well as internal components such as curricula, resources, practical platforms, and evaluation mechanisms. In particular, within universities' talent development systems, problems such as "overemphasis on theory, underemphasis on practice, a mismatch between supply and demand, and insufficient endogenous motivation" persist [3]. Against this background, any synthesis of the factors influencing student innovation and entrepreneurship should adopt a comprehensive perspective, covering aspects such as "students' learning attitudes, the teaching environment, and social factors" [4].

In this study, "innovation and entrepreneurship vitality" is treated as an observable and comparable state. It encompasses not only the frequency of participation, but also stage-based outputs and sustained engagement driven by self-motivation. Building on the questionnaire and data-cleaning procedures, the analysis uses 403 valid undergraduate responses. The results show that the overall mean level of innovation and

entrepreneurship vitality is approximately 3.18 on a five-point scale, indicating a moderate level. The mean for participation vitality is about 3.28, output vitality about 2.81, and sustained vitality about 3.47. This pattern suggests that undergraduates tend to maintain relatively stronger ongoing engagement, while visible outputs remain comparatively weaker. The structural gap also implies that efforts to stimulate vitality should go beyond encouraging "participation" and pay closer attention to the support conditions and conversion mechanisms that enable "outputs."

To identify the key determinants, this study adopts a data-driven approach and aims to develop a factor structure that is both interpretable and actionable. It first uses exploratory factor analysis to refine the underlying structure of the influencing factors, and then applies regression analysis and Lasso selection to assess variable importance and robustness. The findings indicate that individual-level competence and self-efficacy–related variables provide the strongest explanatory power for vitality. Time investment, entrepreneurial motivation, and practical experiences such as participation in competitions or projects also show stable positive effects. At the institutional level, engagement in relevant courses and policy–culture support within universities are associated with higher vitality. Family support is positive in some specifications, but its effect weakens after controlling for other variables. Social environment and policy perception do not display stable or significant effects in this sample.

Overall, this study addresses two practice-oriented questions: (1) what differences emerge across the three dimensions of undergraduate innovation and entrepreneurship vitality—participation, output, and sustained engagement; and (2) which factors can better explain these differences in statistical terms, and how can they be organized into a factor structure and improvement path that inform university governance and curriculum reform. These questions form the starting point of the paper and provide the empirical grounding for the subsequent model construction and policy discussion.

II. Data and Methods

A. Data Sources and Sample Description

This study collected first-hand data through an online questionnaire administered to undergraduate students currently enrolled at universities. A total of 403 valid responses were obtained. In addition to item responses, the dataset includes process information such as completion time, which was used for quality checks and robustness analyses. Data screening confirmed that all scale items were coded on a 1–5 range and that no systematic missingness was observed. After converting completion time into seconds, a small number of extremely short-time cases were identified; likewise, a small number of cases displayed fully repetitive response patterns on the scale items. All valid responses were retained for the main analysis. Robustness checks were conducted under alternative specifications, including excluding extremely short-time cases and excluding fully repetitive-pattern cases, to assess the stability of the main findings.

B. Questionnaire Structure and Variable Design

The questionnaire consists of three parts. The first part includes basic information and experience-related variables (Items 1–8), covering gender, year of study, major category, place of family residence, leadership or student-cadre experience, course exposure, competition/project participation, and weekly time investment. The second part contains scale items (Items 9–50), measured on a five-point Likert scale. The third part comprises open-ended questions (Items 51–52), designed to capture students' perspectives on key drivers and major constraints.

The dependent variable is innovation and entrepreneurship vitality. It is divided into three dimensions: participation vitality (Items 9–11), output vitality (Items 12–14), and sustained vitality (Items 15–17). The overall vitality index (IEV_Total) is constructed as the mean of Items 9–17. Independent variables are organized into a four-tier framework—individual, family, university, and external environment. The individual tier includes competence (Items 18–21), self-efficacy (Items 22–24), motivational investment (Items 25–27), and resilience (Items 28–29). The family tier measures family support (Items 30–33). The university tier includes courses and practice opportunities (Items 34–36), mentoring support (Items 37–39), platform and resource support (Items 40–43), and the policy-and-culture climate (Items 44–45). The external environment tier captures the regional ecosystem and support conditions (Items 46–50). Control variables come from Items 1–8. Binary "yes/no" items were recoded into dummy variables (0/1). Major category and place of family residence were treated as categorical variables, while year of study and weekly time investment were treated as ordinal variables.

C. Index Construction and Measurement Tests

For each dimension, index scores were computed as the mean of the items within that dimension. This approach keeps all indices on the same 1–5 scale and reduces the influence of differences in the number of items across dimensions. Before estimating explanatory models, the study conducted measurement and structural assessments. Internal consistency for each subscale and the vitality scale was evaluated using Cronbach's alpha. The suitability of Items 9–50 for factor analysis was assessed using the KMO measure and Bartlett's test of sphericity. After confirming adequacy, exploratory factor analysis with rotation was performed to examine the interpretability of the item structure and the clarity of dimension membership.

D. Overview of the Research Design and Statistical Methods

This study conducts an empirical analysis based on questionnaire data from undergraduate students. The research process consists of four stages. First, variables are constructed from the questionnaire items. Innovation and entrepreneurship vitality (three sub-dimensions: participation, output, and sustained engagement) and the four-tier set of influencing

factors (individual, family, university, and external environment) are quantified using the mean scores of items within each dimension, and control variables are coded accordingly. Second, data quality checks and analytic specifications are established. The analysis focuses on verifying the response range of scale items, completion time, and repetitive response patterns. While all valid responses are retained for the main analysis, robustness specifications are also implemented, including excluding extremely short completion-time cases and excluding fully repetitive response-pattern cases. Third, measurement and structure tests are conducted. Internal consistency is assessed using Cronbach's alpha, suitability for factor analysis is examined with the KMO measure and Bartlett's test, and exploratory factor analysis is performed to evaluate the interpretability of the item structure. Fourth, key influencing factors are identified within a framework that combines explanatory modeling with data-driven discovery. Multiple linear regression (with robust standard errors and standardized coefficients) is used to estimate the effects of each dimension on vitality, and Lasso with cross-validation is applied to derive a stable list of key factors. Finally, findings from open-ended questions are summarized to complement the quantitative results and to inform the subsequent construction of the factor system and the policy recommendations.

III. Results

A. Sample Characteristics and Overall Level of Innovation and Entrepreneurship Vitality

The study obtained 403 valid responses, all from undergraduate students. The sample included 267 women (66.3%) and 136 men (33.7%). First-year (44.4%) and second-year students (31.5%) accounted for the largest shares. By major category, science and engineering made up 45.7%, followed by medicine and pharmacy (20.3%), economics and management (13.9%), humanities and history (13.6%), and education (6.5%). In terms of family residence, 52.9% came from towns or rural areas, 25.6% from cities, and 21.6% from county-level cities. Students who served as student leaders or core members of student organizations accounted for 43.4%. Those who had taken innovation and entrepreneurship–related courses made up 72.7%, and 41.2% had participated in innovation and entrepreneurship competitions or projects. Weekly time devoted to innovation and entrepreneurship activities was concentrated in "almost none" (43.4%) and "$\leq$2 hours" (42.9%).

The overall mean score of innovation and entrepreneurship vitality was 3.184 (SD = 0.781), indicating a moderate level. By dimension, the mean was 3.275 (SD = 0.944) for participation vitality, 3.465 (SD = 0.873) for sustained vitality, and 2.813 (SD = 0.920) for output vitality. The comparatively lower score for output suggests that many students' engagement remains at the "participation and experience" stage and has not been consistently translated into visible outcomes. This pattern aligns with the view that weaknesses in incentive mechanisms for innovation and entrepreneurship education can lead to a persistent situation in which "the school is enthusiastic while students are not," ultimately limiting educational effectiveness [5].

B. Scale Reliability and Descriptive Statistics

Overall internal consistency was strong across the scales. Cronbach's alpha for the total vitality scale was 0.967; the alphas for the three subscales were 0.912 (participation), 0.797 (output), and 0.890 (sustained). For the individual-level factors, Cronbach's alpha was 0.923 for competence, 0.941 for self-efficacy, 0.895 for motivation, and 0.837 for resilience. Cronbach's alpha for family support was 0.918. For university-level support, the alphas were 0.896 for the policy-and-culture climate, 0.926 for courses and practice opportunities, 0.942 for mentoring support, and 0.942 for platform and resource support. The alpha for the regional ecosystem scale was 0.955. Taken together, these results meet commonly accepted reliability standards in empirical research.

Table 1: Cronbach's Alpha Reliability Analysis

Cronbach's Reliability Analysis		
Number of Items	Sample Size	Cronbach's α Coefficient
50	403	0.967
Summary of Missing Samples		
Items	Sample size	Percentage
Valid Samples	403	100.0%
Excluded Invalid Samples	0	0.0%
Total	403	100%

In terms of mean scores, individual competence (M = 3.473, SD = 0.808), self-efficacy (M = 3.443, SD = 0.856), and motivation (M = 3.433, SD = 0.810) were at a moderate-to-high level, while resilience (M = 3.615, SD = 0.820) was relatively higher. Family support (M = 3.525, SD = 0.812) and university-level support—policy-and-culture climate (M = 3.661), mentoring support (M = 3.629), platform/resource support (M = 3.563), and courses and practice opportunities (M = 3.522)—also generally fell in the moderate-to-high range. Support from the regional ecosystem averaged 3.425 (SD = 0.833), suggesting room for improvement. Conceptually, "innovation and entrepreneurship capability can be regarded as a comprehensive capability developed across the whole process in which college students learn and apply relevant knowledge, skills, methods, and tools to generate and carry out innovation and entrepreneurship activities." [6]. The measurement and analysis in this study are anchored in this process-oriented understanding, and further compare differences in vitality under varying support conditions.

C. Structural Validity and Patterns of Dimensional Clustering

Exploratory factor analysis showed that the KMO measure was 0.962 and Bartlett's test of sphericity was significant (χ^2 = 19877.919, df = 1225, $p < 0.001$), indicating that the data were suitable for factor analysis. Based on eigenvalues and explained variance, the results revealed a relatively clear multi-factor structure. The cumulative variance explained by the first five factors was 72.426%, suggesting that the scale

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items capture the main information of the underlying constructs effectively.

Table 2: KMO and Bartlett's tests

KMO and Bartlett's tests		
KMO value		0.962
Bartlett's test of sphericity	Approximate chi-square	19877.919
	df	1225
	p value	0.000

In terms of factor clustering, items related to individual attributes and university support showed strong primary loadings. Items measuring innovation and entrepreneurship vitality formed a relatively distinct cluster, while items on the regional ecosystem and family support also exhibited fairly stable grouping patterns. Overall, the results support the multilevel structure proposed in this study—"individual–family–university–regional ecosystem." As noted, "influencing factors mainly include regional socio-economic factors, sociocultural factors, the educational environment of universities, and individual student factors." [7]. This classification is consistent with the variable framework adopted here and provides a structural basis for explaining differences in vitality through multiple sources of influence.

D. Results of the Association Analysis

A chi-square test (cross-tabulation) was used to examine whether the item "I will proactively participate in innovation and entrepreneurship competitions or project applications" differed across seven variables: gender, year of study, major category, leadership or core student-organization experience, place of family residence, exposure to innovation and entrepreneurship–related courses, and prior participation in innovation and entrepreneurship competitions/projects. The results show no significant differences by gender, year of study, major category, or place of family residence ($p > 0.05$). In contrast, significant differences were observed for leadership/core experience, course exposure, and prior participation in competitions/projects ($p < 0.05$).

E. Data-Driven Identification of Key Factors: Regression Tests and Lasso Selection

After controlling for gender, year of study, student leadership experience, course exposure, competition/project participation, and time investment, the OLS regression model showed strong explanatory power for innovation and entrepreneurship vitality (R^2= 0.703; adjusted R^2= 0.686). The significant predictors were mainly concentrated in two clusters: (i) "individual competence–motivation–time investment," and (ii) "key support conditions."

(1) Core individual factors. Individual competence had the largest standardized coefficient (β= 0.512, $p < 0.001$), indicating that students with stronger competence reserves are more likely to show higher levels of participation, sustained engagement, and output. Intrinsic motivation was also significant (β= 0.238, $p = 0.001$). Taken together, these results suggest that "wanting to do it" and "being able to do it" form the central axis of vitality. A similar issue appears at the course level: "innovation and entrepreneurship course content often lacks appeal; students show weak initiative and low participation, which can lead to a vicious cycle and reduce students' sense of gain." [8]. When motivation is insufficient or course experience is poor, vitality is less likely to move toward tangible outcomes.

(2) The role of time investment and practical experience. Weekly time investment significantly and positively predicted vitality (β= 0.170, $p < 0.001$). Competition/project participation (β= 0.187, $p = 0.004$) and course exposure (β= 0.190, $p = 0.012$) also had significant positive effects. These findings indicate that vitality is shaped not only by attitudes and cognition, but also by real investment and hands-on experience. As noted, "students who participate deeply in innovation and entrepreneurship education activities often demonstrate high focus and time investment; such investment directly affects final outcomes and is an important condition for achieving good results in highly competitive innovation and entrepreneurship contests." [9]. This observation aligns closely with the interpretation of the significant effect of time investment.

(3) Key support conditions. Family support had a significant positive effect on vitality ($\beta = 0.147$, $p = 0.018$), and the university's policy-and-culture climate was also significant ($\beta = 0.113$, $p = 0.039$). By contrast, courses/practice opportunities, mentoring support, platform/resource support, and the regional ecosystem were not significant within the same model. This suggests that their effects may be "absorbed" or overlap with individual-level variables such as competence and motivation. Regarding policy-and-culture climate, it has been argued that "a sound innovation and entrepreneurship environment provides the necessary energy and momentum for policy implementation and is a prerequisite for achieving policy implementation goals." [2]. The significance of policy-and-culture climate in this study reflects the foundational role of "environment–rules–climate" in supporting student vitality.

(4) A suppression effect for resilience. Resilience showed a significant negative coefficient in the regression ($\beta = -0.109$, $p = 0.040$). This does not mean that "higher resilience leads to lower vitality." A more plausible interpretation is statistical suppression: resilience is strongly correlated with competence and motivation, and when these variables enter the model simultaneously, a suppression pattern may emerge. Given the correlation results and potential multicollinearity, this finding is interpreted cautiously. It also signals the need, in later discussion, to distinguish more clearly between "risk preference/failure tolerance" and "effective action capability."

(5) Consistency check via Lasso selection. To reflect the data-driven logic more directly, the study further applied Lasso regression with feature selection. The test-set R^2 for Lasso was 0.632. The non-zero features selected were concentrated in individual competence, intrinsic motivation, time investment, family support, competition/project participation, student leadership experience, the university's policy-and-culture climate, and course exposure, with competence and

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Table 3: Cross-Tabulation (Chi-Square) Results: Counts (Share) and Percentages

Cross-sectional (chi-square) analysis results (figures/percentages)									
Topic	Name	11. I will actively participate in innovation and entrepreneurship competitions or project applications.(%)					Total	χ^2	p
		1.0	2.0	3.0	4.0	5.0			
1. Your gender	1.0	9(40.91)	18(33.96)	57(30.00)	33(38.82)	19(35.85)	136(33.75)	2.783	0.595
	2.0	13(59.09)	35(66.04)	133(70.00)	52(61.18)	34(64.15)	267(66.25)		
Total		22	53	190	85	53	403		
2. Your year of study	1.0	14(63.64)	20(37.74)	81(42.63)	41(48.24)	23(43.40)	179(44.42)	8.640	0.733
	2.0	6(27.27)	17(32.08)	59(31.05)	25(29.41)	20(37.74)	127(31.51)		
	3.0	2(9.09)	13(24.53)	44(23.16)	17(20.00)	9(16.98)	85(21.09)		
	4.0	0(0.00)	3(5.66)	6(3.16)	2(2.35)	1(1.89)	12(2.98)		
Total		22	53	190	85	53	403		
3. Your major	1.0	9(40.91)	16(30.19)	87(45.79)	43(50.59)	29(54.72)	184(45.66)	21.189	0.171
	2.0	2(9.09)	12(22.64)	22(11.58)	12(14.12)	7(13.21)	55(13.65)		
	3.0	1(4.55)	10(18.87)	30(15.79)	10(11.76)	5(9.43)	56(13.90)		
	4.0	2(9.09)	3(5.66)	10(5.26)	9(10.59)	2(3.77)	26(6.45)		
	5.0	8(36.36)	12(22.64)	41(21.58)	11(12.94)	10(18.87)	82(20.35)		
Total		22	53	190	85	53	403		
4. Whether you have served as a student leader or a key member of a club/organization	1.0	3(13.64)	18(33.96)	77(40.53)	44(51.76)	33(62.26)	175(43.42)	20.591	0.000**
	2.0	19(86.36)	35(66.04)	113(59.47)	41(48.24)	20(37.74)	228(56.58)		
Total		22	53	190	85	53	403		
5. Your family's location	1.0	9(40.91)	16(30.19)	35(18.42)	25(29.41)	18(33.96)	103(25.56)	13.336	0.101
	2.0	2(9.09)	12(22.64)	49(25.79)	15(17.65)	9(16.98)	87(21.59)		
	3.0	11(50.00)	25(47.17)	106(55.79)	45(52.94)	26(49.06)	213(52.85)		
Total		22	53	190	85	53	403		
6. Whether you have taken any courses related to innovation and entrepreneurship	1.0	11(50.00)	32(60.38)	137(72.11)	72(84.71)	41(77.36)	293(72.70)	16.555	0.002**
	2.0	11(50.00)	21(39.62)	53(27.89)	13(15.29)	12(22.64)	110(27.30)		
Total		22	53	190	85	53	403		
7. Whether you have participated in any innovation and entrepreneurship competitions/projects	1.0	4(18.18)	13(24.53)	75(39.47)	45(52.94)	29(54.72)	166(41.19)	19.962	0.001**
	2.0	18(81.82)	40(75.47)	115(60.53)	40(47.06)	24(45.28)	237(58.81)		
Total		22	53	190	85	53	403		
* $p < 0.05$ ** $p < 0.01$									

motivation carrying higher weights. This set is highly consistent with the significant predictors in the OLS model, supporting the robustness of the key factors identified. This is also in line with practice-based recommendations:"universities should use multiple channels to publicize and mobilize innovation and entrepreneurship competitions, ensuring that teachers and students fully understand and actively participate, so that innovation spirit and entrepreneurial capability can be cultivated through competitions." [10]. When competition participation is identified as a key predictor in both models, its explanatory value becomes more convincing.

F. Supplementary Evidence from Open-Ended Responses

To complement the quantitative findings, this study coded and tallied keywords from the two open-ended questions (based on the occurrence of keywords in the text, allowing multiple categories per response). For the question on "the two factors that most enhance vitality," the most frequently mentioned categories were, in order: competence/experience (about 93 mentions), resources/funding (about 88), atmosphere/culture (about 67), mentoring/guidance (about 61), and practice/platforms (about 57). For "the biggest difficulty," the most frequently mentioned categories were competence/experience (about 63), resources/funding (about 62), market/demand (about 49), team/partners (about 46), and time/energy (about 35). These patterns point in the same direction as the regression results: what students care about most is whether they can do it and whether they have the conditions to do it, and time investment and access to practical opportunities are pivotal for moving from intention to outcomes. This also helps contextualize the following view: "diverse practical opportunities, comprehensive student development pathways, effective evaluation and feedback, teacher training and professional development, dynamic educational content, strategic allocation and sharing of resources, and the construction and integration of an innovation and entrepreneurship environment are of great significance for enhancing students, improving educational quality, and promoting local economic development." [11]. It provides a useful backdrop for interpreting why practice opportunities and resource support matter, even if their effects may be absorbed by competence-related variables in multivariate models.

IV. Policy Recommendations

The questionnaire analysis suggests that improving students' innovation and entrepreneurship vitality relies more on the internal drivers of competence and motivation, while time investment and practical experience help translate these drivers into higher vitality. Family support and the university's institutional system also play a safeguarding role in sustaining students' entrepreneurial momentum.

A. Helping Students Move from "Being Able to Do" to "Wanting to Do"

First, innovation and entrepreneurship education should be integrated with disciplinary education to ensure a stable supply of competence development. This study recommends embedding the cultivation of students' innovation and entrepreneurship capability into major-specific courses, so that innovation

and entrepreneurship education develops in coordination with disciplinary education. It is also important to incorporate disciplinary learning and humanistic education into innovation and entrepreneurship courses, thereby fostering students' innovative spirit and lifelong learning habits [12].

Second, motivation can be stabilized through visible growth pathways, turning "interest" into sustained investment. Universities should clarify the developmental trajectory of student innovation and entrepreneurship cultivation and formulate stage-specific targets with clear criteria. Good practices, failure debriefs, and peer support can be institutionalized as regular learning resources so that students have a clear sense of direction and what forms of return to expect. Stage-based assessments built around small, attainable goals can also reduce early drop-out caused by uncertainty.

B. Securing Time Investment and Making Room for Sustained Action

This study finds that time investment has a stable association with students' vitality. Universities therefore need to shift "time investment" from an individual choice to an arrangement that can be supported and protected institutionally. One practical option is to designate fixed "innovation-and-entrepreneurship learning hours" during the semester and safeguard them in the timetable. Universities can also improve credit recognition and flexible enrollment policies, treating project advancement, pitch training, and prototyping as measurable learning outcomes. In academic administration, reducing low-value procedural tasks and creating a "phased workload adjustment" channel for project-based students can help preserve time for meaningful work. In terms of material support, universities can offer small grants, priority access to space, and preferential use of equipment for students who sustain investment over time, thereby lowering the opportunity cost of continued engagement. As noted, universities should further strengthen the concept of innovation and entrepreneurship education, embed it across all aspects of student management, and form an education system with broad participation and full coverage [13]. Once routine learning management is aligned with innovation and entrepreneurship education management, students' time investment becomes more visible—and easier to protect.

C. Strengthening the Practice-to-Outcome Conversion of Innovation and Entrepreneurship Education

This study recommends upgrading the practice system from a "competition-driven" model to a continuous chain of "project-driven work + competition guidance + incubation follow-through." At present, many universities' practice activities are dominated by competition entries, with a tendency to copy practice formats from other institutions, resulting in limited innovation and weak fit to local needs [14]. Three adjustments follow from this diagnosis. First, build a project pool guided by real problems. Universities can work with local government, enterprises, and communities to develop a problem list and match student projects with genuine demands, reducing topic selection that is driven mainly by competition requirements. Second, replace one-off sprints with process-based training. Universities can make field research, prototyping, testing, cost estimation, user feedback, and reflection reports required milestones, supported by templates and tools. Third, use incubation to raise the likelihood of outputs. A project should not "end" when the competition concludes; it should serve as a starting point for entering the next stage. When universities connect "space + platform + industrial park" into a coherent pathway, students are more likely to move from participation to outputs and to sustain their engagement. Universities can integrate on-campus laboratories and maker spaces with off-campus industrial parks to build a full-chain practice carrier—from idea validation to prototype development and business incubation—and develop virtual entrepreneurship platforms to support low-cost trial-and-error and iterative improvement [3].

D. Improving Institutional and Cultural Provision: Using Collaborative Governance to Deliver Resources to Students

Innovation and entrepreneurship education places higher demands on universities in inter-departmental coordination, integration of internal and external resources, and systematic planning and design [15]. For this reason, this study treats the policy-and-culture climate as a long-term variable and recommends using collaborative governance to address fragmented resources. Compared with most disciplinary education work, innovation and entrepreneurship education requires a "two-tier governance" structure that combines university-level coordination with school/department-level implementation. At the university level, rules, funding, and platforms should be unified; at the college or department level, responsibility should focus on project screening, process guidance, and outcome recognition. Universities should publish clear lists of available resources, services, and connection channels to reduce students' information costs. In particular, mentoring, space booking, equipment use, and reimbursement should be provided through standardized, process-based services. The clearer the institutional arrangements and the more stable the cultural climate, the more willing students are to invest—and the more likely they are to persist.

V. Conclusions and Future Directions

A. Conclusions

Based on questionnaire data from 403 undergraduate students, this study develops a measurement framework for students' innovation and entrepreneurship vitality and conducts data-driven identification and mechanism-based interpretation of its influencing factors. The sample shows clear structural differences across the three dimensions of "participation–output–sustained engagement." As noted, "the factors shaping college students' entrepreneurial literacy do not operate in isolation; they are interconnected, intertwined, and jointly promote the formation and improvement of entrepreneurial literacy." [16]. Consistent with this view, the study finds that

participation is easier to initiate, whereas tangible outputs and long-term persistence depend more on stable investment and contextualized training.

Across multivariate models, the core roles of individual competence and motivational investment are repeatedly confirmed. These two factors sit closer to the source of vitality: they determine whether students have the conditions to translate ideas into action. Time investment, course exposure, and competition/project experience function as key conversion links that move innovation and entrepreneurship from intention to behavior. The more stable students' time investment, the more likely they are to cross the threshold from "thinking but not doing." The more substantial their course and project experience, the more likely they are to move beyond "doing but not producing." Family support and the university's policy-and-culture climate constitute important support systems for students' participation in innovation and entrepreneurship activities, providing stable backing for vitality. They reduce the psychological cost of trial and error and lower the opportunity cost of sustained engagement.

B. Theoretical Contributions and Practical Implications

This study makes three main contributions. First, it integrates concept and measurement by operationalizing "vitality" into three measurable dimensions and developing a questionnaire instrument suited to the undergraduate context. Second, it reframes system construction by moving beyond a simple listing of factors and organizing variables into a structure of "core drivers–conversion amplifiers–support safeguards–contextual constraints," with a pathway-based explanation of how the structure functions. Third, it connects empirical findings to actionable recommendations by identifying concrete levers—curriculum redesign, project-chain development, policy and service checklists, resource allocation, and data feedback—and by providing an empirical basis for establishing an improvement mechanism guided by vitality indicators.

C. Limitations

The study has limitations related to measurement and data structure. Some measurement error may be present, as the core variables are primarily based on self-reported questionnaires; common method bias cannot be fully ruled out. The study also faces time-related constraints. Due to practical limits in funding and time, it lacks long-term tracking data, which means the analysis can only provide an immediate assessment of the effects of innovation and entrepreneurship education rather than examine long-run and sustained impacts. At present, the study is better positioned to answer which factors are associated with vitality, and less able to determine whether effects accumulate over time. In addition, the sample coverage is limited: although the focus is on undergraduates, the sample is relatively concentrated. Broader samples are needed to test the stability of the model and its generalizability.

D. Future Research Directions

Future research could adopt longitudinal tracking and pre–post designs to examine how courses, projects, and platform-based support shape students' innovation and entrepreneurship vitality over time. It would also be valuable to record concrete entrepreneurial behaviors, including competition participation, project implementation processes, and output production, as well as usage logs from university innovation and entrepreneurship platforms. In addition, future work should strengthen contextual comparisons. This study suggests conducting subgroup model tests across region types, institution types, major categories, and grade levels, and developing differentiated support strategies for different student groups.

Author Contributions

Both authors contributed equally to the conception, development, and preparation of the manuscript. Both authors have read and approved the final version of the manuscript for publication.

Conflicts of Interest

The authors declare that there are no conflicts of interest related to this work.

Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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